CONTRACT DOCUMENTS

AND

SPECIFICATIONS

FOR

PROJECT NO. SP 20-6 GREENWOOD CULTURAL CENTER FACILITY REHABILITATION

ATTENDANCE AT PRE-BID CONFERENCE IS MANDATORY

PREPARED BY:
JCJ Architecture
8801 S. Yale Ave. Ste. 100
Tulsa, OK 74137
918-922-8837
Alex Kuiper

CITY OF TULSA

PARKS & FACILITIES

CABS – City Architectural Building Services

ANNA AMERICA, DIRECTOR

Account Numbers: 2234B00000.Buildings.Faclity.409P.4094111-541104

Public Works Department
175 East 2nd Street, Suite 261
Tulsa, Oklahoma 74103
(918) 596-9637

Volume II of II

07.01.23

City of Tulsa

FACILITY REHABILITATION

GREENWOOD CULTURAL CENTER

322 N. Greenwood Ave.

Tulsa, OK 74120

Project No. SP 20-6

City of Tulsa, Oklahoma

Department of Parks, Culture and Recreation

JCJ Architecture

Project No. T210188.03

August 15, 2025

SEALS PAGE

PROJECT:
Name: Greenwood Cultural Center Facility Rehabilitation
322 N. Greenwood Ave.
Location: Tulsa, OK 74120

COT Project Number: SP 20-6

JCJ Project Number: T21018.03

ARCHITECT OF RECORD:
JCJ ARCHITECTURE
8801 South Yale Ave., Suite 100
Tulsa, OK 74137
(918) 936-2320



Architect of Record — Date: 8/20/2025

STRUCTURAL ENGINEER OF RECORD:
RICHARDS & ASSOCIATES. INC.
424 East Main Street
Jenks, OK
(405) 627-9584
Certificate of Authorization: OK CA# 4458
Expiration: 2027-06-30



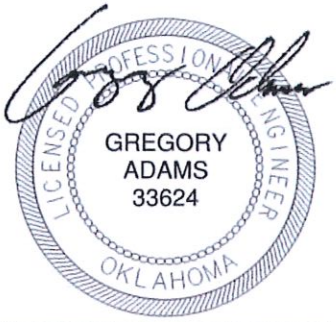
Structural Engineer of Record — Date: 15 Aug 2025

MPFP ENGINEER OF RECORD:
HP ENGINEERING
6666 S Sheridan Road, Suite 230
Tulsa, OK 74133
(918) 324-2172
Certificate of Authorization: OK CA# 5338
Expiration: 2027-06-30



MPFP Engineer of Record — Date: 08/20/2025

ELECTRICAL ENGINEER OF RECORD:
HP ENGINEERING
6666 S Sheridan Road, Suite 230
Tulsa, OK 74133
(918) 324-2172
Certificate of Authorization: OK CA# 5338
Expiration: 2027-06-30



Electrical Engineer of Record — Date: 08/20/2025

END OF SEALS PAGE

RESPONSIBLE DISCIPLINES:
AA - ASSA ABLOY *(Hardware Consultant)*
COT - CITY OF TULSA *(Owner)*
HP - HP ENGINEERING *(M/E/P/FP & Low Voltage & Technology)*
JCJ - JCJ ARCHITECTURE *(Architect of Record)*
RA - RICHARDS & ASSOCIATES *(Structural Engineers of Record)*

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SECTION 011000 - SUMMARY

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Work under separate contracts.
   4. Owner-furnished products.
   5. Access to site.
   6. Coordination with occupants.
   7. Work restrictions.
   8. Specification and drawing conventions.
   9. References
   10. Miscellaneous provisions.

B. Related Documents and Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
   2. Section 015000 - Temporary Facilities and Controls, for limitations and procedures governing temporary use of Owner's facilities.

1.02 PROJECT INFORMATION

A. Project Identification: Greenwood Cultural Center.
   1. Project Location: 322 N. Greenwood Ave., Tulsa, OK.

B. Owner: City of Tulsa (COT).
   1. Owner's Project Manager: Bhree Barrett, Project Manager; 918-596-9407.

C. Architect: JCJ Architecture.
   1. Architect's Project Manager: Barry Goldstein, AIA; 918-270-0099.

1.03 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work consists of facility rehabilitation and replacement of the existing roofing system on the Greenwood Cultural Center building including, but not limited to the following:
   1. Removal of existing roofing system to structural deck.
   2. Repairs to existing structural deck as needed.
   3. Installation of a new TPO Roofing System.
   4. Installation of new roof curbs supporting new mechanical equipment and other roof membrane penetrations as indicated.
   5. Replacement of metal roof edges and copings.
   6. Repair or replacement of existing roof drains as needed.
   7. Replacement of existing HVAC Units.
   8. Reconfiguration of existing restroom facilities.

B. Type of Contract: Project will be constructed under a single prime contract.

1.04 WORK UNDER SEPARATE 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 or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.05 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

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

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.06 COORDINATION WITH OCCUPANTS

A. Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
   2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

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

1.07 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work as specified in General Conditions (GC-19), unless otherwise by user group and COT Field Engineering.

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 providing temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

F. Controlled Substances: Use of tobacco products and other controlled substances within the existing building on Project site is not permitted.

G. Security: During construction period, Contractor shall install barricades as required to restrict construction area access to the public. Contractor to coordinate security requirements with the COT Representative.

H. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

I. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site. Maintain list of approved screened personnel with Owner's representative.

1.08 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.09 REFERENCES

A. Industry Standards:
1. 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.

2. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
3. 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.
   a. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

B. Abbreviations and Acronyms:
   1. 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 Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements governing Owner Allowances.

B. Related Documents and Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 OWNER ALLOWANCES

A. An Owner Allowance has been included in the Contract Sum for additional Work caused by unforeseen, concealed or unknown conditions not identified in the Contract for Construction. The quantity Owner Allowance is shown on the Bid Form. The Owner's Allowance shall be used only at the discretion of the City of Tulsa.

B. If the Contractor encounters conditions at the site that are concealed physical conditions that differ materially from those indicated in the Contact Documents or unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents the Contractor shall provide notice as soon as possible to the Owner and Architect before conditions are disturbed. The Architect will investigate such conditions and if the Architect determines that they differ materially and cause an increase or decrease in the Contract Sum, will recommend to the Owner that an equitable adjustment be made in the Contract Sum.

C. Any allowance balance remaining at the completion of the project will be credited back to the City of Tulsa on the final Application for Payment submitted by the Contractor.

D. Use the Owner Allowance only as directed by Architect and Owner for Owner's purposes indicating quantities and amounts to be charged to the allowance.

E. Contractor's overhead, profit, and related costs for materials, products and equipment as directed by Owner under the allowance are included in the allowance and are not part of the Contract Sum or Alternate Work Sums. These costs include delivery, labor, installation, insurance, equipment rental, and similar costs.

F. Directives authorizing use of funds from the Owner's Allowance will include Contractor's related costs and reasonable overhead and profit margins as originally bid on the Bid Form.

G. The Contractor shall provide to the City of Tulsa Representative, a written request for the use of the allowance, with a schedule of values, and all associated backup information, including any time extensions required to perform the work.

H. Contractor shall proceed with work included in the allowance only after receiving a written order, from the City of Tulsa Representative, authorizing such work. Proceeding with work in the allowance without a written order from the City of Tulsa Representative will be at the Contractor's cost.

1.03 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in purchase amount as part of the allowance.
   2. Submit substantiation of a change in scope of work, if any, claimed in Owner Allowances.
   3. Owner reserves the right to establish the quantity of work-in-place by quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents.
   1. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

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

END OF SECTION 012100

SECTION 012200 - UNIT PRICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for Unit Prices.

B. Related Documents and Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.
   2. Contract – Proposal: for estimated quantities and unit prices.

1.02 DEFINITIONS

A. Unit Price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

B. Determinations for Unit Price Work: Owner will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Owner will review with Contractor the preliminary determinations on such matters before rendering a decision thereon (by recommendation of an Application for Payment or otherwise). Owner's written decision thereon will be final and binding (except as modified to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of any Claims.

C. Unit Price Work:
   1. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
   2. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Owner's Field Engineering personnel.
   3. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

1.03 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Owner will confirm Contractor's measurement of work-in-place that involves use of established unit prices with Owner's Field Engineering personnel.

C. List of Unit Prices: The schedule of unit prices is included in the Contract - Proposal. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

B. Procedures for pricing Alternates.

C. Documentation of changes to Contract Price and Contract Time.

1.02 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.03 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

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

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

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

1.04 SCHEDULE OF ALTERNATES

A. Alternate No. **ALT-1**: Gift Shop at Main Gallery.
   1. Base Bid Item: Gift Shop at Main Gallery shall remain as is.
   2. Alternate Items: Remove existing flooring, wall paneling, ceilings, and built-in wall cases. Infill and patch walls to meet and match adjacent walls. Install new flooring, ceilings, wallcovering, where indicated. Paint walls. Install new reception desk and Gift Shop millwork, as indicated on Drawings.

B. Alternate No. **ALT-2**: Main Gallery and Corridors.
   1. Base Bid Item: Main Gallery and Corridors shall remain as is.

2. Alternate Items: Remove existing ceiling and wall light fixtures. Remove existing ceilings. Patch and repair wall at removed light fixtures to meet and match adjacent walls. Install new ceilings, lighting, and new ceiling mechanical diffusers and return air grills. Remove, paint, and reinstall existing wall diffusers.

C. Alternate No. **ALT-3**: Multipurpose Room.
   1. Base Bid Item: Multipurpose Room shall remain as is.
   2. Alternate Items: Remove existing flooring, acoustical ceilings, and lighting. Install new exterior metal canopy, exterior doors, and interior walls for the new Vestibule and Storage Room. Install new flooring, acoustical ceilings, lighting, and mechanical diffusers and return air grills. Remove exising gypsum board from column surrounds and replace with impact-resistant gypsum board and finish with Level 5 finish. Paint existing gypsum board soffits, and new and existing gypsum board walls.

D. Alternate No. **ALT-4**: Operable Panel Partitions in Multipurpose Room.
   1. Base Bid Item: Existing operable panel partitions shall remain as is.
   2. Alternate Items: Remove existing panels and replace with new panels. Existing track to remain.

E. Alternate No. **ALT-5**: Administration Spaces and Goodwin Chappelle Gallery.
   1. Base Bid Item: Administration Spaces and Goodwin Chappelle Gallery shall remain as is.
   2. Alternate Item: Remove existing flooring, acoustical ceilings, and lighting. Install new flooring, ceilings, and lighting. Paint existing walls.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Documents and Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
   2. Section 016000 - Product Requirements for requirements for submitting comparable product submittals for products by listed manufacturers.

1.02 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
   1. Substitutions during Bidding: Changes proposed by Bidders that are being offered for consideration during the Bidding process.
   2. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   3. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
   4. The Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with Owner's change procedures.
   5. Warranty: The Contractor warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective.

1.03 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. Substitution Request Form: Use facsimile of form provided at the end of this Section.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable.
      a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
      b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      e. Samples, where applicable or requested.

f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES or other qualified code organization.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action during Bidding: Architect may request additional information or documentation for evaluation of the substitution request. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.
   a. Form of Acceptance during Bidding: Addendum.
4. Architect's Action during Construction: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through City Field Engineering of acceptance or rejection of proposed substitution within 15 days of receipt of request.
   a. Form of Acceptance during Construction: Allowance Authorization.
   b. Form of Acceptance during Construction, when cost of proposed substitution exceeds available funds in Owner's Allowance: Change Order.
   c. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.04 QUALITY ASSURANCE

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

1.05 PROCEDURES

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

PART 2 PRODUCTS

2.01 SUBSTITUTIONS DURING BIDDING

A. Substitutions during Bidding: No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for a thorough evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
   1. If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.
   2. Substitution Request Form: Each request for substitution shall be submitted on the Substitution Request Form provided at the end of this Section.

2.02 SUBSTITUTIONS DURING CONSTRUCTION

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: 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:
      a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      b. Requested substitution provides sustainable design characteristics that specified product provided.
      c. Substitution request is fully documented and properly submitted.
      d. Requested substitution will not adversely affect Contractor's construction schedule.
      e. Requested substitution has received necessary approvals of authorities having jurisdiction.
      f. Requested substitution is compatible with other portions of the Work.
      g. Requested substitution has been coordinated with other portions of the Work.
      h. Requested substitution provides specified warranty.
      i. 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. Substitution Request Form: Each request for substitution shall be submitted on the Substitution Request Form provided at the end of this Section.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
   1. 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:
      a. 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.
      b. Requested substitution does not require extensive revisions to the Contract Documents.
      c. Requested substitution is consistent with the Contract Documents and will produce indicated results.

d. Requested substitution provides sustainable design characteristics that specified product provided.
e. Substitution request is fully documented and properly submitted.
f. Requested substitution will not adversely affect Contractor's construction schedule.
g. Requested substitution has received necessary approvals of authorities having jurisdiction.
h. Requested substitution is compatible with other portions of the Work.
i. Requested substitution has been coordinated with other portions of the Work.
j. Requested substitution provides specified warranty.
k. 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. Substitution Request Form: Each request for substitution shall be submitted on the Substitution Request Form provided at the end of this Section.

C. Owner's Approval: Under no circumstances will a substitution be allowed without the Owner's written approval.

PART 3 EXECUTION (NOT USED)

END OF SECTION 012500

SECTION 012501 - SUBSTITUTION REQUEST FORM

Project: Greenwood Cultural Center
To: _____
_____
_____
Re: _____

Substitution Request Number: _____
Date: _____
From: _____
COT Project Number: SP 20-6
Contract for: _____

Specification Section: _____
Specification Title: _____

Description: _____
Page: _____ Article/Paragraph: ____

Proposed Substitution: _____
Manufacturer: _____
Trade Name: _____

Address: _____
_____

Installer/Subcontractor: _____

Address: _____

History: [ ] New Product [ ] 1-4 years old [ ] 5-10 years old [ ] More than 10 years old

Differences between proposed substitution and specified products: _____
_____
_____
_____
_____

[ ] Point-by-Point comparative data attached – REQUIRED BY A/E

Reason for not providing specified item: _____
_____
_____

Similar Installation:
Project: _____
Address: _____
_____

Address: _____
Owner: _____
Date Installed: _____

Proposed substitution affects other parts of the Work: [ ] No [ ] Yes; explain: _____
_____

Savings to Owner (City of Tulsa) for accepting substitution: _____ $ _____
Proposed substitution changes Contract Time: [ ] No [ ] Yes [Add] [Deduct] _____ days.

Supporting data attached: [ ] Drawings [ ] Product Data [ ] Samples [ ] Samples [ ] Tests
[ ] Reports [ ] Other _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: _____

Firm: _____

Address: _____

_____

Telephone: _____ email: _____

Signed by: _____ Date: _____

A/E's REVIEW AND ACTION

[ ] Substitution Approved: Make submittals in accordance with Specification Section 012500 Substitution Procedures.
[ ] Substitutions Approved as Noted: Make submittals in accordance with Specification Section 012500 Substitution Procedures.
[ ] Substitution Rejected: Use specified materials.
[ ] Substitution Request received too late: Use specified materials.

Signed by: _____ Date: _____

Supporting Data Attached: [ ] Drawings [ ] Product Data [ ] Samples [ ] Samples [ ] Tests
[ ] Reports [ ] Other _____

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. Requests for Information (RFIs).
   3. Project Web site.
   4. Project Progress Meetings.

B. Related Documents and Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
   2. Section 017300 - Execution, for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Section 017700 - Closeout Procedures, for coordinating closeout of the Contract.

1.02 DEFINITIONS

A. RFI: Request from Contractor, Owner, City of Tulsa, or Architect seeking information required by or clarifications of the Contract Documents.

B. Day: Calendar Day.

1.03 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare and submit at the Preconstruction Conference, 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. Use CSI Form 1.5A or other format acceptable to Architect and City of Tulsa. Include the following information in tabular form:
   1. Name, address, and phone number of the entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.

B. Key Personnel Names: Submit with subcontract list, 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, office, and cellular telephone numbers and e-mail addresses. Keep list current at all times.

1.04 GENERAL COORDINATION PROCEDURES

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

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

B. 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 City of Tulsa if coordination of their Work is required.

1.05 REQUESTS FOR INFORMATION (RFIS)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit directly to Architect/Engineer an RFI in the form specified below. Copy City of Tulsa Project Manager, Field Engineering Construction Manager and Inspector Manager.
   1. RFI's submitted by any other entities controlled by the Contractor, Architect will return with no response.
   2. Coordinate and submit RFIs in a prompt manner to avoid delays in the Work.

B. RFI Forms: AIA Document G716 or other form with substantially the same content as G716, acceptable to Architect and City of Tulsa Engineering Department Project Manager.
   1. Attachments shall be electronic files in Adobe Acrobat PDF format.

C. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.
   3. Date.
   4. Name of Contractor.
   5. Name of Architect.
   6. Name of COT Construction Inspector or Manager.
   7. RFI number, numbered sequentially.
   8. RFI subject.
   9. Specification Section number and title and related paragraphs, as appropriate.
   10. Drawing number and detail references, as appropriate.
   11. Field dimensions and conditions, as appropriate.
   12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   13. Contractor's signature.
   14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

D. Architect's Action: Architect will review each RFI, determine action required, and respond to Contractor with copy to all parties as specified by COT. Allow five days for Architect's response for each RFI.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for approval of Contractor's means and methods.
      d. Requests for coordination information already indicated in the Contract Documents.
      e. Requests for adjustments in the Contract Time or the Contract Sum.
      f. Requests for interpretation of Architect's actions on submittals.
      g. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.

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 General Conditions."
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and City of Tulsa Construction Manager in writing within 10 days of receipt of the RFI response.
   b. Architect's action is not an authorization to proceed with Work involving a change in Contract Time or Contract Sum, or both. If any action requires a change to either or both, the Contractor shall submit an itemized proposal for the change and obtain Owner's written approval prior to proceeding with the Work.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use CSI Log Form 13.2B or other format approved by City Architect. Include the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect
   4. Name and address of City of Tulsa Construction Manager.
   5. RFI number including RFIs that were returned without action or withdrawn.
   6. RFI description.
   7. Date the RFI was submitted.
   8. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Identify related Minor Change in the Work, Construction Change Directive, and Proposal Request, Field Order, Work Change Directive, and Proposal Request, as appropriate. Review response and notify Architect within seven days if Contractor disagrees with response.

1.06 PRECONSTRUCTION CONFERENCE

A. Preconstruction Conference: City of Tulsa Construction Manager will schedule and conduct a Preconstruction (Pre-Work) Conference before starting construction, at a time convenient to City of Tulsa.
   1. City of Tulsa will conduct the conference to review responsibilities and personnel assignments.
   2. Attendees: Representatives of City of Tulsa, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. 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. Lines of communications.
      f. Procedures for processing field decisions.
      g. Procedures for RFIs.
      h. Procedures for testing and inspecting.
      i. Procedures for processing Applications for Payment.
      j. Distribution of the Contract Documents.
      k. Submittal procedures.
      l. Preparation of record documents.
      m. Use of the premises and Work restrictions.

n. Working hours.
o. Owner's occupancy requirements.
p. Responsibility for temporary facilities and controls.
q. Procedures for moisture and mold control.
r. Procedures for disruptions and shutdowns.
s. Construction waste management and recycling.
t. Parking availability.
u. Office, work, and storage areas.
v. Equipment deliveries and priorities.
w. First aid.
x. Security.
y. Progress cleaning.

4. Minutes: City of Tulsa Construction Manager will record and distribute meeting minutes.

1.07 PROJECT PROGRESS MEETINGS

A. General: City of Tulsa Construction Manager will schedule and conduct monthly progress meetings at Field Engineering Warehouse (23rd & Jackson), unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting.
      a. Notify City of Tulsa Special Projects – Project Manager and Architect of scheduled meeting dates and times.
   2. Agenda: City of Tulsa Field Engineering will prepare the meeting agenda and distribute at each 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.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions, agreements achieved, and will distribute the meeting minutes to everyone concerned, within three days of the meeting.
   4. Schedule Updating: Contractor shall update construction schedule prior to each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.08 PREINSTALLATION CONFERENCES

A. Preinstallation Conferences: Contractor shall conduct preinstallation conferences at Project site before each construction activity that requires detailed 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 City of Tulsa-Special Projects Project Manager, Architect, City of Tulsa Construction Manager of scheduled meeting dates.
   2. Agenda: Review progress of other construction activities and preparations for the specific activity under consideration, including requirements for the following:
      a. Contract Documents, related RFI's and Change Orders.
      b. Purchases and deliveries.
      c. Submittals and review of mockups.
      d. Time schedules.
      e. Weather limitations.

f. Manufacturer's written instructions and warranty requirements.
g. Compatibility of materials and acceptability of substrates.
h. Temporary facilities and controls; space and access limitations.
i. Testing and inspecting requirements.
j. Installation procedures.
k. Coordination and protection with other work, and possible conflicts.
l. Required performance results.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute meeting minutes to parties present and other parties requiring information.
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.

1.09 PROJECT CLOSEOUT CONFERENCE

A. Project Closeout Conference: City of Tulsa Construction Manager will schedule and conduct a project closeout conference, at a time convenient to City of Tulsa.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of City of Tulsa, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Owner's partial occupancy requirements.
k. Installation of Owner's furniture, fixtures, and equipment.
l. Responsibility for removing temporary facilities and controls.
4. Minutes: City of Tulsa Construction Manager will record and distribute meeting minutes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 013100

JCJARCHITECTURE

Request For Information

To: **JCJARCHITECTURE**
8801 South Yale Avenue,
Suite 100
Tulsa, Oklahoma 74137
Attn:

Project: **FACILITY REHABILITATION GREENWOOD CULTURAL CENTER**
322 N. Greenwood Ave.
Tulsa 74120

Request For Information (RFI) No: _____

Date: _____

Initiated By: _____

Response requested by (Date): _____

Design Consultants Affected: _____

Subject: _____

Description of Clarification or Information Requested (Attach Data as Required):

Proposed Solution:

Signed: _____ Initiator Date: _____

AE Response:

Signed: _____ Date: _____
JCJ/Design Consultant

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

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

B. Related Documents and Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
   2. General Conditions: Payment Procedures for submitting Applications for Payment and the schedule of values.

1.02 DEFINITIONS

A. Submittals: Written and graphic information and physical samples that require Architect's and COT-Field Engineering responsive action. Action submittals are those submittals indicated in individual Specification Sections as "Submittals."

B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.03 SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and COT-Field Engineering and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 14 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
      a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
   4. Format: Arrange the following information in a tabular format:
      a. Scheduled date for first submittal.
      b. Specification Section number and title.
      c. Submittal category: Action; informational.
      d. Name of subcontractor.
      e. Description of the Work covered.
      f. Scheduled date for Architect's and COT-Field Engineering final release or approval.
      g. Scheduled date of fabrication.

1.04 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files 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. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   4. 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 and COT-Field Engineering reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's and COT-Field Engineering receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect and COT-Field Engineering will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect and COT-Field Engineering.
   3. Include the following information for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Construction Manager.
      e. Name of Contractor.
      f. Name of subcontractor.
      g. Name of supplier.
      h. Name of manufacturer.
      i. 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., 061000.01).
      j. Number and title of appropriate Specification Section.
      k. Drawing number and detail references, as appropriate.
      l. Location(s) where product is to be installed, as appropriate.
      m. Other necessary identification.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect and COT-Field Engineering observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect and COT-Field Engineering.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect and COT-Field Engineering will discard submittals received from sources other than Contractor.
   a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
      1) Project name.
      2) Date.
      3) Destination (To:).
      4) Source (From:).
      5) Name and address of Architect.
      6) Name of Construction Manager.
      7) Name of Contractor.
      8) Name of firm or entity that prepared submittal.
      9) Names of subcontractor, manufacturer, and supplier.
      10) Category and type of submittal.
      11) Submittal purpose and description.
      12) Specification Section number and title.
      13) Specification paragraph number or drawing designation and generic name for each of multiple items.
      14) Drawing number and detail references, as appropriate.
      15) Indication of full or partial submittal.
      16) Transmittal number, numbered consecutively.
      17) Submittal and transmittal distribution record.
      18) Remarks.
      19) Signature of transmitter.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect and COT-Field Engineering on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. 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 with approval notation from Architect's and COT-Field Engineering's action stamp.

H. 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.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and COT-Field Engineering's action stamp.

PART 2 PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Submittals: Submit six paper copies of each submittal unless otherwise indicated. Architect, through COT-Field Engineering will return three copies.
   2. Certificates and Certifications Submittals: Provide a 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.
      a. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.
   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams showing factory-installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
   5. Submit Product Data before or concurrent with Samples.
   6. Submit Product Data in the following format: Six paper copies of Product Data unless otherwise indicated. Architect, through COT-Field Engineering will return three copies.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.
   2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 22 by 34 inches.
   3. Submit Shop Drawings in the following format:
      a. Six opaque (bond) copies of each submittal. Architect and COT-Field Engineering, will return three copy(ies).

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   2. Identification: Attach label on unexposed side of Samples that includes the following:
      a. Generic description of Sample.
      b. Product name and name of manufacturer.
      c. Sample source.
      d. Number and title of applicable Specification Section.
      e. Specification paragraph number and generic name of each item.
   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 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 six sets of Samples. Architect and COT – Field Engineering will retain three Sample sets; remainder will be returned.
         1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.
   5. Submit product schedule in the following format:
      a. Six paper copies of product schedule or list unless otherwise indicated. Architect, through COT-Field Engineering, will return three copies.

F. Contractor's Construction Schedule: Comply with requirements specified in agreement.

G. Application for Payment and Schedule of Values: Comply with General Conditions.

H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 - Quality Requirements.

I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 - Closeout Procedures.

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

K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

L. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

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

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

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

P. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

Q. Material Safety Data Sheets (MSDS): Submit MSDS directly to the General Contractor. Do not submit this information to the Architect. If submitted to Architect, Architect will not review the entire submittal and will return it as "Rejected."

R. Product Test Reports: Submit written reports indicating that 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.

S. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

T. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

U. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

V. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.02 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and six paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 EXECUTION

3.01 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and COT-Field Engineering.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 - Closeout Procedures.

C. 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.

3.02 ARCHITECT'S AND COT-FIELD ENGINEERING ACTION

A. Action Submittals: Architect and COT-Field Engineering will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect and COT-Field Engineering will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and COT-Field Engineering.

C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

D. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

JCJARCHITECTURE

Transmittal/Submittal Coversheet

Contractor:

Project No.:
Project:

Spec. Division _____ **Submittal Number** _____ **Spec. Section** _____

Subcontractor/Supplier _____

QUANTITY	ITEM

Contractor: Rec'd from Sub/Supplier: Date: _____ Quantity Sent: _____

Sent to: ☐ JCJ Date: _____ Action: _____
☐ Consultant: _____

cc: _____

Consultant: Rec'd from Contractor: Date: _____ Quantity Sent: _____

Sent to JCJ: Date: _____ Action: _____

JCJ: Rec'd from: ☐ Contractor Date: _____ Quantity Sent:
☐ Consultant _____

Sent to Contractor: Date: _____ Action: _____

Architect's Distribution Main File: # **T20013.00** (T. only)

☐ Architect
JCJ Architecture
8801 South Yale Avenue, Suite 100
Tulsa, Oklahoma 74137
Attn:

☐ Project Representative:

Action Key
NET/No Exception
AN/Amend as Noted
RS/Resubmit
R/Rejected

Date received By C.M.	Date Received By Consultant	Date Received By JCJ

JCJARCHITECTURE

JCJ.COM

8801 SOUTH YALE AVENUE, SUITE 100
TULSA, OK 74137
TEL 918.936.2320
TULSA@JCJ.COM

AN EMPLOYEE OWNED COMPANY

SUBMITTAL ROUTING REVIEW STAMP COVER SHEET

SUBMITTAL NO:

Project Name:
Project Number:
Project Address:

SUBMITTAL REVIEW STAMPS

CIVIL REVIEW STAMP	STRUCTURAL REVIEW STAMP

MEP REVIEW STAMP	ARCHITECTURAL STAMP

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. 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.
   4. Specific test and inspection requirements are not specified in this Section.

C. Related Documents and Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
   2. Section 012100 - Allowances, for testing and inspecting allowances.

1.02 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.03 CONFLICTING REQUIREMENTS

A. Referenced Standards: 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 conflicting 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.

1.04 SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
   1. Indicate manufacturer and model number of individual components.
   2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

C. Qualification Data: For Contractor's quality-control personnel.

D. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
   1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
   2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

E. Testing Agency Qualifications: 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.

F. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

1.05 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
   1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
   2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
   3. Owner-performed tests and inspections indicated in the Contract Documents.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.06 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. 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 re-inspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical 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.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

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.

1.07 QUALITY ASSURANCE

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

B. 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.

C. 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.

D. 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.

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 in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. 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.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
      a. Allow seven days for initial review and each re-review of each mockup.
   6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   7. Demolish and remove mockups when directed unless otherwise indicated.

1.08 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 re-inspecting 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. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
   1. 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.
   2. 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.
   3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   6. 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 Section 013300 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Re-inspecting: 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.

F. 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, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   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.

G. 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.

H. 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.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
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.

1.09 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:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews 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 to 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 re-inspecting corrected work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TEST AND INSPECTION LOG

A. Test and Inspection Log: 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 revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.02 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 or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 - Execution.

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 014533 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Code-required special inspections.

B. Testing services incidental to special inspections.

C. Submittals.

1.02 DEFINITIONS

A. Code or Building Code: ICC (IBC), International Building Code, most recent edition adopted by authority having jurisdiction, including all applicable amendments and supplements without limitation, and specifically Chapter 17 - Special Inspections and Tests.

B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.

C. NIST: National Institute of Standards and Technology.

D. Special Inspections and Tests: Inspections and testing of materials, installation, fabrication, erection, or placement of components and connections mandated by Building Code to safeguard public welfare.
   1. Special inspections and tests are separate from and independent of tests and inspections conducted by Owner or Contractor for purposes of quality assurance and contract administration.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Special Inspection Agency Qualifications: Prior to start of work, Special Inspection Agency is required to:
   1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Submit certification that Special Inspection Agency is acceptable to AHJ.
   4. Submit documentation that Special Inspection Agency is accredited by IAS according to IAS AC291.

C. Testing Agency Qualifications: Prior to start of work, Testing Agency is required to:
   1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Submit certification that Testing Agency is acceptable to AHJ.
   4. Submit documentation that Testing Agency is accredited by IAS according to IAS AC89.

D. Manufacturer's Qualification Statement: When required by AHJ, submit documentation of manufacturing capability and quality control procedures. Include documentation of AHJ approval.

E. Special Inspection Reports: After each special inspection, Special Inspector is required to submit at least two copies of report; one to Architect and one to AHJ.

F. Test Reports: After each test or inspection, Testing Agency is required to submit report to Architect and to AHJ.

1.04 SPECIAL INSPECTION AND TESTING AGENCY

A. Owner or Architect to employ services of Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by building code.

B. Special Inspection Agency may delegate to independent testing agency to perform testing and sampling associated with special inspections and required by building code.

C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of contract documents.

1.05 TESTING AND INSPECTION AGENCIES

A. Owner or Architect may employ services of independent testing agency to perform additional testing and sampling required by contract documents or associated with special inspections but not required by building code.

B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of contract documents.

1.06 QUALITY ASSURANCE

A. Special Inspection Agency Qualifications:
   1. Independent firm specializing in performing testing and inspections of the type specified in this section.
   2. Accredited by IAS according to IAS AC291.

B. Testing Agency Qualifications:
   1. Independent firm specializing in performing testing and inspections of the type specified in this section.
   2. Accredited by IAS according to IAS AC89.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SPECIAL INSPECTIONS AND TESTING

A. The Code requires special inspections and testing of certain materials, components, assemblies, and connections used in constructing the project. Special inspections and testing will be performed in accordance with the Code.

B. Special inspections and testing will be performed in accordance with the Code for the following materials and project components:
   1. Concrete.

2. Fabricated items.
3. Sprayed fire-resistant materials.
4. Fire-resistant penetrations and joints.
5. Special cases as determined by building official and required by ICC (IBC) section 1705.1.

3.02 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

A. Special Inspection Agency shall:
   1. Verify samples submitted by Contractor comply with the referenced standards and the approved Contract Documents.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified reference standards.
   4. Ascertain compliance of materials and products with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Submit reports of all tests or inspections specified.

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

C. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

D. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.03 TESTING AGENCY DUTIES AND RESPONSIBILITIES

A. Testing Agency Duties:
   1. Test samples submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Submit reports of all tests or inspections specified.

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

C. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.

D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

3.04 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. Contractor Responsibilities, General:
   1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
   2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to work to be tested or inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
      c. To facilitate tests or inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
   5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

END OF SECTION 014533

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Statement of Special Inspections

Project: **Greenwood Cultural Center**

Location: **322 N Greenwood Ave., Tulsa**

Owner:

This Statement of Special Inspections encompass the following discipline: **Structural**

This ***Statement of Special Inspections*** is submitted as a condition preceding construction in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to this project as well as the name of the Structural Special Inspection Coordinator (SSIC). A list of the identity of approved agencies to be retained for conducting these inspections and tests should be submitted as soon as possible.

The Structural Special Inspection Coordinator shall keep records of all Structural inspections and shall furnish inspection reports to the Building Code Official (BCO) and the Structural Registered Design Professional in Responsible Charge (SRDP). Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Structural Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the Building Official and the Structural Registered Design Professional in Responsible Charge at an interval determined by the SSIC and the BCO.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted to the BCO prior to issuance of a Certificate of Use and Occupancy.

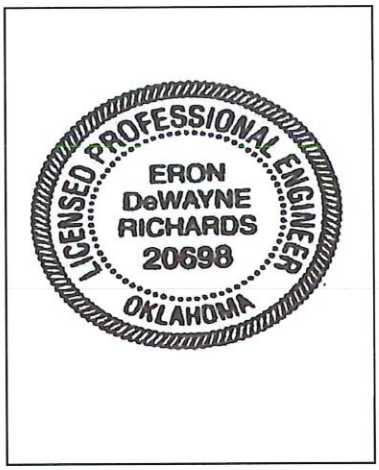
Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: ☒ *Upon request of Building Official* _____ or _ per attached schedule.

Prepared by:

Eron D. Richards
(type or print name of the Structural Registered Design Professional in Responsible Charge)

15 August 2025
Signature Date



Owner's Authorization:

Signature Date

Building Code Official's Acceptance:

Signature Date

Structural Statement of Special Inspections (Continued)

List of Agents

Project: **Greenwood Cultural Center**

Location: **322 N Greenwood Ave., Tulsa**

Owner:

This *Statement of Special Inspections* encompass the following discipline: **Structural**

(Note: *Statement of Special Inspections* for other disciplines may be included under a separate cover)

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

Y Soils and Foundations
Y Cast-in-Place Concrete
N Precast Concrete System
N Masonry Systems
Y Structural Steel
N Wood Construction ☐ Special Cases

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. STRUCTURAL Special Inspections Coordinator (SSIC)		
2. Special Inspector (SI 1)		
3. Special Inspector (SI 2)		
4. Testing Agency (TA 1)		
5. Testing Agency (TA 2)		
6. Other (O1)		

Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

Structural Statement of Special Inspections (Continued)

Final Report of Special Inspections (SSIC/SI 1)

[To be completed by the Structural Special Inspections Coordinator (SSIC/SI 1). Note that all Agent's Final Reports must be received prior to issuance.]

Project: **Greenwood Cultural Center**

Location: **322 N Greenwood Ave., Tulsa**

Owner:

Owner's Address:

Architect of Record:	Randall Hull AIA	JCJ Architecture
	(name)	*(firm)*
Structural Registered Design Professional in Responsible Charge:	Eron D. Richards P.E.,S.E.	Richards & Associates Inc.
	(name)	*(firm)*

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved.

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Structural Special Inspection Coordinator

(Type or print name)

(Firm Name)

Signature Date

Licensed Professional Seal

Structural Statement of Special Inspections (Continued)

Special Inspector's/Agent's Final Report

Project: **Greenwood Cultural Center**

Special Inspector or Agent: _____
(name) *(firm)*

Designation:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Inspector/Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved.

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector or Agent:

_____
(Type or print name)

_____
Signature Date

Licensed Professional Seal or
Certification Number

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspections

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided to the Special Inspection Coordinator for their records. *NOTE VERIFICATION THAT QUALIFIED INDIVIDUALS ARE AVAILABLE TO PERFORM STIPULATED TESTING AND/OR INSPECTION SHOULD BE PROVIDED PRIOR TO SUBMITTING STATEMENT. AGENT QUALIFICATIONS IN SCHEDULE ARE SUGGESTIONS ONLY; FINAL QUALIFICATIONS ARE SUBJECT TO THE DISCRETION OF THE REGISTERED DESIGN PROFESSIONAL PREPARING THE SCHEDULE.*

Key for Minimum Qualifications of Inspection Agents:

When the Registered Design Professional in Responsible Charge or Special Inspector of Record deems it appropriate that the individual performing a stipulated test or inspection have a specific certification, license or experience as indicated below, such requirement shall be listed below and shall be clearly identified within the schedule under the Agent Qualification Designation.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

Experienced Testing Technician

ETT	Experienced Testing Technician – An Experienced Testing Technician with a minimum 5 years experience with the stipulated test or inspection

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.

International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Pre-stressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

Other

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspections
SOILS & FOUNDATION CONSTRUCTION

VERIFICATION AND INSPECTION IBC 2018 Chapter 17	Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. Verify existing soil conditions, fill placement and load bearing requirements						
a. Verify materials below footings are adequate to achieve the design bearing capacity. .	N	P	IBC 1704		PE/GE, EIT or ETT	
b. Verify excavations are extended to proper depth and have reached proper material. .	N	P	IBC 1704		PE/GE, EIT or ETT	
c. Perform classification and testing of controlled fill materials. .	N	P	IBC 1704		PE/GE, EIT or ETT	
d. Verify use of proper materials, densities and lift thicknesses during placement and compaction of controlled fill.	N	C	IBC 1704			
e. Prior to placement of controlled fill, observe subgrade and verify that site has been prepared properly.	Y	P	IBC 1704			
2. Pile foundations:						
a. Verify pile materials, sizes and lengths comply with the requirements. .	N	C	IBC 1704		PE/GE, EIT or ETT	
b. Determine capacities of test piles and conduct additional load tests, as required. .	N	C	IBC 1704		PE/GE, EIT or ETT	
c. Observe driving operations and maintain complete and accurate records for each pile. .	N	C	IBC 1704		PE/GE, EIT or ETT	
d. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any pile damage.	N	C	IBC 1704		AWS-CWI	
e. For steel piles, perform additional inspections in accordance with Section 1704.3.	N		IBC 1704			
f. For concrete piles and concrete-filled piles, perform additional inspections in accordance with Section 1704.4.	N		IBC 1704			
g. For specialty piles, perform additional inspections as determined by the registered design professional in responsible charge.	N		IBC 1704			
h. For augered uncased piles and caisson piles, perform inspections in accordance with Section 1704.9.	N		IBC 1704			
3. Pier foundations:					PE/GE, EIT or ETT	
a. Observe drilling operations and maintain complete and accurate records for each pier.	N	C	IBC 1704		PE/GE, EIT or ETT	
b. Verify placement locations and plumbness, confirm pier diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end bearing strata capacity.	N	C	IBC 1704		PE/GE, EIT or ETT	
c. For concrete piers, perform additional inspections in accordance with Section 1704.4	N		IBC 1704		PE/GE, EIT or ETT	
d. For masonry piers, perform additional inspections in accordance with Section 1704.5	N		IBC 1704			

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspections

CONCRETE CONSTRUCTION

VERIFICATION AND INSPECTION IBC 2018 Chapter 17	Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. Inspection of reinforcing steel, including prestressing tendons, and placement	Y	P	ACI 318: 3.5, 7.1-7.7		PE/SE or EIT	
2. Inspection of reinforcing steel welding in accordance with Table 1704.3, Item 5B	N		AWS D1.4 ACI 318: 3.5.2		AWS-CWI	
3. Inspect bolts to be installed in concrete prior to and during placement of concrete where allowable loads have been increased	Y	C	IBC 1912.5		PE/SE or EIT	
4. Verifying use of required design mix	Y	P	ACI 318: Ch 4, 5.2-5.4		PE/SE or EIT	
5. At time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests and determine the temperature of the concrete	Y	C	ASTM C 172 ASTM C 31 ACI 318: 5.6, 5.8		ACI-CFTT or ACI-STT	
6. Inspection of concrete and shotcrete placement for proper application techniques	N	C	ACI 318: 5.9, 5.10		PE/SE or EIT	
7. Inspection for maintenance of specified curing temperature and techniques	N	P	ACI 318: 5.11-5.13		PE/SE or EIT	
8. Inspection of Prestressed Concrete						
a. Application of prestressing force.	N	C	ACI 318: 18.20		PE/SE or EIT	
b. Grouting of bonded prestressing tendons in the seismic force-resisting system	N	C	ACI 318: 18.18.4		PE/SE or EIT	
9. Erection of precast concrete members	N	P	ACI 318: Ch 16		PE/SE or EIT	
10. Verification of in-situ concrete strength, prior to stressing of tendons in post tensioned concrete and prior to removal of shores and forms from beams and structural slabs	N	P	ACI 318: 6.2		ACI-STT	
11. Inspect formwork for shape, location and dimensions of the concrete member being formed	N	P	ACI 318: 6.1.1			

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspections

MASONRY CONSTRUCTION – LEVEL 1 (NON-ESSENTIAL FACILITY)

VERIFICATION AND INSPECTION IBC 2018 Chapter 17	Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. As masonry construction begins, the following shall be verified to ensure compliance:						
a. Proportions of site-prepared mortar.	N	P	ACI530.1, 2.6A		PE/SE or EIT	
b. Construction of mortar joints.	N	P	ACI530.1, 3.3B		PE/SE or EIT	
c. Location of reinforcement and connectors, prestressing tendons and anchorages	N	P	ACI530.1, 3.4, 3.6A		PE/SE or EIT	
d. Prestressing technique.	N	P	ACI530.1, 3.6B		PE/SE or EIT	
e. Grade and size of prestressing tendons and anchorages.	N	P	ACI530.1, 2.4B, 2.4H		PE/SE or EIT	
2. The inspection program shall verify:						
a. Size and location of structural elements.	N	P	ACI530.1, 3.3G		PE/SE or EIT	
b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction.	N	P	ACI530, 1.2.2(e), 2.1.4, 3.1.6		PE/SE or EIT	
c. Specified size, grade and type of reinforcement.	N	P	ACI530, 1.13		PE/SE or EIT	
d. Welding of reinforcing bars.	N	C	AC530, 2.1.10.7.2, 3.3.3..4 (b)		AWS-CWI	
e. Protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).	N	P	IBC 2104, 2104.4; ACI530.1, 1.8C, 1.8D		PE/SE or EIT	
f. Application and measurement of prestressing force.	N	P	ACI530.1, 3.6B		PE/SE or EIT	
3. Prior to grouting, the following shall be verified to ensure compliance:						
a. Grout space is clean.	N	P	ACI530.1, 3.2D		PE/SE or EIT	
b. Placement of reinforcement and connectors and pre-stressing tendons and anchorages.	N	P	ACI530, 1.13, ACI530.1, 3.4		PE/SE or EIT	
c. Proportions of site-prepared grout and prestressing grout for bonded tendons.	N	P	ACI530.1, 2.6B		PE/SE or EIT	
d. Construction of mortar joints.	N	P	ACI530.1, 3.3B		PE/SE or EIT	
4. Grout placement shall be verified to ensure compliance with code and construction document provisions.	N	C	ACI530.1, 3.5		PE/SE or EIT	
a. Grouting of prestressing bonded tendons.	N	C	ACI530.1, 3.6C		PE/SE or EIT	
5. Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed.	N	C	IBC 2105, 2105.3; ACI530.1, 1.4		PE/SE or EIT	
6. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	N	P	ACI530.1, 1.5		PE/SE or EIT	

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspections

MASONRY CONSTRUCTION – LEVEL 2 (ESSENTIAL FACILITY)

VERIFICATION AND INSPECTION IBC 2018 Chapter 17	Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. From the beginning of masonry construction, the following shall be verified to ensure compliance:						
a. Proportions of site-prepared mortar, grout and prestressing grout for bonded tendons.	N	P	ACI530.1, 2.6A		PE/SE or EIT	
b. Placement of masonry units and construction of mortar joints.	N	P	ACI530.1, 3.3B		PE/SE or EIT	
c. Placement of reinforcement, connectors and prestressing tendons and anchorages.	N	P	ACI530, 1.13; ACI530.1, 3.4, 3.6 A		PE/SE or EIT	
d. Grout space prior to grouting.	N	C	ACI530.1, 3.2D		PE/SE or EIT	
e. Placement of grout.	N	C	ACI530.1, 3.5		PE/SE or EIT	
f. Placement of prestressing grout.	N	C	ACI530.1, 3.6C		PE/SE or EIT	
2. The inspection program shall verify:						
a. Size and location of structural elements.	N	P	ACI530.1, 3.3G		PE/SE or EIT	
b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction.	N	C	ACI530, 1.2.2(e), 2.1.4, 3.1.6		PE/SE or EIT	
c. Specified size, grade and type of reinforcement.	N	P	ACI530, 1.13; ACI530.1, 2.4, 3.4		PE/SE or EIT	
d. Welding of reinforcing bars.	N	C	ACI530, 2.1.10.7.2, 3.3.3.4(b);		PE/SE or EIT	
e. Protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).	N	P	IBC 2104 ACI530.1, 1.8C, 1.8D		PE/SE or EIT	
f. Application and measurement of prestressing force.	N	C	ACI530.1, 3.6B		PE/SE or EIT	
3. Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed.	N	C	IBC 2105; ACI 530.1, 1.4		PE/SE or EIT	
4. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	N	P	ACI530.1, 1.5		PE/SE or EIT	

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspections - STEEL CONSTRUCTION

VERIFICATION AND INSPECTION IBC 2018 Chapter 17	Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. Material verification of high-strength bolts, nuts and washers:						
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	N	P	Applicable ASTM material specifications; AISC 360, Section A3.3		PE/SE or EIT	
b. Manufacturer's certificate of compliance required.	N	P			PE/SE or EIT	
2. Inspection of high-strength bolting						
a. Bearing-type connections.	N	P	AISC 360 Section M2.5 IBC Sect 1704		AWS/AISC-SSI	
b. Slip-critical connections.	N	C or P (method dependent)			AWS/AISC-SSI	
3. Material verification of structural steel :						
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	N	S	ASTM A 6 or ASTM A 568 IBC Sect 1708		PE/SE or EIT	
b. Manufacturers' certified mill test reports.	N	S	ASTM A 6 or ASTM A 568 IBC Sect 1708		PE/SE or EIT	
4. Material verification of weld filler materials:						
a. Identification markings to conform to AWS specification in the approved construction documents.	N	S	AISC 360, Section A3.5		PE/SE or EIT	
b. Manufacturer's certificate of compliance required.	N	S			PE/SE or EIT	
5. Inspection of welding: a. Structural steel:						
1) Complete and partial penetration groove welds	N	C	AWS D1.1, IBC 1704.3.1			
2) Multi-pass	N	C	AWS 31.1, IBC 1704.3.1			
3) Sing-pass fillet welds > 5/16"	N	C	AWS D1.1, IBC 1704.3.1			
4) Single-pass fillet welds ≤ 5/16"	Y	P	AWS D1.1, IBC 1704.3.1			
5) Floor and roof deck welds	N	P	AWS D1.3			
b. Reinforcing steel:			AWS D1.4, ACI 318: 3.5.2			
1) Verification of weld-ability of reinforcing steel other than ASTM A 706	N	P	AWS D1.4, ACI 318: 3.5.2			
2) Reinforcing steel-resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special reinforced concrete shear walls and shear reinforcement	N	C	AWS D1.4, ACI 318: 3.5.2			
3) Shear reinforcement	N	C	AWS D1.4, ACI 318: 3.5.2			
4) Other reinforcing steel	N	P	AWS D1.4, ACI 318: 3.5.2			
6. Inspection of steel frame joint details for compliance with approved construction documents:	N	P	IBC 1704			
a. Details such as bracing and stiffening:	N	C				
b. Member locations	N	C				
c. Application of joint details at each connection	N	C				

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspection Services

FABRICATION AND IMPLEMENTATION PROCEDURES – STRUCTURAL STEEL

VERIFICATION AND INSPECTION IBC 2018 Chapter 17	Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. Fabrications Procedures: Review of fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by an approved special inspection agency. At the completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building code official stating that the work was performed in accordance with the approved construction documents. -OR- 2. AISC Certification	N	S	Fabricator shall submit one of the two qualifications		PE/SE or EIT	
3. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building code official stating that the work was performed in accordance with the approved construction documents.	N	S	IBC 1704		PE/SE or EIT	

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspection Services

FABRICATION AND IMPLEMENTATION PROCEDURES – WOOD TRUSSES

VERIFICATION AND INSPECTION IBC 2018 Chapter 17	Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. Fabrications Procedures: Review of fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by an approved special inspection agency. At the completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building code official stating that the work was performed in accordance with the approved construction documents. -OR- 2. TPI Inspection Program: Fabricator shall participate in the TPI Quality Assurance Inspection Program, and maintain a copy of the Quality Assurance Procedures Manual, QAP-90. Submit copy of certificate. All trusses shall bear the TPI Registered Mark.	N	S	Fabricator shall submit one of the two qualifications		PE/SE or EIT	
3. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building code official stating that the work was performed in accordance with the approved construction documents	N	S	IBC 1704		PE/SE or EIT	

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Structural Schedule of Special Inspections

WOOD CONSTRUCTION

VERIFICATION AND INSPECTION IBC 2018 Chapter 17	Y/N	EXTENT: CONTINUOUS, PERIODIC, SUBMITTAL, OR NONE	COMMENTS	AGENT	AGENT QUALIFICATION	TASK COMPLETED
1. Fabrication of high-load diaphragms: High-load diaphragms designed in accordance with Table 2306.3.2 shall be installed with special inspections as indicated in Section 1704.1.						
a. Verify wood structural panel sheathing for grade and thickness	N	P	IBC 1704		PE/SE or EIT	
b. Verify the nominal size of framing members at adjoining panel edges	N	P	IBC 1704		PE/SE or EIT	
b. Verify the nail or staple diameter and length	N	P	IBC 1704		PE/SE or EIT	
b. Verify the number of fastener lines	N	P	IBC 1704		PE/SE or EIT	
b. Verify the spacing between fasteners in each line and at edge margins	N	P	IBC 1704		PE/SE or EIT	
2. Load Tests for Joist Hangers: Provide evidence of manufacturer's load test in accordance with ASTM D1761 including the vertical load bearing capacity, torsional moment capacity, and deflection characteristics when there is no calculated procedure recognized by the code.	N	S	IBC 1715 [submit ICBO reports]		PE/SE or EIT	

Prepared by:

Eron D. Richards / Richards & Associates

Building Code Official's Acceptance:

Project: Greenwood Cultural Center, 322 N Greenwood Ave.
Date Prepared: August 15, 2025

Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Quality Assurance Plan and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Building Official.

_____ _____

Signature Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of reports are attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

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

B. Related Requirements:
1. Section 011000 - Summary, for work restrictions and limitations on utility interruptions.

1.02 USE CHARGES

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

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.03 INFORMATIONAL SUBMITTALS

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

B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire prevention program.

1.04 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.

1.05 PROJECT CONDITIONS

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

PART 2 PRODUCTS

2.01 EQUIPMENT

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

PART 3 EXECUTION

3.01 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.

3.02 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Review first subparagraph below with Owner's insurance carrier. Revise to suit Project.
   2. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241.
   3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

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

D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
   1. Identification Signs: Provide Project identification signs as indicated on Drawings.
   2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
      a. Provide temporary, directional signs for construction personnel and visitors.
   3. Maintain and touchup signs so they are legible at all times.

E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

F. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
   1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.03 SECURITY AND PROTECTION FACILITIES INSTALLATION

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

B. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

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

D. 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; manage fire prevention program.
   1. Prohibit smoking in construction areas.
   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
   4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.04 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 - Closeout Procedures.

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:
   1. Section 012500 - Substitution Procedures, for requests for substitutions.
   2. Section 013300 - Submittal Procedures, for submittal requirements.
   3. Section 017700 - Closeout Procedures, for closeout requirements.

1.02 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process 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. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," 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 additional manufacturers named in the specification.

1.03 SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. 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 Section 013300 - Submittal Procedures.
      b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 - Submittal Procedures. Show compliance with requirements.

1.04 QUALITY ASSURANCE

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

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. 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 determine compliance with the Contract Documents and to determine 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. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   6. Protect stored products from damage and liquids from freezing.

1.06 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: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for 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 indicated form properly executed.
   3. Refer to Divisions 02 through 33. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 - Closeout Procedures.

PART 2 PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, 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. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   3. Products:
      a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
      b. Non-restricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
   4. Manufacturers:
      a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
      b. Non-restricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
   5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated 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 requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
   1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 - Substitution Procedures, for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.02 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
   1. Evidence that the proposed product does not require 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 017300 - EXECUTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Installation of the Work.
   3. Cutting and patching.
   4. Coordination of Owner-installed products.
   5. Progress cleaning.
   6. Starting and adjusting.
   7. Protection of installed construction.

B. Related Documents and Requirements:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
   2. Section 017700 - Closeout Procedures, for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.02 SUBMITTALS

A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
   1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
   2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
   3. Products: List products to be used for patching and firms or entities that will perform patching work.
   4. Dates: Indicate when cutting and patching will be performed.
   5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
      a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.03 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
   2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

3.02 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

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

3.03 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.

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. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

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. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by 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.

3.04 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using cutting machine, such as abrasive saw or diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
      a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
      b. Restore damaged pipe covering to its original condition.
   3. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

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

3.05 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees Fahrenheit.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 - Temporary Facilities and Controls.

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.

3.06 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

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: Comply with qualification requirements in Section 014000 - Quality Requirements.

3.07 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.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Closeout Submittals.
   2. Substantial Completion procedures.
   3. Final Completion procedures.
   4. Final cleaning.
   5. Repair of the Work.

1.02 CLOSEOUT SUBMITTALS

A. Contractor's List of Incomplete Items (Punch List): Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

C. Project Warranties: Final submittal at Final Completion.

D. Operation and Maintenance Manual Submittals: Final submittal at Final Completion.

E. Record Drawings: Submit copies of Record Drawings as specified herein.

F. Record Specifications: Submit Project's Record Specifications, including addenda and contract modifications, as specified herein.

G. Record Product Data: Submit Project's Record Product Data as specified herein.

H. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit Miscellaneous Record Submittals as specified.

1.03 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items (Punch List): Prepare and submit to Architect a list of items to be completed and corrected, indicating the value of each item on the list and reasons why the Work is incomplete.
   1. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A or other form as approved by City of Tulsa Construction Manager.
   2. Submit three paper copies of list of incomplete items (unless otherwise directed). Architect will return two copies, through City of Tulsa Construction Manager.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Submit closeout submittals specified in other Division 01 Sections, including Contractor's As-Built project documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by City of Tulsa Construction Manager. Label with manufacturer's name and model number where applicable.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Complete startup and testing of systems and equipment.
2. Perform preventive maintenance on equipment used prior to Substantial Completion.
3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
4. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
5. Complete final cleaning requirements, including touchup painting.
6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Schedule and coordinate Substantial Completion inspection with City Construction Manager a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. City of Tulsa Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. City of Tulsa Construction Manager will prepare the Substantial Completion documentation after inspection or will notify Contractor of items, either on Contractor's list or additional items identified, that must be completed or corrected before certificate will be issued.
1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.04 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to City of Tulsa Construction Manager instructions.
2. List of Incomplete Items (Punch List): Submit copy of Substantial Completion inspection list of items to be completed or corrected, endorsed and dated by City of Tulsa Construction Manager. Inspection List shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Schedule Final Inspection with City Construction Manager to determine acceptance. City of Tulsa Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. City of Tulsa Construction Manager 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

PART 2 PRODUCTS

2.01 PROJECT WARRANTIES MANUAL

A. Time of Submittal: Submit written warranties on request of City of Tulsa Construction Manager for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch 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.
   4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

2.02 OPERATION AND MAINTENANCE MANUALS - GENERAL

A. Operation and Maintenance Manual Submittals: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals.
   1. Submit reviewed manual content formatted and organized as required by this Section.
      a. Architect will comment on whether content of operations and maintenance submittals are acceptable.
      b. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
   2. Format: Submit operations and maintenance manuals in the following format:
      a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
      b. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      c. Enable inserted reviewer comments on draft submittals.
      d. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect, through City of Tulsa Construction Manager, will return two copies.
   3. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

2.03 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. Use designations for systems and equipment indicated on Contract Documents.
   2. Operating standards.
   3. Operating procedures.
   4. Operating logs.

5. Wiring diagrams.
6. Control diagrams.
7. Piped system diagrams.
8. Precautions against improper use.
9. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
1. Manufacturer's name, product name and model number. Use designations for products indicated on Contract Documents.
2. Equipment identification with serial number of each component.
3. Equipment function.
4. Operating characteristics.
5. Limiting conditions.
6. Performance curves.
7. Engineering data and tests.
8. 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.

2.04 PRODUCT MAINTENANCE MANUALS

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. Manufacturer's name, product name and model number.
2. Color, pattern, and texture.
3. Material and chemical composition.
4. 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. List of cleaning agents and methods of cleaning detrimental to product.
3. Schedule for routine cleaning and maintenance, and 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.

2.05 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

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 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 video recording, 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.

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.

2.06 RECORD DRAWINGS

A. Contractor's As-Built Drawings: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Mark 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 provide information for preparation of corresponding marked-up record prints. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
2. Mark the Contract Drawings and Shop Drawings completely and accurately.
3. Mark record sets with erasable, red-colored pencil.
4. Note Construction Change Directive numbers, alternate numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "CONTRACTOR AS-BUILT DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows.
   a. Date: MM/DD/YYYY
   b. Designation "CONTRACTOR AS-BUILT DRAWINGS."

2.07 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.

B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.08 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 products delivered to Project site and changes in manufacturer's written instructions for installation.

B. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.

2.09 MATERIALS FOR CLEANING

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

3.01 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: 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 Substantial Completion for entire Project or for a designated 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. Remove tools, construction equipment, machinery, and surplus material from Project site.
      d. 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.
      e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      f. Sweep concrete floors broom clean in unoccupied spaces.
      g. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
      h. Wipe surfaces of mechanical and electrical equipment and similar equipment.
      i. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
      j. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
      k. Leave Project clean and ready for occupancy.

3.02 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
   1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
   2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
      a. Do not paint over "UL" and other required labels and identification, including fire rated doors and frames, mechanical and electrical nameplates. Remove paint applied to required labels and identification.
   3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
   4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

3.03 RECORD DOCUMENTS RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until 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 and City of Tulsa Construction Manager's reference during normal working hours.

END OF SECTION 017700

SECTION 024100 - SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of building elements for alteration purposes.

C. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

D. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.

D. Section 017300 - Execution: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

E. Section 070150.19 - Preparation for Re-Roofing: Removal of existing roofing, roof insulation, flashing, trim, and accessories.

1.03 DEFINITIONS

A. Deconstruction: Systematic dismantling and removal of a structure or its parts and salvage of elements and components for reuse, recycling, and retaining maximum value.

B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.

C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.

D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

F. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

G. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

H. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

I. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

J. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

K. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

L. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

M. Retain: To keep an element or detail secure and intact.

N. Strip: To remove existing finish down to base material unless otherwise indicated.

1.04 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.05 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Site Plan: Indicate:
1. Vegetation to be protected.
2. Areas for temporary construction and field offices.
3. Areas for temporary and permanent placement of removed materials.

C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
2. Instructions for removal and disposition of period materials specified to be salvaged or recycled.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.06 QUALITY ASSURANCE

A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. Review and finalize protection requirements.
7. Review procedures for noise control and dust control.

8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

B. Refrigerant Recovery Technician Qualifications: Universal certified by an EPA-approved certification program.

1.07 FIELD CONDITIONS

A. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with demolition work.

B. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

D. Steel Tendons: Locate tensioned steel tendons, if any, and include recommendations for de-tensioning.

3.02 PREPARATION

A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

3.03 ITEMS TO BE SALVAGED

A. General: Salvage elements and components to the maximum extent possible. Maintain a chain of custody of salvaged materials, including the condition of such materials before and after salvage operations.
   1. Remove historic items to be salvaged from the structure prior to deconstruction work.
   2. Accomplish removal of salvageable items by hand labor to the maximum extent possible.

3. Take care not to damage historic portions of the structure scheduled to remain or items identified for salvage.

B. Specialty Elements: Remove intact and salvage specialty elements indicated on drawings.

3.04 DEMOLITION

A. Remove portions of existing building as indicated on Drawings.

B. Remove paving and curbs as indicated on drawings.

C. Break up paving as indicated on drawings to permit natural moisture drainage; leave pieces not larger than 1 square yard.

D. Concrete: Remove in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts
1. Remove concrete slabs on grade as indicated on drawings.

E. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 070150.19 for re-roofing requirements.

G. Remove other items indicated, for salvage, relocation, and recycling.

3.05 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with requirements in Section 017300.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
1. Obtain required permits.
2. Comply with applicable requirements of NFPA 241.
3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
4. Provide, erect, and maintain temporary barriers and security devices.
5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
7. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
8. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
10. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
    a. Do not proceed with the work in question until directed by Architect.

C. Do not begin removal until receipt of notification to proceed from Owner.

D. Do not begin removal until built elements to be salvaged or relocated have been removed.

E. Protect existing structures and other elements to remain in place and not removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

F. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. Hazardous Materials:
   1. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.

H. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

I. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.06 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Unused underground piping may be abandoned in place, provided it is completely drained and capped; remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.07 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

4. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.

B. Separate areas in which demolition is being conducted from areas that remain occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction as required, and as approved by Architect.

C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.

D. Remove existing work as indicated and required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction indicated.
   2. Remove items indicated on drawings.
   3. Resilient Floor Coverings: Remove floor coverings and adhesive in accordance with recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
   1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. See Section 011000 - Summary for limitations on outages and required notifications.
   4. Verify that abandoned services serve only abandoned facilities before removal.
   5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Salvaged Materials:
   1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
   2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.
   6. If required by Owner, reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

G. Storage: Catalog items being stored within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

H. Protect existing work to remain.
   1. Prevent movement of structure. Provide shoring and bracing as required.
   2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch to match new work.

3.08 DEBRIS AND WASTE REMOVAL

A. Remove materials not to be reused on site; comply with disposal acceptable to authorities having jurisdiction.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

3.09 CLEANING

A. Upon completion of work, clean dust, dirt, and debris caused by salvage and demolition operations from portions of existing structure to remain and adjacent areas. Remove and transport debris and rubbish in a manner that prevents spillage on streets or adjacent areas. Obey local regulations regarding hauling and disposal.

END OF SECTION 024100

SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Concrete building frame members.

C. Elevated concrete slabs.

D. Floors and slabs on grade.

E. Concrete reinforcement.

F. Joint devices associated with concrete work.

G. Miscellaneous concrete elements, including equipment pads, light pole bases, flagpole bases, thrust blocks, and manholes.

H. Concrete curing.

1.02 REFERENCES

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International;

B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International;

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International;

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International;

E. ACI 308 - Standard Practice for Curing Concrete; American Concrete Institute International;

F. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2021.

G. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement; 1997.

H. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 1996a.

I. ASTM C 33 - Standard Specification for Concrete Aggregates;

J. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 1996.

K. ASTM C 94 - Standard Specification for Ready-Mixed Concrete;

L. ASTM C 150 - Standard Specification for Portland Cement;.

M. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete;

N. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 1994a.

O. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete;

P. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 1998a.

Q. ASTM E 1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers;

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures.

B. Reinforcing Drawings, including placement drawings and bar schedules showing all shapes, sizes, and dimensions

C. Concrete Mix Designs, including historical performance reports prepared by an Independent Testing Laboratory.

D. Product Data: Submit manufacturers' data on manufactured products.

E. Samples: Submit two, 6 inch long samples of waterstops and construction joint devices.

F. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

G. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

H. Reproduction of Construction Documents not permitted for shop drawings.

1.04 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
1. Maintain one copy of each document on site.

B. All concrete provided is to be tested in accordance with the guidelines of Section 1400.

C. Acquire cement from same source and aggregate from same source for entire project.

D. Notify Architect and Owner's Representative 24-hours in advance of any concrete placement. The Architect, and its consultant, must examine conditions prior to any concrete placement.

PART 2 PRODUCTS

2.01 FORMWORK

A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide a stain-free and "true" final appearance.
2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.

2.02 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420), unless indicated otherwise on drawings.
1. Deformed billet-steel bars.
2. Unfinished.

B. Welded Steel Wire Fabric: ASTM A 185, plain type.
1. Mesh Size and Wire Gage: As indicated on drawings.

C. Reinforcement Accessories:
1. Tie Wire: Annealed, minimum 16 gage.

2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.03 UNDERSLAB STRATA

A. Capillary Break below Floor Slab(s) on grade: minimum 4" thick layer of 3/4" gap graded stone (no fines). Bottom of rock layer to be equal to or higher than the outside grade.

2.04 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type I - Normal Portland type.

B. Fine and Coarse Aggregates: ASTM C 33.

C. Water: Clean and not detrimental to concrete.

2.05 ADMIXTURES

A. Air Entrainment Admixture: ASTM C 260. Use in all exterior concrete. Refer to Concrete / Structural Notes on the drawings.

B. Water Reducing Admixture: ASTM C494, Type A.

C. All admixtures are to be approved by the Architect and Engineer before using. These must be included in the Concrete Mix designs submitted for approval.

D. No admixtures shall be used that will detrimental to the proper stamping and staining of the slab.

2.06 CONCRETE ACCESSORIES

A. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.

B. Bonding Agent: ASTM C 1059, Type II acrylic non-redispersable type.

C. Epoxy Bonding System: ASTM C 881, type as required by project conditions.

D. Vapor Barrier: Extremely low permeance 15 mil vapor barrier, with all laps a minimum of 6" and taped continuously with tape recommended by manufacturer. Acceptable products:

1. Stego Wrap (15 mil) Vapor Barrier by STEGO INDUSTRIES LLC, San Juan Capistrano, CA. (877) 464-7834 www.stegoindustries.com
2. W.R. Meadows® premoulded membrane with Plasmatic Core.
3. Vaporguard® by Reef® Industries
4. Equal pre-approved products. See Section 016000.

E. Non-Shrink Grout: ASTM C 1107; premixed compound consisting of aggregate, cement, water reducing and plasticizing agents.
1. Minimum Compressive Strength at 28 Days: 7,000 psi.

F. Curing: Chemical Curing Compounds will not be permitted on surfaces to receive surface applied waterproofing compounds or adhesive applied floor finishes, including tile and carpet. Use water sprinklers with edge dams and curing cover to maintain wet surface for not less than seven (7) days then reduce to a damp surface for three additional days. Failure to maintain the required curing enviroment may result in rejection of work. Curing compounds may be used on exterior slabs only.

G. Moisture-Retaining Cover: ASTM C 171; white curing paper or white burlap-polyethylene sheet.

H. Liquid Curing Compound: ASTM C 309, Type 1, clear or translucent. EXTERIOR CONCRETE ONLY.

2.07 JOINT DEVICES AND MATERIALS

A. Waterstops: Rubber type, COE CRD-C 513. Provide joint materials manufactured by Greenstreak or equal.

B. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, 1/2 inch thick and full depth of slab less 1/2 inch.

C. Construction Joint Devices: Integral galvanized steel or extruded plastic, 3.5 inch thick, or as shown on the drawings, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge (must be removed prior to next pour). Site-built joint device in combination with tooled edges as detailed are acceptable.

D. Smooth Dowels: to be size and type as shown on drawings.

E. Sealant and Primer: As specified in Section 079200.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific project conditions. (Sidewalks only)

C. Normal Weight Concrete:

1. Compressive Strength, when tested in accordance with ASTM C 39 at 28 days: As indicated on drawings. If not noted, allow for 4,000psi in bid, but confirm required strength during the submittal process.
2. Water-Cement Ratio: Maximum 45 percent by weight.
3. Total Air Content: 5 percent, per ASTM C 173 -- Exterior exposed concrete only.
4. Maximum Slump: 4 inches (+/- 1").
5. Maximum Aggregate Size: .75 inch.
6. Use accelerating admixtures in cold weather only when approved by Architect. Use of admixtures will not relax cold weather placement requirements.
7. The Use of calcium chloride shall not be allowed.
8. Use set retarding admixtures during hot weather when approved by Architect.
9. Use superplasticizer for pumped placements when approved by the Architect.

2.09 MIXING

A. Transit Mixers: Comply with ASTM C 94.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Earth forms are permitted for continuous and spot footings only.

B. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301. All forms shall conform to the shape, lines, and dimensions of members as shown on drawings, and shall be substantially free from surface defects. All concrete shall be formed, except flat areas to be finished, unless shown or noted otherwise on the drawings. Construct forms sufficiently tight to prevent leakage of water.

C. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to over-stressing by construction loads.

D. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

E. Align joints and make watertight. Keep form joints to a minimum.

F. Obtain approval before framing openings in structural members which are not indicated on the Drawings.

G. Apply form release agent on formwork in accordance with manufacturer's recommendations. Apply prior to placement of reinforcing steel, anchoring devices and embedded items.

H. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are effected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

I. Provide formed openings where required for items to be embedded in passing through concrete work.

J. Locate and set in place items which will be cast directly into concrete.

K. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

L. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

M. Loosen forms carefully. do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

N. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

O. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

P. For floor slabs on grade, first place a 6" layer of 3/4" Class A (no fines) rock, thoroughly consolidated with a plate compactor. Granular Fill shall meet ASTM D448.

Q. For sidewalks on grade, first place a 2" leveling course of well consolidated (plate compactor) sand.

R. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

3.03 INSTALLING REINFORCEMENT

A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice, ACI 318.

B. Locate reinforcing splices not indicated on drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

C. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

D. Place, support and secure reinforcement against displacement. Do not deviate from required position. Accommodate placement of formed openings.

E. Install wire fabric in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect and Owner's Representative not less than 24 hours prior to commencement of placement operations.

D. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

E. Concrete shall be conveyed from mixer to the place of final deposit by methods which will prevent segregation or loss of materials. Chutes shall be metal and have maximum slope of 4 to 12. Chutes greater than 20 feet long are not permitted.

F. The concreting shall be carried on at such a rate that concrete is plastic at all times and flows readily into spaces between bars. Concrete temperature shall be 60-80 degrees Fahrenheit. No concrete that is partially hardened or has been contaminated by foreign materials shall be deposited, nor shall re-tempered concrete be used.

G. Separate slabs on grade from vertical surfaces with joint filler.

H. Each batch shall begin at a bulkhead, edge form, or into the edge of the previously placed concrete to avoid stone pockets and segregation.

I. Do not interrupt successive placement; do not permit cold joints to occur. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously place.

J. Bring concrete to the correct level with a straight edge and strike off. Use floats to smooth the surface, leaving the concrete free of humps or hollows.

K. Place concrete continuously between predetermined expansion, control, and construction joints.

L. Place floor slabs in joint pattern indicated on drawings.

M. Type and use of vibrator shall be in conformance with ACI 309, "Recommended Practice for Consolidation of Concrete", lower frequency vibrators may be used with "flowing" concrete. Vibrators shall be inserted in accordance with manufacturer's instructions.

N. Screed slabs on grade level, maintaining surface flatness of maximum of 1/8" in 10 ft.

O. Minimum of two (2) hours are required between placing columns and floors.

P. Install joint devices in accordance with manufacturer's instructions.

Q. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

R. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.

3.05 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:

1. Steel trowel surfaces that will receive carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
2. Steel trowel surfaces that will be left exposed.
3. After concrete has been properly placed, struck off, and darbied or bullfloated, it shall not be worked until ready for floating. Lapse time between darbying and power floating may vary from 2 to 8 hours depending on weather conditions, concrete temperature, and concrete mixture. Power floating shall begin when the water sheen has disappeared, and/or mix has stiffened sufficiently that the weight of a man standing on it leaves only a slight imprint on the surface. If two power floating operations are necessary to bring surface to desired state, concrete shall be allowed to stiffen or become harder before beginning second floating operation.
4. Both power and hand troweling shall be required. Begin power troweling as soon as little or no cement paste clings to blades. Continue troweling until surface is dense, smooth, and free of all minor blemishes, such as trowel marks.
5. Final hand troweling shall be required to remove slight imperfections left by troweling machines and to bring surface to a dense, smooth polished finish. continue hand troweling until a ringing sound is heard as the trowel passes over surface.
6. Steps and platforms receive a light broom finish following sufficient troweling to seal the surface and remove all minor blemishes, such as trowel marks.
7. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.06 CONTROL JOINTS

A. Control joints shall be located as shown on drawings or per approved alternative layout.

B. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade.

C. Perform sawing of control joints with approved mechanical saw in satisfactory working condition, adequately powered to cut rapidly to the depth and width shown on drawings. Saws shall be water cooled and have suitable guides to insure straight line cutting.

D. Begin sawing as soon as the concrete hardens sufficiently to prevent undue raveling of the edges. Succeeding joints shall be sawed consecutively from beginning to end of the days pour and sawed soon enough to prevent uncontrolled cracking.

E. Remove residue by flushing with water and cleaning with air jet prior to placing joint filler.

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI 308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
1. Normal concrete: Not less than 7 days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

D. Surfaces Not in Contact with Forms:
1. Start initial curing as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than seven (7) days by water ponding, water-saturated sand, water-fog spray, or saturated burlap. Where curing compound is used, apply at the rate of 400 square feet per gallon in accordance with recommendations of the manufacturer and shall not be used on any surface against which additional concrete or other cementitious finishing materials are to be bonded.
2. Begin final curing after initial curing but before surface is dry.
a. Moisture-retaining cover: Seal in place with waterproof tape or adhesive. Do Not Use Paper products.

3.08 JOINT SEALANTS

A. Paving: Vulkem 202 or Sonneborn "Sonometric 2"

B. Sidewalks: Soft joints, Pecora Synthacalk GC9.

C. Interior Floor Slabs:
1. Exposed: Slabs subject to motorized vehicular traffic; semi-flexible epoxy "Masterfill" CJ or as approved by the Architect. Joints shall be refilled if cracking of sealant occurs.
2. Exposed slabs not subjected to vehicular traffic: "Pecora" Synthacalk GC9 or as approved by the Architect.
3. Slabs beneath floor finishes: Hard filler "Floorstone" or as approved by the Architect.

3.09 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to Architect for review and approval prior to commencement of concrete operations.

D. Compressive Strength Tests: ASTM C 39. For each test, mold and cure four concrete test cylinders. Obtain test samples for every 25 cu yd or less of each class of concrete placed.

E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

F. Perform one slump test for each set of test cylinders taken.

3.10 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect, Owner's Representative, and General Contractor within 24 hours of test.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by the Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

END OF SECTION 033000

SECTION 033511 - CONCRETE FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface treatments for formed concrete planter.

B. Clear, penetrating, moisture-vapor-resistant sealers.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.06 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

B. Maintain ambient temperature of 50 degrees F minimum.

1.07 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide two-year manufacturer warranty for concrete sealer commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.01 CONCRETE FINISH APPLICATIONS

A. Penetrating Clear Sealer: Use where **CONC-S1** is indicated.

2.02 COATINGS

A. Clear, Penetrating, Moisture Vapor-Resistant Coating (**CONC-S1**): Vapor-resistant and pH-reducing coating recommended by manufacturer for new and existing concrete floors and slabs.
   1. Type: High solids epoxy; two-component.
   2. Products: Provide one of the following, or approved equivalent.
      a. LATICRETE International, Inc; Vapor Ban E: www.laticrete.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

C. Verify concrete forms are in place, and colored concrete mix is placed in accordance with Section 033000 and ACI-301.
   1. Forms shall be removed in accordance with ACI-347.
   2. Formed concrete shall be smooth rubbed with carborundum brick or other abrasive, not more than 24 hours after form removal.

3.02 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.

C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

D. Apply coatings/sealers in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

3.04 PROTECTION

A. Protect installed coatings from subsequent construction operations.

B. Do not permit traffic over unprotected floor surface.

END OF SECTION 033511

SECTION 051300- STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. SUMMARY
1. This Section includes the following:

a. Roof deck.
2. Related Sections include the following:

a. Section 051200 "Structural Steel" for shop-welded shear connectors.
b. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

B. ACTION SUBMITTALS
1. Product Data: For each type of deck, accessory, and product indicated.
2. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.

C. INFORMATIONAL SUBMITTALS
1. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.
2. Welding Certificates: Copies of certificates for welding procedures and personnel.
3. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:

a. Mechanical fasteners.

D. QUALITY ASSURANCE
1. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
2. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
3. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
4. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those steel deck units tested for fire resistance per ASTM E 119 by a testing and inspection agency acceptable to authorities having jurisdiction.

a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
b. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
5. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

E. DELIVERY, STORAGE, AND HANDLING

1. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
2. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

2.01 PRODUCTS

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:

a. Steel Deck:

1) Consolidated Systems, Inc.
2) Epic Metals Corp.
3) Nucor Corp.; Vulcraft Div.
4) United Steel Deck, Inc.
5) Verco Manufacturing Co.
6) Wheeling Corrugating Co.; Div. of Wheeling-Pittsburgh Steel Corp.

B. ROOF DECK
1. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 29, and the following:

a. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
b. Deck Profile: Type F, intermediate rib.
c. Profile Depth: 1-1/2 inches.
d. Design Uncoated-Steel Thickness: As indicated.
e. Span Condition: Triple span or more.
f. Side Laps: Overlapped.

C. ACCESSORIES
1. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
2. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
3. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
4. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
5. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
6. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
7. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
8. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2- inch minimum depth. For drains, cut holes in the field.
9. Galvanizing Repair Paint: ASTM A 780.
10. Repair Paint: Lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

3.01 EXECUTION

A. EXAMINATION
1. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. INSTALLATION, GENERAL
1. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.
2. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
3. Locate decking bundles to prevent overloading of supporting members.
4. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
5. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
6. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.
7. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
8. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

C. ROOF DECK INSTALLATION
1. Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

    a. Screw: #12 Teks, nominal.
    b. Screw Spacing: As indicated.
2. Side-Lap and Perimeter Edge Fastening: As indicated and as follows:

    a. Mechanically fasten with self-drilling No. 10 (4.8-mm-) diameter or larger carbon-steel screws.
3. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

    a. End Joints: Lapped 2 inches minimum.
4. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches apart with at least 1 weld at each corner.
5. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

D. FIELD QUALITY CONTROL
1. Testing: Contractor will engage a qualified independent testing agency to perform field quality-control testing.
2. Field welds will be subject to inspection.
3. Shear connector stud welds will be inspected and tested according to AWS D1.1 for stud welding and as follows:

    a. Shear connector stud welds will be visually inspected.

b. Bend tests will be performed if visual inspections reveal less than a full 360-degree flash or welding repairs to any shear connector stud.
c. Tests will be conducted on additional shear connector studs if weld fracture occurs on shear connector studs already tested according to AWS D1.1.

4. Testing agency will report test results promptly and in writing to Contractor and Architect.
5. Remove and replace work that does not comply with specified requirements.
6. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
7. A structural engineer licensed in the state of Oklahoma shall inspect the deck and shear connector stud welds prior to concrete placement.

E. REPAIRS AND PROTECTION
1. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
2. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 055000 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel and aluminum items.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.03 QUALITY ASSURANCE

A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Slotted Channel Fittings: ASTM A1011/A1011M.

C. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

D. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.

E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Bolts, Nuts, and Washers: Stainless steel.

C. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by intermittent welds and plastic filler.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

2.05 FINISHES - STEEL

A. Prime paint steel items.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

2.06 FINISHES - ALUMINUM

A. Interior Aluminum Surfaces: Class I natural anodized.

B. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils thick.

2.07 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preservative treated wood materials.

B. Fire retardant treated wood materials.

C. Concealed wood blocking, nailers, and supports.

1.02 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No.2 or Standard Grade.
   2. Boards: Standard or No.3.

2.03 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2.04 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature, low hygroscopic type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
   a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
   b. Interior concealed rough carpentry items are to be fire retardant treated.
   c. Treat rough carpentry items as indicated.
   d. Do not use treated wood in applications exposed to weather or where the wood may become wet.
   e. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M-20 at 92 percent relative humidity. Use where exterior type is not indicated
   f. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.

C. Preservative Treatment:
1. General: Lumber treated with Alkaline Copper Quatenaries (ACQ), Sodium Borates (SBX), Copper Azoles (CBA), or Copper Zinc Arsenate (ACZA) shall comply wtih the following:
   a. Metals, including coated metals, must not have direct contact with treated lumber.
   b. Membrane: Place a water resistant barrier membrane between treated lumber and metal. Membrane must not include paper, felt, or any other material that can absorb water. Acceptable materials include:
      1) Bituminous Coating.
      2) Peel and Stick.
   c. Fasteners: Stainless steel fasteners, including stainless steel ring shank nails.
2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A.
   a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
   b. Treat lumber in contact with roofing, flashing, or waterproofing.
   c. Treat lumber in other locations as indicated.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Provide the following specific nonstructural framing and blocking:
   1. Wall brackets.
   2. Grab bars.
   3. Toilet accessories.
   4. Wall-mounted door stops.
   5. Wall paneling and trim.

3.03 CLEANING

A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061053

SECTION 064100 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops and panels.

C. Hardware.

1.02 RELATED REQUIREMENTS

A. Section 061053 - Miscellaneous Rough Carpentry: Support framing, grounds, and concealed blocking.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide information as required by AWI/AWMAC/WI (AWS).

C. 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. Specimen warranty.

D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.

B. Quality Certification:
   1. Provide letters indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   2. Submit letters upon completion of installation that verifies this work is in compliance with specified requirements.

1.05 MOCK-UPS

A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware and finishes.

B. Locate where directed.

C. Mock-up may remain as part of the work, if approved.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.07 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Custom Cabinets:
1. Finish - Exposed Exterior Surfaces: Decorative laminate and wall panels below.
2. Finish - Exposed Interior Surfaces: Decorative laminate.
3. Finish - Semi-Exposed Surfaces: Decorative laminate
4. Finish - Concealed Surfaces: Manufacturer's option.
5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
6. Casework Construction Type: Type A - Frameless.
7. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
   a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
8. Adjustable Shelf Loading: 50 psf.
   a. Deflection: L/144.
9. Drawer Side Construction: Manufacturer's option.
10. Drawer Construction Technique: As recommended by fabricator.

2.02 PANEL CORE MATERIALS

A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
1. Grade: 130; moisture resistance: MR30.
2. Panel Thickness: 1 inch.

2.03 THERMALLY FUSED LAMINATE PANELS

A. Thermally Fused Laminate (TFL): Melamine- or polyester-resin-saturated decorative papers; for fusion to composite wood substrates under heat and pressure.
1. Test in accordance with NEMA LD 3 Section 3.
2. Panel Core Substrate: Medium Density Fiberboard (MDF).
3. Color: As selected from manufacturer's standard range of colors.

2.04 LAMINATE MATERIALS

A. Manufacturers: Provide products indicated by the following, or an approved equivalent.
1. Formica Corporation; Commercial: www.formica.com/#sle.
2. Wilsonart LLC; Standard Laminate: www.wilsonart.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, colors as indicated.
   1. **PL-1**: Wilsonart; #8211K-28 "*Phantom Pearl*," Gloss Line finish.
   2. **PL-2**: Formica; #5796-NG "*Graphite Elm*," Natural Grain finish.

C. Provide specific types as indicated.
   1. Horizontal Surfaces: HGL, 0.039 inch nominal thickness, colors as indicated, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, colors as indicated, finish as indicated.
   3. Cabinet Liner: CLS, 0.020 inch nominal thickness, white color.
   4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.05 COUNTERTOPS AND SIDE PANELS

A. Solid Quartz Surfacing (**CT-1**): Solid quartz surfacing with plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Basis-of-Design Product: Vicostone; Classic Collection: www.us.vicostone.com, or approved equivalent.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Finish on Exposed Surfaces: Polished, gloss rating of 55 to 80.
      d. Color and Pattern: #BQ262 *"Carbon."*
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
   5. Vertical Panels: As indicated on drawings.
   6. Fabricate in accordance with manufacturer's standard requirements.

2.06 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded ABS or PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's full range.
   2. Use at all exposed panel edges.
   3. Use at all exposed shelf edges.

C. Mouldings (**MT-1**): Primed FJ pine trim.
   1. Type: S4SSE 1x3.
   2. Finish: Shop finished as indicated below.
      a. Color: Black.
   3. Basis-of-Design Product: WindsorONE; Traditional Boards: www.windsorone.com, or approved equivalent.

D. Fasteners: Size and type to suit application.

E. Concealed Joint Fasteners: Threaded steel.

F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to blend with adjacent surface, as selected by Architect.

2.07 HARDWARE

A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
   1. Hardware Types: As indicated on drawings, with types indicated below.
   2. Product Grade: As required by specified woodworking quality grade.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

C. Shelf Unit: B+N; Sorbetti 2.0 electrified Modular Shelving System: www.bnind.com, or approved equivalent. Configuration as indicated on drawings.
   1. Components:
      a. Electrified uprights with spanning steel hang rails.
      b. Spanning laminate wood shelves.
      c. Spanning cabinet w/laminate wood doors.
   2. Finishes: Anodized black metal. Black matte laminate.

D. Countertop Brackets; L-shaped and Flat, Single-Leg-Support, top of knee wall mounting.
   1. Material: Industrial aluminum.
   2. Finish: Manufacturer's standard, factory-applied, powder coat.
   3. Color: Black.
   4. Support Length: 22 inches.
   5. Bracket Thickness and Width: 1/2 inches by 2-1/2 inches.
   6. Basis-of-Design Product: The Original Granite Bracket; Original Knee Wall Countertop Support Bracket #IKW-22: www.originalgranitebracket.com, or approved equivalent.
      a. Substitutions: See Section 016000 - Product Requirements.

E. Drawer and Door Pulls: Bar pull. Provide Studio 917; Cornerstone Collection Bar Pull, Multiple CC #DHP140BSN-96: www.studio917hardware.com, or approved equivalent.
   1. Size: 96 mm center-to-center length.
   2. Finish: Matte Black.

F. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.

G. Cabinet Hinges:
   1. Provide european style concealed self-closing type cabinet door hinges, steel with nickel-plated finish, unless otherwise indicated.

H. Pocket Door Hardware System (**DH-4**): Provide Hawa; Concepta 50 pivoting and lateral sliding-in paired for a flush-fitting design, or approved equivalent.
   1. Description: Hardware kit; facilitates doors to slide into dedicated door pockets; includes swinging door hinges, two-leaf folding door hinges.
   2. Door Opening Width: As indicated on drawings.
   3. Pocket Opening Width: As indicated on drawings.
   4. Door Opening Configuration: Two single-leaf doors.

2.08 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises.

2.09 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.

C. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
   1. Opaque: Semi-concealed surfaces.
      a. System - 5, Varnish, Conversion.
      b. Color: As selected by Architect.
      c. Sheen: Satin.
      d. Products:
         1) Sherwin-Williams Sher-Wood F3 Kemvar Plus Conversion Varnish, AWI Finishing System 2: www.sherwin-williams.com/#sle.
         2) Substitutions: Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate concealed angles and anchorages.

3.03 ADJUSTING

A. Test installed work for rigidity and ability to support loads.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework.

END OF SECTION 064100

SECTION 068316 - FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

B. Trim.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
   1. Panolam Industries International, Inc; FRP: www.panolam.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels:
   1. Panel Size: 4 by 8 feet.
   2. Panel Thickness: 0.09 inch, Class A.
   3. Surface Design: Embossed (pebbled).
   4. Color: *"Gray."*
   5. Attachment Method: Adhesive only, with trim and sealant in joints and edges.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.

B. Trim: Vinyl; color coordinating with panel.

C. Adhesive: Type recommended by panel manufacturer.

D. Sealant: Type recommended by panel manufacturer; color matching panel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturer's recommended gap for panel field and corner joints.

F. Place trim on panel before fastening edges, as required.

G. Fill channels in trim with sealant before attaching to panel.

H. Install trim with adhesive and screws or nails, as required.

I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION 068316

SECTION 070150.19 - PREPARATION FOR RE-ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Replacement of existing roofing system in preparation for new roofing system in designated areas as indicated on drawings.

B. Removal of existing flashing and counterflashings.

C. Temporary roofing protection.

1.02 RELATED REQUIREMENTS

A. Section 075400 - Thermoplastic Membrane Roofing.

B. Section 076200 - Sheet Metal Flashing and Trim: Replacement of flashing and counterflashings.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with affected mechanical and electrical work associated with roof penetrations.

B. Preinstallation Meeting: Convene 30 days before starting work of this section.
   1. Attendees:
      a. Architect.
      b. Contractor.
      c. Owner.
      d. Installer.
      e. Roofing system manufacturer's field representative.
      f. Inspection and Testing Agency Representatives.
   2. Meeting Agenda: Provide agenda to participants prior to meeting in preparation for discussions on the following:
      a. Removal and installation schedule.
      b. Necessary preparatory work.
      c. Protection before, during, and after roofing system installation.
      d. Removal of existing roofing system.
      e. Installation of new roofing system.
      f. Temporary roofing and daily terminations.
      g. Transitions and connection to and with other work.
      h. Inspections and testing of installed systems.

C. Schedule work to coincide with commencement of installation of new roofing system.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate size, configuration, and installation details.

C. Materials Removal Company Qualification Statement.

1.05 QUALITY ASSURANCE

A. Materials Removal Company Qualifications: Company specializing in performing work of type specified with at least three years of documented experience.
   1. Comply with EPA notification regulations prior to start of roofing removal work.
   2. Comply with removal and disposal regulations of local authorities having jurisdiction (AHJ).

1.06 DELIVERY, STORAGE, AND HANDLING

A. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

1.07 FIELD CONDITIONS

A. Existing Roofing System: Modified bituminous roofing.

B. Do not remove existing roofing membrane when weather conditions threaten the integrity of building contents or intended continued occupancy.

C. Maintain continuous temporary protection prior to and during installation of new roofing system.

D. Provide notice at least three days before starting activities that will affect normal building operations.

E. Verify that occupants have been evacuated from building areas when work on structurally impaired roof decking is scheduled to begin.

F. Owner will occupy building areas directly below re-roofing area.
   1. Provide Owner with at least 48 hours written notice of roofing activities that may affect their operations and to allow them to prepare for upcoming activities as necessary.
   2. Do not disrupt Owner's operations or activities.
   3. Maintain access of Owner's personnel to corridors, existing walkways, and adjacent buildings.

PART 2 PRODUCTS

2.01 COMPONENTS

A. See the following sections for additional information on components relating to this work:
   1. Replacement and removal of existing roofing system in preparation for entire new roofing system as indicated on Drawings, see Section 075400.
   2. Remove existing flashing and counterflashings in preparation for replacement of these materials as part of this work, see Section 076200 for material requirements.

2.02 MATERIALS

A. Temporary Roofing Protection Materials:
   1. Contractor's responsibility to select appropriate materials for temporary protection of roofing areas as determined necessary for this work.

2.03 ACCESSORIES

A. Fasteners: Type and size as required and compatible with existing and new roofing system to resist local wind uplift.

PART 3 EXECUTION

3.01 MATERIAL REMOVAL

A. Remove only existing roofing materials that can be replaced with new materials the same day.

B. Remove metal counter flashings.

C. Remove insulation and fasteners, cant strips, and damaged blocking.

D. Repair existing damaged metal deck surface to provide smooth working surface for new roof system.

3.02 INSTALLATION

A. Coordinate scope of this work with requirements for installation of new roofing system, see Section 075400 for additional requirements.

3.03 FIELD QUALITY CONTROL

A. Independent agency inspection and testing will be provided under provisions of Section 014000.

B. Inspection firm will identify the exact limits to material removal.

3.04 PROTECTION

A. Provide protection of existing roofing system that is not having work performed on it.

B. Provide temporary protective sheeting over uncovered deck surfaces.

C. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights or temporary fasteners.

D. Provide for surface drainage from sheeting to existing drainage facilities.

E. Do not permit traffic over unprotected or repaired deck surface.

END OF SECTION 070150.19

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.

B. Insulation, flat and tapered.

C. Cover boards.

D. Membrane and liguid flashings.

E. Roofing stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 061053 - Miscellaneous Rough Carpentry, for wood nailers, curbs, and blocking.

B. Section 070150.19 - Preparation for Re-Roofing.

C. Section 076200 - Sheet Metal Flashing and Trim, for metal roof flashings and counterflashings.

D. Section 077200 – Roof Accessories, for roof pipe & conduit supports.

1.03 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, fasteners, and adhesive.

C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and setting plan for tapered insulation.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions, special procedures, and perimeter conditions requiring special attention.

F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. Testing firm's qualification statement.

J. Informational Submittals:
   1. Qualification Data: For Installer and manufacturer.
   2. Roofing installer's current Oklahoma Roofer Registration number with Commercial Endorsement from the Oklahoma Construction Industries Board.
   3. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article. Provide evidence that system manufacturer has reviewed and approved roofing system for compliance with minimum warranty requirements.
   4. Manufacturer's Thermal Resistance Calculations: Submit manufacturer's calculations for average R-value for each roof area.
   5. Sample Warranties: For manufacturer's special warranties.

K. Closeout Submittals:
   1. Maintenance Data: For roofing system to include in maintenance manuals.
   2. Manufacturer's weatherproof sign indicating that this roof is under warranty with phone number to call in case of damage to roof.
   3. Warranties: Submit manufacturer's and installer's warranties and lists of circumstances and conditions that would affect validity of warranties. Include Owner's responsibilities for notification of installer, supplier, and manufacturer to maintain warranties.

1.06 QUALITY ASSURANCE

A. Preliminary Roofing Conference: Before starting roof preparation, conduct conference at Project site.
   1. Meet with Owner, Architect, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
   7. Review temporary protection requirements for roofing system during and after installation.
   8. Review roof observation and repair procedures after roofing installation.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified or UL listed as applicable for roofing system specified in this section, with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of this section with at least three years of documented experience, and approved, authorized, or licensed by roofing system manufacturer.
   1. Roofing installer shall be registered with the Oklahoma Construction Industry Board and have active Commercial Endorsement.

D. Testing Firm Qualifications: Company specializing in performing work of the type specified and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, approval or listing agency markings, and directions for storing and mixing with other components.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

1.08 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather. Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

D. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Roofing Manufacturer's Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period, including the following.
   1. Special warranty shall include cost of labor and materials for loss of weather tightness without financial limit (NDL).
   2. Manufacturer's Warranty includes roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system.
   3. Manufacturer's Warranty shall also include Roofing Specialties specified in Section 077100.
   4. Warranty wind speeds up to 105 mph.
   5. Hail Damage: Caused by hail up to 3 inches in diameter.
   6. Warranty Period: 20 years from date of Final Completion.

C. 115-mil FleeceBack adhered TPO, with manufacturer's full system NDL 20-year warranty and 3-inch hail impact resistance warranty with 20 hours per year accidental puncture repair at no additional cost to the Owner, plus covering both labor and material, for 72 mph sustained wind resistance and 90 mph wind gust for 3 seconds per IBC 2018.

D. If Carlisle "Flexible FAST" adhesive is used, full coverage or 4" oc beads, add 1-inch additional hail coverage and 4 extra hours of Accidental Puncture coverage.

E. Installer's Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
   1. Warranty Period: Two years (min) from date of Final Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible fleece-backed TPO sheet.
   1. Basis-of-Design Product: Carlisle SynTec Systems; FleeceBACK TPO Adhered: www.carlisle-syntec.com/#sle.
   2. Elevate; UltraPly TPO XR Membrane: www.holcimelevate.com/#sle.
   3. Versico Roofing Systems; VersiFleece RL TPO RapidLock Membrane: www.versico.com/#sle.
   4. Substitutions: Not permitted.

B. Insulation:
   1. Carlisle SynTec Systems; SecurShield Insulation: www.carlisle-syntec.com/#sle.
   2. Elevate; ISO 95+ GL Insulation: www.holcimelevate.com.
   3. Versico Roofing Systems; SecurShield Insulation: www.versico.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

C. Parapet/Cover Boards (**GB-14**): ASTM C1177, glass-mat, water-resistant gypsum substrate, 1/2 inch thick. Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
   1. CertainTeed Corporation; GlasRoc Sheathing: www.certainteed.com.
   2. Georgia-Pacific Corporation; Dens Deck Prime: www.buildgp.com.
   3. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing: www.goldbondbui.
   4. USG Corporation; Securock Glass Mat Roof Board: www.usg.com.
   5. Substitutions: Not permitted.

2.02 ROOFING

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.

B. Roofing Assembly Requirements:
   1. Installed roofing and base flashings shall withstand required uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
      a. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
      b. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D3746 or ASTM D4272.
   2. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

3. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and are listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
   a. Wind Uplift Load Capacity: 105 psf.
   b. Hail-Resistance Rating: Up to 3 inches in diameter.
4. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Acceptable Insulation Types - Constant Thickness Application:
   1. Minimum 2 layers of polyisocyanurate board.

D. Acceptable Insulation Types - Tapered Application:
   1. Tapered polyisocyanurate board.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:
   1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sinternally fabric- or scrim-reinforced, uniform, flexible fleece-backed TPO sheet.
      a. Thickness: 115 mil, 0.115 inch, minimum.
   2. Sheet Width: Factory fabricated into widest possible sheets.
      a. Adhered Application: Limit width to 120 inches, maximum, when ambient temperatures are less than 40 degrees F for extended period of time during installation.
   3. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

D. Flexible Flashing Material: Material recommended by membrane manufacturer.
   1. Base Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 60 mils thick, minimum, of same color as TPO sheet.
   2. Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

E. Liquid-Applied Flashing: Manufacturer's single ply liquid and fabric reinforced flashing system created with a fleece polyester scrim and a two-component polyurethane-based liquid applied flashing material, consisting of a liquid resin and a curing agent.
   1. Liquid Applied Flashing Primer: Manufacturer's single ply liquid flashing primer.

F. Bonding Adhesive: Flexible FAST Adhesive at Full Spray or 4" o.c. beads.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8-inch thick; with anchors.

2.04 PARAPET/COVER BOARDS

A. Parapet/Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
   1. Thickness: 1/2 inch, fire-resistant.
   2. Products:

a. CertainTeed Corporation; GlasRoc Sheathing: www.certainteed.com.
b. Georgia-Pacific; DensDeck Prime with EONIC Technology: www.densdeck.com/#sle.
c. Gold Bond Building Products, LLC; National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing: www.goldbondbuilding.com.
d. USG Corporation; Securock Glass Mat Roof Board: www.usg.com.
e. Substitutions: See Section 016000 - Product Requirements.

2.05 INSULATION

A. Polyisocyanurate (ISO) Board Insulation (**IN-3b**): Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
         2) Compressive Strength: Classes 1-2-3, Grade 2, 20 psi (138 kPa), minimum.
         3) Thermal Resistance, R-value: At 1-1/2 inches thick; Class 1, Grades 1-2-3, 8.4 (1.48), minimum, at 75 degrees F.
   2. Board Size: 48 by 48 inches.
   3. Minimum Board Thickness: 2.0 inches.
   4. Tapered Board: Slope 1/2 inch per 12 inches; minimum thickness 1/2 inch; fabricate of fewest layers possible.
   5. Board Edges: Square.
   6. Provide preformed saddles, tapered edge strips, and other insulation shapes where indicated and required for sloping to drain. Fabricate to slopes indicated.

B. Mineral Wool Block and Board Thermal Insulation (**IN-6c**): Complying with ASTM C612, Type III.
   1. Facing: None, unfaced.
   2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
   3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with ASTM E84.
   4. Size: As indicated on drawings.
   5. Thermal Conductivity (k-factor): Btu inch/hr sq ft degrees F of 0.26 per inch, minimum, at 75 degrees F when tested in accordance with ASTM C518.
   6. Maximum Density: 4 pcf, nominal.

2.06 ACCESSORIES

A. Conductive Primer for Electronic Leak Detection (ELD): Enables ELD of conventional roofing assemblies by providing required conductive substrate directly below roofing membrane.
   1. Apply primer directly under roofing membrane on nonconductive surface in accordance with manufacturer's requirements.

B. Prefabricated Roofing Expansion Joint Flashing: Sheet butyl over closed-cell foam backing seamed to galvanized steel flanges.

C. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

D. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

E. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   1. Length as required for thickness of first layer of insulation material and penetration of deck substrate, with metal washers.

F. Membrane Adhesive: As recommended by membrane manufacturer.

G. Insulation Adhesive: As recommended by insulation manufacturer.

H. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach subsequent layers of roof insulation to another insulation layer as follows:
   1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

I. Walkway Pads: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads and rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
   1. Walkway to remain flat, without wrinkles and fishmouths after installation.
   2. Surface Color: White or Yellow.

J. Pipe Support Pads: Same as walkways, size as shown on drawings, adhered underneath pipe supports specified in Section 077200.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surfaces and site conditions are ready to receive work.
   4. Verify deck is supported and secure.
   5. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
   6. Verify deck surfaces are dry and free of snow or ice.
   7. Verify that roof openings, curbs, and penetrations through roof are solidly set, and nailing strips are in place.

3.02 PREPARATION

A. Prepare work area in accordance with Section 070150.19 - Preparation for Re-Roofing.

B. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Substrate must be relatively smooth, free of protrusions, sharp edges and projections, foreign materials, free of accumulated water, ice and snow. Cracks or voids greater than 1/4-inch shall be filled with material suitable to roofing manufacturer.

C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.03 INSTALLATION, GENERAL

A. Perform work in accordance with roofing system manufacturer's instructions applicable requirements.

B. Do not apply roofing membrane during cold or wet weather conditions.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

G. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

H. Install parapet board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt parapet boards together.

3.04 INSTALLATION - INSULATION, UNDER MEMBRANE

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Attachment of Insulation:
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and FM DS 1-28 Factory Mutual requirements.
   2. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

C. Install tapered insulation to conform to slopes indicated.

D. Install flat insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 12 inches in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
   1. Fill gaps exceeding 1/4 inch with insulation.
   2. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

H. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

I. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

J. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

K. Do not install more insulation than can be covered with membrane in same day.

3.05 INSTALLATION - COVER BOARD

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

B. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

C. At internal roof drains, conform to slope of drain sump.
   a. Trim cover board so that water flow is unrestricted.

D. Cut and fit cover board tight to nailers, projections, and penetrations.

E. Adhere cover board to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
   a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3.06 INSTALLATION - ELECTRONIC LEAK DETECTION (ELD) SYSTEM

A. Install components in accordance with manufacturer's installation instructions and at locations indicated on drawings.

3.07 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel per warranty requirements.

D. Accurately align roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer and allow to partially dry before installing roofing. Fully adhere one roll before proceeding to adjacent rolls.

F. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

G. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.

H. At intersections with vertical surfaces:
   1. Extend membrane up a minimum of 4 inches onto vertical surfaces.

2. Fully adhere flexible flashing over membrane and up to and over nailing strips.
3. Secure flashing to nailing strips at 4 inches on center.

I. Around roof penetrations, seal flanges and flashings with flexible flashing.

J. Install roofing expansion joints where indicated. Make joints watertight.
1. Install prefabricated joint components in accordance with manufacturer's instructions.

K. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.
1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

L. Coordinate replacement of non-functioning roof drains and sumps and related flashings.

3.08 INSTALLATION - BASE FLASHING

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars and sealant.

3.09 WALKWAY INSTALLATION

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

3.10 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing in accordance with requirements.

C. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

D. Electronic Leak Detection (ELD) Testing: Test roofing areas for leaks using ELD method that locates discontinuities in membrane roofing in accordance with ASTM D7877 or ASTM D8231.
1. Testing agency to submit Daily Field Report (DFR) in accordance with ASTM D8231 indicating daily details of work performed.

2. Testing agency to submit training certification to ensure that technician performing ELD testing is currently certified in accordance with relevant training program.

E. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

F. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 CLEANING

A. See Section 017300 - Execution for additional requirements.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

D. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from roof area.
1. Remove adhesive and other blemishes from entire roof surface, surfaces at seams, perimeter edges, and adjacent surfaces.
2. Sweep surfaces thoroughly.
3. Wash surfaces to remove marks and soil.

E. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

F. Leave roof membrane in a clean and pristine condition at Final Completion inspection.

3.12 PROTECTION

A. Protect installed roofing and flashings from mars, marks, indentations, and other construction operations in accordance with manufacturer's written instructions.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

C. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Project Completion and according to warranty requirements.

END OF SECTION 075400

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including metal copings, flashings, counterflashings, gutters, downspouts, and exterior penetrations.

B. Sealants for joints within sheet metal fabrications.

C. Precast concrete splash pads.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
   1. Plans, elevations, sections, and attachment details.
   2. Fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
   3. Identification of material, thickness, weight, and finish for each item and location in Project.
   4. Details for forming, including profiles, shapes, seams, and dimensions.
   5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
   6. Details of roof-penetration flashing.
   7. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
   8. Details of special conditions.
   9. Details of connections to adjoining work.

C. Samples: Submit two samples, 12 by 12 inches in size, illustrating material of typical external corner, internal corner, junction to vertical dissimilar surface, and metal finish color.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, as required to match existing.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal.

B. Coated Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 0.032 inch thick; coil-coated to match existing.

2.02 PREFINISHED ALUMINUM SHEETS

A. Description: Factory-applied topcoat systems applied to aluminum flat sheet substrates prior to fabrication by coil coating; topcoat systems consist of primers and organic topcoats on exposed side and backing coats on unexposed side.

B. Aluminum Sheet Substrates: ASTM B209/B209M.

C. Superior Performance Organic Coating System: Comply with AAMA 2605 for aluminum preparation, pretreatment, primer and finish coat system; provide thermally cured 70-percent PVDF fluoropolymer systems; tested for weathering for 10 years with 5 delta units color change maximum.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

G. Fabricate expansion joint cover from prefinished aluminum sheet at locations and of .

2.04 GUTTERS AND DOWNSPOUTS

A. Gutters and Downspouts: Size and profile to match existing.

B. Accessories: Profiled to suit gutters and downspouts, and match existing.

C. Splash Pads: Precast concrete type, of size and profiles to match existing; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.

D. Seal metal joints.

2.05 FLASHING

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.06 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Underlayment: Self-adhering, high-temperature polyethylene-film laminated sheet, 30 mil, 0.03 inch thick.
   1. Thermal Stability: ASTM D1970; stable after testing at 240 degrees F.
   2. Low-Temperature Flexibility: ASTM D1970; passes after testing at minus 20 degrees F.

C. Primer Type: Zinc chromate.

D. Concealed Sealants: ASTM C1311, single-component, non-curing butyl sealant.

E. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

F. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

2.07 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Obtain field measurements for accurate fit before shop fabrication.
   2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   2. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
   3. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
   4. Install sealant tape where indicated.
   5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
   1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

F. Apply plastic cement compound between metal flashings and felt flashings.

G. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

H. Seal or solder metal joints watertight.

I. Do not solder metallic-coated steel sheet.
   1. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

J. Parapet Cap Flashing (Coping):

1. Install sheet metal coping with continuous cleat in accordance with SMACNA requirements, profiles as indicated.
   a. Set cleat in full bed of sealant, overlaying and concealing continuous parapet waterproofing membrane.
   b. Secure cleat at 6 inches on center to nailer.
2. Install coping in accordance with SMACNA Figure 3-1 over shaped fiber board; secure roof side edge using washered screws in staggered pattern through slotted or oversized holes located at maximum 12" on-center.
3. Provide coping in minimum 10 to maximum 25 foot lengths.
4. Provide thermal expansion joints using joints in accordance with SMACNA Figure 3-3, Covered Plate Seam. Set lap in beds of sealant.

K. Secure gutters and downspouts in place with fasteners.

L. Slope gutters 1/4 inch per 10 feet, minimum.

M. Set splash pads under downspouts.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.05 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof curbs.

B. Equipment supports.

C. Non-penetrating pedestals for mounting piping and conduit.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including City of Tulsa Bidding Documents, General, Supplementary Conditions, Special Provisions and Division 01 Specification Sections, apply to this Section.

B. Section 061053 - Miscellaneous Rough Carpentry, for wood nailers and blocking.

C. Section 075400 – Thermoplastic Membrane Roofing, for roof penetration flashing.

D. Section 076200 - Sheet Metal Flashing and Trim, for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

E. Division 22 Plumbing Sections: For coordination with plumbing materials and systems on and penetrating roof membrane.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
   1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.

D. Maintenance Data: For roof accessories to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Owner Coordination: Notify Owner's Maintenance and Operations Manager within 48 hours prior to removing rooftop equipment from existing roof. Coordinate HVAC shutdown and sealing of intakes. Review methods and procedures related to HVAC removal and reinstallation with Owner's Maintenance and Operations Manager.

B. Qualifications for Welding Work: Qualify field welding operators in accordance with AWS Standard.

1. Qualification Procedures: Provide certification that field welders have passed AWS qualification tests with previous 12 months.
2. If recertification of welders is required, provide without additional cost to Owner.

1.05 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Structural Roof Curbs:
   1. Ship curbs to site palletized and banded.
   2. Curb Manufacturer shall furnish Curb Schedule identifying curb "Type" and roof penetration for which curb is to be used.
      a. Curb Schedule shall identify identical curbs as single "Type" (i.e., Type A – 10 ton RTU's, Type B – 5 ton RTU's, Type C – skylights, Type D – satellite dish, Type E – expansion joints, etc.).
      b. Identity each curb with "Type" designation painted in 1-inch high letters on outside face of curb.
   3. Stack curbs at site to prevent twisting, bending or permanent installation.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store products under cover and elevated above grade.

D. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 180 degrees F, material surfaces.

2.02 ROOF CURBS

A. Roof Curbs Manufacturers:
   1. AES Industries Inc: www.aescurb.com/#sle.

2. The Pate Company: www.patecurbs.com/#sle.
3. LMCurbs: www.lmcurbs.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings and equipment supports.
2. Roof Curb Mounting Substrate: Curb substrate consists of existing metal roof deck with insulation.
3. Sheet Metal Material:
   a. Galvalume Steel: Hot-dip aluminum zinc alloy coated steel sheet complying with ASTM A792/A792M; AZ55 coating designation; 18 gauge, 0.048 inch thick.
      1) Finish: Factory primed.
4. Provide preservative treated wood nailers along top of curb.
5. Insulate inside curbs with polyisocyanurate foam; both faces covered with glass fiber felt; thickness to match wood nailer.
6. Height Above Finished Roof Surface: 8 inches, minimum.
7. Provide layouts and configurations indicated on drawings.

C. Field Painting of Existing Manufactured Curbs to Remain:
1. Perform preparation and cleaning procedures in accordance with paint manufacturer's published instructions for each particular substrate condition.
2. Remove loose paint by scrape or wire brush as necessary. Clean surfaces thoroughly and roughen existing paint surfaces by light sanding. Clean and remove mildew using trisodium phosphate. Touch up bare surfaces with manufacturer's recommended prime coat. Painted surfaces with existing sound prime or finish coats do not require additional prime coating.
3. Remove barrier coats over incompatible primers or remove and reprime as required.
4. Touch-up shop-applied prime coats where damaged or bare. Clean and touch-up with same type shop primer.
5. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent. Apply coat of etching primer if required by paint manufacturer.
6. Remove accessories and similar items in place and not to be painted and provide surface applied protection prior to surface preparation and painting operations. Reinstall all removed items after completion of paint work.
7. Clean surfaces to be painted before applying paint or surface treatment. Remove oil and grease prior to mechanical cleaning.
8. Apply paint only on surfaces free of dirt, rust, scale, grease, moisture, scuffed surfaces, and conditions otherwise detrimental to formation of a durable paint film.

2.03 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.
2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

B. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.

C. Duct Supports: Provide extruded aluminum supports and sized in accordance with diameter of supported ducts, and with base that is non-penetrating of roofing membrane.

D. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
   1. Bases: High density polypropylene.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 077200

SECTION 078400 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

C. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.

D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

E. Certificate from authority having jurisdiction indicating approval of materials used.

F. Installer's qualification statement.

1.03 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Trained by manufacturer.
   2. Recognized as a Qualified Contractor in compliance with requirements of UL (DIR) Solutions Qualified Firestop Contractor Program.
   3. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
   4. Verification of minimum three years documented experience installing work of this type.
   5. Verification of at least five satisfactorily completed projects of comparable size and type.
   6. Licensed by local authorities having jurisdiction (AHJ).

1.04 MOCK-UPS

A. See Section 014000 - Quality Requirements for additional requirements.

B. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.

2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot of firestopping.

C. If accepted, mock-up will represent minimum standard for this work.

D. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.05 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
2. A/D Fire Protection Systems Inc.: www.adfire.com/#sle.
3. Hilti, Inc: www.hilti.com/#sle.
4. Nelson FireStop Products: www.nelsonfirestop.com/#sle.
5. RectorSeal, a CSW Industrials Company: www.rectorseal.com/firestop-solutions/#sle.
6. Specified Technologies Inc.: www.stifirestop.com/#sle.
7. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
8. Substitutions: Not permitted.

2.02 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.

C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

E. Fire Ratings: Refer to drawings for required ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.

B. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

2.05 FIRESTOPPING SYSTEMS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

SECTION 079200 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

C. Owner-provided field quality control.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Backing material recommended by sealant manufacturer.
   4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   5. Substrates the product should not be used on.
   6. Substrates for which use of primer is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   8. Certification by manufacturer indicating that product complies with specification requirements.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

E. Installation Plan: Submit at least four weeks prior to start of installation.

F. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

G. Installation Log: Submit filled-out log for each length or instance of sealant installed.

H. Field Quality Control Log: Submit filled-out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.03 QUALITY ASSURANCE

A. Installation Plan: Include schedule of sealed joints, including the following:
   1. Joint width indicated in Contract Documents.
   2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.

3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgment that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
4. Approximate date of installation, for evaluation of thermal movement influence.
5. Installation Log Form: Include the following data fields, with known information filled out.
   a. Unique identification of each length or instance of sealant installed.
   b. Location on project.
   c. Substrates.
   d. Sealant used.
   e. Stated movement capability of sealant.
   f. Primer to be used, or indicate no primer is used.
   g. Size and actual backing material used.
   h. Date of installation.
   i. Name of installer.
   j. Actual joint width; provide space to indicate maximum and minimum width.
   k. Actual joint depth to face of backing material at centerline of joint.
   l. Air temperature.

B. Owner will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
   1. Contractor shall cooperate with testing agency and repair failures discovered and destructive test location damage.

C. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.
   2. Nondestructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
      a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 24 inches thereafter.
      b. If any failures occur in the first 10 linear feet, continue testing at 12 inches intervals at no extra cost to Owner.
   3. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

D. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

E. Nondestructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
   1. Record results on Field Quality Control Log.
   2. Repair failed portions of joints.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints:
      a. Do not seal exterior joints unless indicated on drawings as sealed.
      b. Seal the following joints:
         1) Wall expansion and control joints.
         2) Joints between doors, windows, and other frames or adjacent construction.
         3) Joints between different exposed materials.
   2. Interior Joints:
      a. Seal the following joints:
         1) Joints between door frames, window frames, and other frames and adjacent construction.
   3. Do Not Seal:
      a. Joints indicated to be covered with expansion joint cover assemblies.
      b. Joints where sealant installation is specified in other sections.
      c. Joints between suspended ceilings and walls.

B. Exterior Joints (**S1**): Use nonsag silicone sealant, unless otherwise indicated.

C. Exterior Joints (**S2**): Lap Joints in Sheet Metal Fabrications: Butyl rubber, noncuring.

D. Interior Joints (**P1**): Use nonsag polyurethane sealant, unless otherwise indicated.

E. Interior Joints (**P2**): Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.

2.02 NONSAG JOINT SEALANTS

A. Type **S1** - Silicone Sealant: ASTM C920, Grade NS, Uses S, M, A, and G; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   3. Color: To match adjacent finished surfaces, as approved by Architect from manufacturer's full range.
   4. Service Temperature Range: Minus 20 to 180 degrees F.
   5. Products:
      a. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/#sle.
      b. Momentive Performance Materials, Inc/GE Silicones; SilPruf: www.siliconeforbuilding.com/#sle.
      c. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
      d. Pecora Corporation; Pecora 864 NST (Non-Staining Technology): www.pecora.com/#sle.
      e. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
      f. Tremco Commercial Sealants & Waterproofing; Spectrem 2: www.tremcosealants.com/#sle.
      g. Tremco Commercial Sealants & Waterproofing; Spectrem 3: www.tremcosealants.com/#sle.
      h. Substitutions: See Section 016000 - Product Requirements.

B. Type **P1** - Polyurethane Sealant: ASTM C920, Grade NS, Uses S, M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Color: To match adjacent finished surface, as selected by Architect from manufacturer's full range.
   3. Service Temperature Range: Minus 40 to 180 degrees F.

4. Products:
   a. Master Builders Solutions; MasterSeal NP1: www.master-builders-solutions.com/en-us/#sle.
   b. Pecora Corporation; DynaTrol II: www.pecora.com/#sle.
   c. Tremco Commercial Sealants & Waterproofing; Dymonic 100: www.tremcosealants.com/#sle.
   d. Substitutions: See Section 016000 - Product Requirements.

C. Type **P2** - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.

D. Type **S2** - Noncuring Butyl Sealant: Solvent-based, single component, nonsag, nonskinning, nonhardening, nonbleeding; nonvapor permeable; intended for fully concealed applications.

2.03 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

B. Sealant Backing Rod, Closed-Cell Type:
   1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
   2. Size: 25 to 50 percent larger in diameter than joint width.

C. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

D. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

E. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

F. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
   1. Width/depth ratio of 2:1.
   2. Neck dimension no greater than 1/3 of the joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.

D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION 079200

SECTION 081213 - HOLLOW METAL FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal frames for flush wood doors.

1.02 RELATED REQUIREMENTS

A. Section 081416 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.

B. Section 087100 - Door Hardware: Hardware, silencers, and weatherstripping.

C. Section 099123 - Painting: Field painting.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

D. Installer's qualification statement.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Door Frame Type: Provide hollow metal door frames with integral casings.
   1. Interior Doors: Use frames with integral casings.

B. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.

C. Accessibility: Comply with ICC A117.1 and ADA Standards.

D. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

2.02 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

A. Frame Finish: Factory primed and field finished.

B. Interior Door Frames, Non-Fire Rated: Knock-down type.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.

2.03 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.04 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Install door hardware as specified in Section 087100.
   1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

3.04 SCHEDULE - SEE DRAWINGS

END OF SECTION 081213

SECTION 081416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush configuration; non-rated.

1.02 RELATED REQUIREMENTS

A. Section 081213 - Hollow Metal Frames.

B. Section 087100 - Door Hardware.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS).

D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

E. Manufacturer's Installation Instructions: Indicate special installation instructions.

F. Warranty, executed in Owner's name.

1.04 QUALITY ASSURANCE

A. Woodwork Quality Assurance:
   1. Provide letter indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   2. Submit letter upon completion of installation that verifies this work is in compliance with specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.06 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
   1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. High Pressure Decorative Laminate (HPDL) Faced Doors:
   1. Oregon Door: www.oregondoor.com/#sle.
   2. VT Industries, Inc.: www.vtindustries.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

2.02 DOORS

A. Doors:
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
   2. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.

2.03 DOOR CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

A. High Pressure Decorative Laminate (HPDL) Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS; Wilsonart; Premium Laminate: www.wilsonart.com, #8211 "*Phantom Pearl;*" #28 Gloss Line finish.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores constructed with stiles and rails:
   1. Provide solid blocks at lock edge for hardware reinforcement.
   2. Provide solid blocking for other throughbolted hardware.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with the quality standard specified.

2.06 ACCESSORIES

A. Door Hardware: See Section 087100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION 081416

SECTION 083100 - ACCESS DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall- and ceiling-mounted access units.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

D. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.

E. Project Record Documents: Record actual locations of each access unit.

PART 2 PRODUCTS

2.01 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:
1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
2. ACUDOR Products Inc: www.acudor.com/#sle.
3. Babcock-Davis: www.babcockdavis.com/#sle.
4. BAUCO Access Panel Solutions Inc: www.bauco.com/#sle.
5. Best Access Doors: www.bestaccessdoors.com/#sle.
6. Karp Associates, Inc: www.karpinc.com/#sle.
7. MIFAB, Inc: www.mifab.com/#sle.
8. Nystrom, Inc: www.nystrom.com/#sle.
9. Substitutions: See Section 016000 - Product Requirements.

B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Material: Steel.
2. Style: Recessed door panel for infill with wall/ceiling finish.
3. Door Style: Single thickness with rolled or turned in edges.
4. Frames: 16-gauge, 0.0598-inch minimum thickness.
5. Single Steel Sheet Door Panels: 16-gauge, 0,0625-inch minimum thickness.
6. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 5/8 inch back from wall/ceiling face.
7. Steel Finish: Primed.
8. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
9. Hardware:
   a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
   b. Latch/Lock: Tamperproof tool-operated cam latch.
   c. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 083100

SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

B. Section 088000 - Glazing: Glass and glazing accessories.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

E. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

F. Installer's qualification statement.

G. Specimen warranty.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Center-Set Style, Thermally-Broken (Exterior):
   1. Basis of Design: Kawneer; Trifab VersaGlaze 451T Framing System: www.kawneer.us.
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

B. Substitutions: See Section 016000 - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

A. Center-Set Style (Interior):
   1. Basis of Design: Kawneer; Trifab VersaGlaze 451 Framing System: www.kawneer.us.
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

B. Substitutions: See Section 016000 - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.03 BASIS OF DESIGN -- SWINGING DOORS

A. Medium Stile, Monolithic Glazing:
   1. Basis of Design: Kawneer; Standard Entrance 350: www.kawneer.us.
   2. Thickness: 1-3/4 inches.

B. Substitutions: See Section 016000 - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.04 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Class I natural anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.

2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
5. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements (Insulating Units):
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Design Wind Loads: Comply with requirements of ASCE 7.
   b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
3. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.05 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.

B. Glazing: See Section 088000.

C. Swing Doors: Glazed aluminum.
1. Thickness: 1-3/4 inches.
2. Top Rail: 4 inches wide.
3. Vertical Stiles: 4-1/2 inches wide.
4. Bottom Rail: 10 inches wide.
5. Glazing Stops: Square.
6. Finish: Same as storefront.

2.06 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.

D. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch minimum thickness.

E. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.

F. Sealant for Setting Thresholds: Non-curing butyl type.

G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

H. Glazing Accessories: See Section 088000.

2.07 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.08 HARDWARE

A. For each exterior door, include weatherstripping.

B. Other Door Hardware: See Section 087100.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

D. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all exterior doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Install hardware using templates provided.
   1. See Section 087100 for hardware installation requirements.

K. Install glass using exterior dry glazing method; see Section 088000.

L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as directed by Architect.
   2. Conduct tests in each area prior to 70 percent completion of this work.

B. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084313

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing panels.

1.02 RELATED REQUIREMENTS

A. Section 088000 - Glazing.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.

F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

G. Designer's Qualification Statement.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.
   1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with installer.

C. Finish Warranty: Provide 10-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN - CURTAIN WALL SYSTEMS

A. Pressure Cap Four Sides; Not Unitized, Field Assembled:
   1. Basis of Design: Kawneer North America; 1620, 2-inch wide face, Outside Glazed Curtain Wall: www.kawneer.us, or approved equivalent.

B. Other Manufacturers: Provide either product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below.
   1. Oldcastle Building Envelope: www.oldcastlebe.com/#sle.
   2. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.

C. Substitutions: See Section 016000 - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Fabrication Method: Field fabricated stick system.
   2. Glazing Method: Field glazed system.
   3. Vertical Mullion Depth From Face of Glazing to Back of Frame: 6 inches.
   4. Finish: Class I natural anodized.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   5. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.

6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
1. Design Wind Loads: Comply with the requirements of ASCE 7
   a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
   b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
   a. Expansion and contraction caused by 180 degrees F surface temperature.
   b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
   c. Movement of curtain wall relative to perimeter framing.
   d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
1. Test Pressure Differential: 12 psf.
2. Test Method: ASTM E331.

D. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.24 psf pressure difference across assembly.

E. Thermal Performance Requirements:
1. Condensation Resistance Factor of Framing: 70, minimum, measured in accordance with AAMA 1503.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: See Section 088000.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

C. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.

D. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

E. Exposed Flashings: Aluminum sheet, 20-gauge, 0.032-inch minimum thickness; finish to match framing members.

F. Concealed Flashings: Stainless steel, 26-gauge, 0.0187-inch minimum thickness.

G. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.

H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

I. Glazing Accessories: See Section 088000.

2.05 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

H. Pressure Plate Framing: Install glazing using exterior dry glazing method; see Section 088000.

I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet noncumulative or 0.5 inches per 100 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.

B. See Section 014000 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

C. Provide field testing of installed curtain wall system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
   3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
      a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.

D. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

3.06 PROTECTION

A. Protect installed products from damage until date of Substantial Completion.

END OF SECTION 084413

SECTION 087100 - DOOR HARDWARE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes commercial door hardware for the following:
   1. Swinging doors.
   2. Sliding doors.
   3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Cylinders specified for doors in other sections.

C. Related Sections:
   1. Division 08 Section "Hollow Metal Door Frames".
   2. Division 08 Section "Flush Wood Doors".
   3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC (IBC) International Building Code.
   3. NFPA 70 - National Electrical Code.
   4. NFPA 80 - Fire Doors and Windows.
   5. NFPA 101 - Life Safety Code.
   6. NFPA 105 - Installation of Smoke Door Assemblies.
   7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
   1. ANSI/BHMA Certified Product Standards - A156 Series.
   2. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   3. ANSI/UL 294 - Access Control System Units.
   4. UL 305 - Panic Hardware.
   5. ANSI/UL 437- Key Locks.

1.03 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

D. Informational Submittals:
   1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.04 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.05 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
   1. Function of building, purpose of each area and degree of security required.
   2. Plans for existing and future key system expansion.
   3. Requirements for key control storage and software.
   4. Installation of permanent keys, cylinder cores and software.
   5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
   1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
   2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
   3. Review sequence of operation narratives for each unique access controlled opening.
   4. Review and finalize construction schedule and verify availability of materials.
   5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.06 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.07 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.08 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
   1. Structural failures including excessive deflection, cracking, or breakage.
   2. Faulty operation of the hardware.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.02 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
   1. Quantity: Provide the following hinge quantity:
      a. Two Hinges: For doors with heights up to 60 inches.
      b. Three Hinges: For doors with heights 61 to 90 inches.
      c. Four Hinges: For doors with heights 91 to 120 inches.
      d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
   2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
      a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
      b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
5. Manufacturers:
   a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.03 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
   1. Manufacturers:.
      a. Pemko (PE).

2.04 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
   1. Push/Pull Plates: Minimum 0.050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
   2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
   3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
   4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
   5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
   6. Manufacturers:
      a. Rockwood (RO).

2.05 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
   1. Threaded mortise cylinders with rings and cams to suit hardware application.
   2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
   4. Tubular deadlocks and other auxiliary locks.
   5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
   6. Keyway: Manufacturer's Standard.

C. Keying System: Each type of lock and cylinders to be factory keyed.
   1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. Existing System: Field verify and key cylinders to match Owner's existing system.

D. Key Quantity: Provide the following minimum number of keys:
   1. Change Keys per Cylinder: Two (2)
   2. Master Keys (per Master Key Level/Group): Five (5).
   3. Construction Keys (where required): Ten (10).

E. Construction Keying: Provide construction master keyed cylinders.

F. Key Registration List (Bitting List):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.

2.06 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
   1. Manufacturers:
      a. Lund Equipment (LU).
      b. MMF Industries (MM).
      c. Telkee (TK).

2.07 CYLINDRICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Commercial Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.
   1. Manufacturers:
      a. ASSA ABLOY ACCENTRA (YA) 4700LN Series.
      b. No Substitution.

B. Cylindrical Indicator Locksets, Grade 1 (Commercial Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed. Listed manufacturers shall meet all functions and features as specified herein.
   1. Provide locksets with functions and features as follows:
      a. Visual status indicators in rose, displaying bold visuals for vacant or occupied lock status.
      b. Meets ANSI/BHMA A156.41 for single motion egress.
      c. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
      d. Three-year limited warranty.
   2. Manufacturers:
      a. ASSA ABLOY ACCENTRA (YA) - YPL Series.
      b. No Substitution.

2.08 DEADLOCKS AND LATCHES

A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.
   1. Manufacturers:
      a. ASSA ABLOY ACCENTRA (YA) - 350 Series.
      b. No Substitution.

2.09 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   1. Strikes for Mortise Locks and Latches: BHMA A156.13.
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
   4. Dustproof Strikes: BHMA A156.16.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
   1. Exit devices shall have a five-year warranty.
   2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL 305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
   3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
   4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
   5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
   6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
      a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
      b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide locksets with functions and features as follows:
   a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
   b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
   c. Five-year limited warranty for mechanical features.
2. Manufacturers:
   a. ASSA ABLOY ACCENTRA (YA) - 6000 Series.
   b. No Substitution.

2.11 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL 10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
1. Manufacturers:
   a. ASSA ABLOY ACCENTRA (YA) - 3500 Series.
   b. No Substitution.

C. Door Closers, Surface Mounted (Standard Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size,

frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Manufacturers:
   a. ASSA ABLOY ACCENTRA (YA) - 2700 Series.
   b. No Substitution.

2.12 ARCHITECTURAL TRIM

A. Door Protective Trim
   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
   3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
   4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
      a. Stainless Steel: 300 grade, 050-inch thick.
   5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
   6. Manufacturers:
      a. Rockwood (RO).

2.13 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
   1. Manufacturers:
      a. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
   1. Manufacturers:
      a. Norton Rixson (RF).
      b. Rockwood (RO).
      c. Sargent Manufacturing (SA).

2.14 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors

and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL 10C.
   1. Provide intumescent seals as indicated to meet UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:
   1. Pemko (PE).

2.15 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.16 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.03 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
   1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
   2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
   3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
   4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.04 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
   1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.06 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.07 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.08 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
   1. Quantities listed are for each pair of doors, or for each single door.
   2. The supplier is responsible for handing and sizing all products.
   3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
   4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:
   1. MK - McKinney
   2. PE - Pemko
   3. YA - ASSA ABLOY ACCENTRA
   4. RO - Rockwood
   5. RF - Rixson
   6. NO - Norton

Hardware Sets

Set: 1.0

Doors: 149a

Description: EXT DBL ALUM EXIT - CLOSER w/ SPRING STOP

2	Cont Hinge	10BEFM__SLI-HD1	PE

1	Surface Vert Rod Exit, Exit Only	6210 EO	613E	YA
1	Surface Vert Rod Exit, Classroom	6210 121NL	613E	YA
2	Door Pull	RM3310-24	US10B	RO
2	Surface Closer - HD Spring	3531	613E	YA
2	Drop Plate as Req'd		613E	YA
1	Gasketing by door mfg			OT
1	Rain Guard	346_ x Width of Frame Head		PE
2	Sweep	345_		PE
1	Threshold	252x__FG		PE

Set: 2.0

Doors: 148a, 149b, 149c

Description: DBL INT EXIT - CLOSER w/ OVHD STOP

2	Cont Hinge	10BEFM__SLI-HD1		PE
1	Surface Vert Rod Exit, Classroom	6210 LBR AU506F	613E	YA
1	Surface Vert Rod Exit, Exit Only	6210 EO	613E	YA
2	Surface Closer - HD Spring	3531	613E	YA
2	Drop Plate as Req'd		613E	YA
1	Gasketing by door mfg			

Set: 3.0

Doors: 118a

Description: SGL INT STORAGE - CLOSER w/ OVHD STOP

3	Hinge, Hvy Wt	T4A3386 4 1/2" x 4 1/2"	US32D	MK
1	Storeroom or Closet Lock	AU 4705LN	626	YA
1	Surface Closer - Spring	2731	689	YA
1	Kick Plate	K1050 10" High CSK BEV	US32D	RO
3	Silencer	608-RKW		RO

Set: 4.0

Doors: 135a

Description: SGL INT STORAGE - CLOSER w/ WALL STOP

3	Hinge	TA2714 4 1/2" x 4 1/2" (NRP as applicable)	US32D	MK
1	Storeroom or Closet Lock	AU 4705LN	626	YA
1	Surface Closer	2701	689	YA
1	Kick Plate	K1050 10" High CSK BEV	US32D	RO
1	Wall Stop	409	US32D	RO
1	Gasketing	2891APK		PE

Set: 5.0

Doors: 113a

Description: SGL INT STORAGE - CLOSER w/ OVHD STOP

3	Hinge	TA2714 4 1/2" x 4 1/2" (NRP as applicable)	US32D	MK
1	Storeroom or Closet Lock	AU 4705LN	626	YA
1	Surface Closer - Spring	2731	689	YA
1	Kick Plate	K1050 10" High CSK BEV	US32D	RO
3	Silencer	608-RKW		RO

Set: 6.0

Doors: 134a

Description: SGL OFFICE - OVHD STOP

3	Hinge	TA2714 4 1/2" x 4 1/2" (NRP as applicable)	US32D	MK
1	Office Lock	AU 4704LN	626	YA
1	Surf Overhead Stop	10-x36	689	RF
1	Surface Closer	2701	689	YA
1	Kick Plate	K1050 10" High CSK BEV	US32D	RO
3	Silencer	608-RKW		RO

Set: 7.0

Doors: 117a

Description: SGL INT PRIVACY - CLOSER w/ WALL STOP

3	Hinge	TA2714 4 1/2" x 4 1/2" (NRP as applicable)	US32D	MK
1	Privacy	AU YPL02	626	YA
1	Surface Closer	2701	689	YA
1	Kick Plate	K1050 10" High CSK BEV	US32D	RO
1	Wall Stop	409	US32D	RO
1	Gasketing	S88BL		PE

Set: 8.0

Doors: 114a, 116a

Description: SGL INT PUSH/PULL - CLOSER w/ WALL STOP

3	Hinge, Hvy Wt	T4A3786 4 1/2" x 4 1/2" (NRP as applicable	US26D	MK
1	Push Plate	70C-RKW	US32D	RO
1	Door Pull	RM3301-12	US32D	RO
1	Surface Closer	2701	689	YA

1	Kick Plate	K1050 10" High CSK BEV	US32D	RO
1	Wall Stop	409	US32D	RO
1	Gasketing	S88BL		PE

Set: 10.0

Doors: 136b, 145b, 146b

Description: Field Verify - Kick Plate

2	Kick Plate	K1050 10" High CSK BEV	US32D	RO

1 Balance of existing Hardware to remain

Notes: Application:
-Field verify existing conditions and field modify existing door and frame, as required, to accept new hardware specified.
-Immediately inform the Architect of product that may not work with the existing frame and door conditions.
-Use above new hardware, all other hardware to remain.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units, monolithic.

C. Glazing accessories.

1.02 RELATED REQUIREMENTS

A. Section 084313 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

B. Section 102800 - Toilet Accessories: Mirrors.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 12 by 12 inch in size of glass units.

E. Installer's qualification statement.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with GANA (GM) and IGMA TM-3000 for glazing installation methods.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.06 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
   1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
   2. Guardian Glass, LLC: www.guardianglass.com/#sle.
   3. Pilkington North America Inc: www.pilkington.com/na/#sle.
   4. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
   5. Substitutions: Not permitted.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   3. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.04 INSULATING GLASS UNITS

A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV.
   3. Spacer Color: Black.
   4. Edge Seal:
      a. Single-Sealed System: Provide silicone, polysulfide, or polyurethane sealant as seal applied around perimeter.
      b. Color: Black.
   5. Purge interpane space with dry air, hermetically sealed.

C. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
      b. Coating: Low-E (passive type), on #2 surface.
   4. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
   5. Total Thickness: 1 inch.
   6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
   7. Visible Light Transmittance (VLT): 70 percent, nominal.
   8. Solar Heat Gain Coefficient (SHGC): 0.39, nominal.
   9. Visible Light Reflectance, Outside: 11 percent, nominal.
   10. Glazing Method: Dry glazing method, gasket glazing.
   11. Product: Vitro; Solarban 60 on 1/4" Clear; 1/2" air space; 1/4" clear.
   12. Substitutions: See Section 016000 - Product Requirements.

2.05 GLAZING UNITS (INTERIOR)

A. Monolithic Safety Glazing:
   1. Applications:
      a. Glazed lites in doors.
      b. Glazed sidelights to doors.
   2. Glass Type: Fully tempered safety glass as specified.
   3. Tint: Clear.
   4. Thickness: 1/4 inch, nominal.

2.06 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
   1. Width: As required for application.

C. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed (Existing Storefront Framing): Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.

C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

E. Place glazing tape on free perimeter of glazing in same manner described above.

F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

G. Carefully trim protruding tape with knife.

3.06 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

C. Monitor and report installation procedures and unacceptable conditions.

3.07 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.08 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 088000

SECTION 090561 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile.
   2. Carpet tile.
   3. Thin-set ceramic tile and stone tile.

B. Removal of existing floor coverings.

C. Preparation of new and existing concrete floor slabs for installation of floor coverings.

D. Testing of concrete floor slabs for moisture and alkalinity (pH).

E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Visual Observation Report: For existing floor coverings to be removed.

C. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

D. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Product data for recommended remedial coating.
   7. Submit report to Architect.
   8. Submit report not more than two business days after conclusion of testing.

E. Adhesive Bond and Compatibility Test Report.

F. Copy of RFCI (RWP).

1.04 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.

C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

D. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.

B. Deliver materials in manufacturer's packaging; include installation instructions.

C. Keep materials from freezing.

1.06 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:

a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
b. Removal of existing floor covering.

2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
   a. Do not attempt to remove coating or penetrating material.
   b. Do not abrade surface.
3. Preliminary cleaning.
4. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
6. Specified remediation, if required.
7. Patching, smoothing, and leveling, as required.
8. Other preparation specified.
9. Adhesive bond and compatibility test.
10. Protection.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.

B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 090561

SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum wallboard.

F. Joint treatment and accessories.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

C. Sequencing: Install service utilities in an orderly and expeditious manner.

1.03 SUBMITTALS

A. Refer to Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data:
   1. Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, joint finishing system, and acoustical insulation.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

C. Shop Drawings: Indicate special details associated with acoustic seals.

D. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Perform metal stud design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions and shop drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216.

2.02 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
   1. Structural Grade: As required to meet design criteria.
   2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.

D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

E. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Flexible Wood Backing: Fire-retardant-treated wood with sheet steel connectors.
      a. Products:
         1) ClarkDietrich; Danback: www.clarkdietrich.com/#sle.
         2) Substitutions: See Section 016000 - Product Requirements.

F. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Products:
      a. Armstrong World Industries; FRAMEALL Drywall Grid: www.armstrongceilings.com.
      b. USG Corporation; Drywall Suspension System: www.usg.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.

2.03 BOARD MATERIALS

A. Manufacturers:
   1. American Gypsum Company: www.americangypsum.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
   4. Gold Bond Building Products, LLC provided by National Gypsum Company: www.goldbondbuilding.com/#sle.
   5. USG Corporation: www.usg.com/#sle.
   6. Substitutions: Not permitted.

B. Gypsum Wallboard, General:
   1. Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   2. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   3. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
      b. Mold resistant board is required in wet areas indicated to be painted and where indicated.
   5. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   6. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 1/2 inch, unless otherwise indicated.
   7. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.04 INTERIOR GYPSUM WALL BOARD

A. Paper-Faced Products (**GB-1**): Type X or C per UL assembly, 5/8-inch thickness, fire-rated, to be painted or have wall coverings applied.
   1. Application: For fire-rated and non-fire-rated partitions, where no other type is indicated.
   2. Products:
      a. American Gypsum Company; FireBloc Type X Gypsum Wallboard: www.americangypsum.com/#sle.
      b. CertainTeed Corporation; Type X Drywall: www.certainteed.com/#sle.
      c. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gpgypsum.com/#sle.
      d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Fire-Shield X 5/8" Gypsum Board: www.goldbondbuilding.com/#sle.
      e. USG Corporation; Sheetrock Brand Firecode X Panels 5/8 in. (15.9 mm): www.usg.com/#sle.
      f. Substitutions: See Section 016000 - Product Requirements.

2.05 IMPACT RESISTANT WALL BOARD

A. Impact Resistant Wallboard:
   1. Application: High-traffic areas indicated on Drawings.
   2. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   4. Type: Fire-resistance-rated Type X, UL or WH listed.
   5. Thickness: 5/8 inch.
   6. Edges: Tapered.

7. Non Fire-Rated Products (**GB-11**):
   a. American Gypsum Company; M-Bloc IR Type X: www.americangypsum.com/#sle.
   b. CertainTeed Corporation; Extreme Drywall with M2Tech: www.certainteed.com/#sle.
   c. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant: www.gpgypsum.com/#sle.
   d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Hi-Impact Gypsum Board: www.goldbondbuilding.com/#sle.
   e. USG Corporation; Sheetrock Brand Mold Tough VHI Firecode X Panel: www.usg.com/#sle.
   f. Substitutions: See Section 016000 - Product Requirements.

2.06 TILE BACKING PANELS (**GB-7**)

A. Interior Glass Mat Faced Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Type: Regular and Type X, in locations indicated.
   5. Thickness: 5/8 inch.
   6. Edges: Tapered.
   7. Tile Backer Board For Non-Wet Areas, Non-Rated (**GB-7**): Products: Provide one of the following or an approved equivalent:
      a. CertainTeed Corporation; 5/8" GlasRoc Tile Backer: www.certainteed.com/#sle.
      b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Tile Backer Panel: www.goldbondbuilding.com/#sle.
      c. USG Corporation; Fiberock Aqua-Tough AR Interior Panels: www.usg.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

2.07 INTERIOR GYPSUM CEILING BOARD

A. Ceiling Board, Paper Faced (**GB-5**) Product:
   1. Description: Interior, non fire-rated, sag resistant gypsum board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   2. Application: Ceilings, unless otherwise indicated.
   3. Thickness: 1/2 inch.
   4. Edges: Tapered.
   5. Products:
      a. American Gypsum Company; Interior Sag-Resistand Ceiling Gypum Board: www.americangypsum.com/#sle.
      b. CertainTeed Corporation; 1/2-inch, Interior Ceiling Drywall: www.certainteed.com/#sle.
      c. Georgia-Pacific Gypsum; ToughRock Span 24 Lite-Weight Ceiling Board: www.gpgypsum.com/#sle.
      d. Gold Bond Building Products, LLC provided by National Gypsum Company; 1/2-inch, Gold Bond High Strength Ceiling Board: www.goldbondbuilding.com/#sle.
      e. USG Corporation; 1/2-inch, Sheetrock Brand Sag Resistant Interior Gypsum Ceiling Board: www.usg.com/#sle.
      f. Substitutions: See Section 016000 - Product Requirements.

2.08 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness as required for STC.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
      a. Products:
         1) CertainTeed Corporation; No-Coat Drywall Corner: www.certainteed.com/#sle.
         2) ClarkDietrich; Strait-Flex OS-300: www.clarkdietrich.com/#sle.
         3) Phillips Manufacturing Co; Everlast Corner Bead: www.phillipsmfg.com/#sle.
         4) Trim-Tex, Inc.: www.trim-tex.com/#sle.
         5) Substitutions: See Section 016000 - Product Requirements.
   2. L-Trim with Tear-Away Strip: Sized to fit 1/2-inch thick gypsum wallboard.
      a. Products:
         1) Phillips Manufacturing Co; gripSTIK L-Tear: www.phillipsmfg.com/#sle.
         2) Substitutions: See Section 016000 - Product Requirements.
   3. Expansion Joints:
      a. Fire-Resistance Rated: rating as indicated when joint system tested in accordance with UL 2079.
      b. Type: Off-angle inside corner expansion.
      c. Products:
         1) Phillips Manufacturing Co; 093 Expansion Control Joint: www.phillipsmfg.com/#sle.
         2) Trim-Tex, Inc; Fire Rated 093V Expansion Bead: www.trim-tex.com/#sle.
         3) Substitutions: See Section 016000 - Product Requirements.

D. Moisture Guard Trim: ASTM C1047, rigid plastic, 48 inch length, applied to bottom edge of gypsum board, in wet areas, throughout building.
   1. Height: 1/2 inch.
   2. Depth: 5/8 inch.
   3. Products:
      a. Waterguard USA; Waterguard: www.waterguard-usa.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
   3. Joint Compound: Drying type, vinyl-based, ready-mixed.
   4. Joint Compound: Setting type, field-mixed.

F. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
   1. Products:
      a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfacer with M2Tech: www.certainteed.com/#sle.
      b. USG Corporation; USG Sheetrock Brand Tuff-Hide Primer-Surfacer: www.usg.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.

G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.

F. Blocking: Install wood blocking for support of:
   1. Wall-mounted cabinets and hardware.
   2. Plumbing fixtures.
   3. Toilet partitions.
   4. Toilet accessories.
   5. Wall-mounted door hardware.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Locate gypsum board joints over framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

D. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Moisture Guard Trim: Install on bottom edge of gypsum board in wet areas.

3.06 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish, or wall coverings, and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish, unless otherwise indicated.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile.

C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.08 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION 092116

SECTION 093000 - TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

B. Section 090561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

C. Section 092116 - Gypsum Board Assemblies: Tile backer board.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, perimeter conditions, junctions with dissimilar materials, control and expansion joints, and setting details.

D. Samples: Mount tile and apply grout on two plywood panels, minimum 24 by 24 inches in size illustrating pattern, color variations, and grout joint size variations.

E. Installer's Qualification Statement.

F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Tile: 1 percent of each size, color, and surface finish combination installed, but no less than the following.
   3. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.06 MOCK-UPS

A. See Section 014000 - Quality Requirements for general requirements for mock-up.

B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
   1. Minimum 50 sq. ft. size mock-up where directed by Architect.
   2. Approved mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products of each type by the same manufacturer.
   1. Crossville Inc.: www.crossville.com.
   2. Dal-Tile Corporation: www.daltile.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Porcelain Tile: ANSI A137.1 standard grade.
   1. Porcelain Floor Tile (**T-1** and **T-4**) : Daltile; Reminiscent, #RM22 "*Souvenir Gray.*"
      a. Size: 12 x 24 inches.
      b. Thickness: 5/16-inch.
      c. Grout: As selected by Architect from manufacturer's full line, 3/16-inch joint width.
      d. DCOF: 0.60 w/Stepwise Technology.
   2. Porcelain Wall Tile (**T-2**) : Crossville; Access Point, #WBC01 "*Concrete White.*"
      a. Size: 12 x 24 inches.
      b. Thickness: 8.5-mm.
      c. Finish: Unpolished (UPS).
      d. Grout: As selected by Architect from manufacturer's full line., 3/16-inch joint width.

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Finish as indicated below, style and dimensions to suit application, for setting using tile mortar or adhesive. Field
   1. Transition Types:
      a. **TS-1**: Schluter; Jolly; TSBG "*Greige*."
         1) Application: Open edges of wall tile.
      b. **TS-2**: Schluter; RENO-TK; AE, Satin Aluminum Anodized.
         1) Application: Transition between floor finishes of different heights.
      c. **TS-3**: Schluter; RENO-T; AE, Satin Aluminum Anodized.
         1) Application: Transition between new and existing floor tiles.

d. **TS-4**: Schluter; RENO RAMP K; AE, Satin Aluminum Anodized.
   1) Application: Transition between new tile and concrete floor.
e. **TS-5**: Schluter; DILEX-AHK; 1/2 inch height, "*Greige*."
   1) Application: Floor-to-wall joints.

2. Products:
   a. Blanke Corporation: www.blankecorp.com/#sle.
   b. Genesis APS International: www.genesis-aps.com/#sle.
   c. Schluter-Systems: www.schluter.com/#sle.
   d. Profilitec Positive Profile: www.us.profilitec.com.
   e. Substitutions: See Section 016000 - Product Requirements.

2.03 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Manufacturers:
   1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
   2. Custom Building Products: www.custombuildingproducts.com/#sle.
   3. LATICRETE International, Inc: www.laticrete.com/#sle.
   4. Mapei Corporation: www.mapei.com/#sle.

C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
   1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated. Provide exterior type where indicated.

2.04 GROUTS

A. Manufacturers:
   1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
   2. Custom Building Products: www.custombuildingproducts.com/#sle.
   3. LATICRETE International, Inc: www.laticrete.com/#sle.
   4. Mapei Corporation: www.mapei.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
   1. Applications: Use this type of grout where indicated and where no other type of grout is indicated. Provide exterior type where indicated.
   2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
   3. Color(s): As indicated below.
      a. **GRT-1**: Custom Building Products #542 "*Graystone*."
      b. **GRT-2**: Custom Building Products #545 "*Bleached Wood*."
      c. **GRT-3**: Custom Building Products #545 "*Bleached Wood*."
      d. **GRT-4**: Custom Building Products #542 "*Graystone*."

2.05 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
   1. Applications: Between tile and plumbing fixtures.
   2. Color(s): As selected by Architect from manufacturer's full line.
   3. Manufacturers:
      a. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
      b. Custom Building Products: www.custombuildingproducts.com/#sle.
      c. LATICRETE International, Inc: www.laticrete.com/#sle.

d. Mapei Corporation: www.mapei.com/#sle.
e. Substitutions: See Section 016000 - Product Requirements.

2.06 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Crack Resistance: No failure at 1/8 inch gap, minimum.
2. Peel-and-Stick Sheet Type:
a. Material: Rubberized membrane laminated to reinforcing fabric.
b. Thickness: 20 mils, maximum.
c. Products:
1) LATICRETE International, Inc; FRACTURE BAN: www.laticrete.com/#sle.
2) Mapei Corporation; Mapeguard CI: www.mapei.com/#sle.
3) Proflex Products, Inc; Maxxim Sim-40: www.proflex.us/#sle.
4) Protecto Wrap; AFM Anti-Fracture Membrane: www.protectowrap.com/#sle.
5) Sika Corp; SikaTile 225 PNS: www.sika.com/#sle.
6) Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
1. Test in accordance with Section 090561.
2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

A. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

B. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base, and wall joints.

C. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

D. Form internal angles square and external angles bullnosed.

E. Install non-ceramic trim in accordance with manufacturer's instructions. Field verify heights prior to ordering transitions strips.

F. Sound tile after setting. Replace hollow sounding units.

G. Keep control and expansion joints free of mortar, grout, and adhesive.

H. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

I. Grout tile joints unless otherwise indicated.

J. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F102, with high performance polymer modified grout.

B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, improved latex-portland cement mortar bond coat, with standard grout, unless otherwise indicated.
   1. Use uncoupling membrane under all tile unless other underlayment is indicated.

C. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - WALL TILE

A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 093000

SECTION 095100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning.

C. Product Data: Provide data on suspension system components and acoustical units.

D. Samples: Submit two full size samples illustrating material and finish of acoustical units.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.04 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panels (**ACP-2**): Painted mineral fiber, with the following characteristics:
   1. Application(s): Kitchen areas.
   2. Classification: ASTM E1264 Type III.
      a. Form: 2, water felted.
      b. Pattern: "G" - smooth.
   3. Size: 24 by 48 inches.
   4. Thickness: 3/4 inch.
   5. Light Reflectance: 0.88 percent, determined in accordance with ASTM E1264.
   6. Ceiling Attenuation Class (CAC): 33, determined in accordance with ASTM E1264.

7. Panel Edge: Square.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products:
    a. Armstrong World Industries, Inc; Georgian: www.armstrongceilings.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

C. Acoustical Panels (**ACP-1**): Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Classification: ASTM E1264 Type IV.
    a. Form: 1, nodular and 2, water felted.
    b. Pattern: "E" - lightly textured.
2. Size: 24 by 24 inches.
3. Thickness: 3/4 inch.
4. Light Reflectance: 0.90 percent, determined in accordance with ASTM E1264.
5. NRC Range: 0.70 to 0.75, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
7. Panel Edge: Tegular.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products:
    a. USG Corporation; Mars Acoustical Panels: www.usg.com/ceilings/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

2.02 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, and splices as required.

B. Exposed Suspension System: Hot-dip galvanized steel grid and cap.
1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
2. Profile: Tee; 15/16 inch face width.
3. Finish: Baked enamel.
4. Products:
    a. Armstrong World Industries, Inc; Prelude ML: www.armstrongceilings.com/#sle.
    b. USG Corporation; Donn Brand DX/DXL 15/16 inch Acoustical Suspension System: www.usg.com/ceilings/#sle.
    c. Substitutions: See Section 016000 - Product Requirements.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Perimeter Moldings: Same metal and finish as grid.
1. Size: As required for installation conditions.
2. Shadow Molding: Shaped to create a perimeter reveal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

C. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

J. Form expansion joints where required. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

G. Install hold-down clips on panels within 20 ft of an exterior door.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

A. See Section 017300 - Execution for additional requirements.

B. Clean surfaces.

C. Replace damaged or abraded components.

END OF SECTION 095100

SECTION 096500 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate floor patterns.

D. Verification Samples: Submit two samples, in size illustrating color and pattern for each resilient flooring product specified.

E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

G. Installer's Qualification Statement.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Wall Base: Quantity equivalent to 2 percent of each type and color installed.
   3. Extra Flooring Materials: Quantity equivalent to 2 percent of each type and color installed.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience and approved by flooring manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

D. Protect roll materials from damage by storing on end.

E. Do not double stack pallets.

1.05 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Vinyl Tile - LVT: Surface-decorated, with wear layer.
   1. Basis-of-Design Product: J&J Flooring; Legend: www.jjflooringgroup.com.
      a. Substitutions: See Section 016000 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
   3. Plank Tile Size: 18 by 36 inch.
   4. Wear Layer Thickness: 0.020 inch.
   5. Total Thickness: 0.20 inch.
   6. Patterns and Colors: As indicated.
      a. **FT-1**: Legend; #1059 *"Fiction."*
      b. **FT-2**: Legend; #1057 *"Tale."*
   7. Installation: Staggered.

2.02 RESILIENT BASE

A. Resilient Base (**WB-1**): ASTM F1861, Type TP, rubber, thermoplastic; style as scheduled.
   1. Manufacturers:
      a. Johnsonite, a Tarkett Company; Baseworks: www.johnsonite.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Height: 4 inches.
   3. Thickness: 0.125 inch.
   4. Finish: Satin.
   5. Length: Roll.
   6. Color: #44 "*Burnt Umber.*"

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Same material as flooring, as approved by Architect.

D. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 090561.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

D. Prohibit traffic until filler is fully cured.

E. Clean substrate.

F. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:
   1. Spread only enough adhesive to permit installation of materials before initial set.
   2. Fit joints and butt seams tightly.
   3. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.

F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

G. At movable partitions, install flooring under partitions without interrupting floor pattern.

3.04 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Install plank tile with a random offset of at least 6 inches from adjacent rows.

3.05 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 096500

SECTION 096813 - TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

A. Section 090561 - Common Work Results for Flooring Preparation:
   1. Removal of existing floor coverings, cleaning, and preparation.
   2. Concrete slab moisture and alkalinity testing procedures.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Shop Drawings: Indicate layout of joints.

D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

G. Installer's Qualification Statement.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tile Carpeting (**CPT-1**): Tufted and textured loop, manufactured in one color dye lot.
   1. Product: Stereovision Lightwave manufactured by Milliken & Company: www.milliken.com, or approved equivalent.
   2. Tile Size: 9.84 by 39.4 inch, nominal.
   3. Finished Pile Thickness: 0.087 inch.

4. Color: #LWV27 "*Gearhead.*"

B. Tile Carpeting (**CPT-2**): Tufted and textured loop, manufactured in one color dye lot.
1. Product: Moving IO536 manufactured by Patcraft & Shaw Industries Group, Inc.: www.patcraft.com, or approved equivalent.
2. Tile Size: 24 by 24 inches, nominal.
3. Thickness: 0.279 inch.
4. Color: #00540 "*Stroll.*"
5. Installation: Quarter Turn.

2.02 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: As specified in Section 093000.

C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
1. Test in accordance with Section 090561.
2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates for installation of flooring in accordance with Section 090561.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in ashlar pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Fully adhere carpet tile to substrate.

G. Trim carpet tile neatly at walls and around interruptions.

H. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION 096813

SECTION 097200 - WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation and prime painting.

B. Wall covering.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide data on wall covering and adhesive.

C. Shop Drawings: Indicate wall elevations with seaming layout.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

F. Installer's Qualification Statement.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Wall Covering Materials: 25 linear feet of each color and pattern of wall covering; store where directed.
   3. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.04 MOCK-UPS

A. Provide panel, 3 panel drops wide, full height, illustrating installed wall covering and joint seaming technique.

B. Locate where directed.

C. Mock-up may remain as part of the Work, if approved.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.06 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. General Requirements:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.

B. Wall Covering (**WC-1**): Fabric-backed vinyl roll stock.
   1. Comply with ASTM F793/F793M, Category V, Type II.
   2. Roll Width: 52 inches.
   3. Backing: Dense polyester/cotton fabric.
   4. Color: ENS #5586 "*Stone.*"
   5. Pattern: Reverse hang.
   6. Pattern Match: Random
   7. Basis-of-Design Product:
      a. Wolf-Gordon; Ennis: www.wolfgordon.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

C. Wall Covering (**WC-2** and **WC-3**): Fabric-backed vinyl roll stock.
   1. Comply with ASTM F793/F793M, Category V, Type II.
   2. Color: Custom Digital.

D. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

F. Substrate Primer and Sealer: Alkyd enamel type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.02 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.

E. Marks: Seal with shellac those that may bleed through surface finishes.

F. Apply one coat of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth.

G. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall surface immediately prior to application of wall covering.

C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

D. Butt edges tightly.

E. Horizontal seams are not acceptable.

F. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

G. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.

H. Do not install wall covering more than 1/4 inch below top of resilient base.

I. Cover spaces above and below windows, above doors, in pattern sequence from roll.

J. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION 097200

SECTION 099123 - PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Materials for backpriming woodwork.

D. Scope: Finish interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In finished areas, paint shop-primed and galvanized items, including piping.
      c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
      d. Paint dampers exposed behind louvers, grilles, to match face panels.

E. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes, including powder coating.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
   9. Glass and aluminum.
   10. Acoustical materials, unless specifically indicated.
   11. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
   3. Semi-Gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. Cross-reference to specified paint system products to be used in project; include description of each system.
   3. Manufacturer's installation instructions.

C. Samples: Submit two paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, submit each color in each sheen available.
   3. Allow 30 days for approval process, after receipt of complete samples by Architect.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
   3. Label each container with color, type, and room locations in addition to the manufacturer's label.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years documented experience.

1.05 MOCK-UP

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Provide panel, 10 feet long by 10 feet wide, illustrating paint color, texture, and finish.

C. Provide door and frame assembly illustrating paint color, texture, and finish.

D. Locate where directed by Architect.

E. Mock-up may remain as part of the work, if approved.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
1. Base Manufacturer: The Sherwin-Williams Company (S-W): www.sherwin-williams.com, or approved equivalent by one of the following, and as indicated in Color Schedule.
2. Benjamin Moore Corporation: www.benjaminmoore.com.
3. Pittsburgh Paints: www.ppgpaints.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 016000 - Product Requirements, and the following:
1. Products are approved by manufacturer in writing for application specified.
2. Products meet performance and physical characteristics of basis of design product including published ratio of solids by volume, plus or minus two percent.

E. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each paint material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Sheens: Provide the sheens indicated in each paint system unless otherwise indicated. Where sheen is not specified, sheen will be selected from "draw down" sampless by Architect from the manufacturer's full line.

D. Colors: As indicated in Color Schedule.
   1. If not indicated, selection to be made by Architect after award of contract.
   2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
   3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.03 PAINT SYSTEMS - INTERIOR

A. Two top coats and one coat primer, unless otherwise indicated.

B. Metal Substrates (Steel, Galvanized Steel):
   1. Waterbased Acrylic System: Standard system for doors & frames, misc metals.
      a. Prime Coat: Primer, rust-inhibitive, water based:
         1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
      b. Intermediate Coat: Water-based Acrylic, interior, matching topcoat.
      c. Topcoat: Water-based Acrylic, semi-gloss, interior:
         1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
   2. Water-Based Dry-Fall System: Exposed Ceiling Structure.
      a. Top Coat: Dry-fall latex, flat:
         1) S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-181 Series, at 6.0 mils wet, 1.5 mils dry.

C. Gypsum Board Substrates:
   1. Latex System: Sheen Eggshell standard.
      a. Prime Coat: Primer, latex, interior:
         1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.0 mils dry.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior, flat for ceilings:
         1) S-W ProMar 200 Zero VOC Latex Flat, B30-12600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
      d. Topcoat: Latex, interior, eggshell for walls:
         1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-12600 Series, at 4.0 mils wet, 1.7 mils) dry, per coat.
   2. Water-Based Light Industrial Coating System: For added durability and burnish protection, corridors, kitchens, and ultradeep accent colors.
      a. Prime Coat: Primer sealer, latex, interior:
         1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 wet, 1.0 mils dry.
      b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
      c. Topcoat: Light industrial coating, interior, water based, eggshell:
         1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-1151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
   3. Epoxy-Modified Latex System: For toilet rooms, chemical resistance.
      a. Prime Coat: Primer sealer, latex, interior:
         1) S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600, at 1.0 mils dry, per coat.
      b. Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
      c. Topcoat: Epoxy-modified latex, interior, eggshell:

1) S-W Pro Industrial Waterbased Catalyzed Epoxy Eggshell, B73-360 Series, at 2.0 to 4.0 mils dry, per coat.

2.04 PAINT SYSTEMS - EXTERIOR

A. Metal Substrates (Steel, Galvanized Steel):
1. Waterbased Acrylic System: Standard system for doors & frames, misc. metals.
a. Prime Coat: Primer, rust-inhibitive, water based:
1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
b. Intermediate Coat: Water-based Acrylic, interior, matching topcoat.
c. Topcoat: Water-based Acrylic, semi-gloss, interior:
1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
1. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
1. Gypsum Wallboard: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair. Prepare gypsum board with a Level 5 finish where indicated.

G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

H. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

I. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Dark Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to inspect and test questionable coated areas.

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.07 COLOR SCHEDULE

A. Paint colors not indicated on Drawings, shall be selected by Architect for each application from manufacturer's full range.

B. **P-1**: Sherwin Williams; SW 9165 *"Gossamer Veil."*

C. **P-2**: Sherwin Williams; SW 7009 "*Pearly White*."

D. **P-3**: Sherwin Williams; SW 7048 "*Urbane Bronze*."

END OF SECTION 099123

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dimensional letter signage.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.

D. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment.

E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.03 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dimensional Letter Signs:
   1. A.R.K. Ramos: www.arkramos.com/#sle.
   2. CityScapes Inc: www.cityscapesinc.com/#sle.
   3. FASTSIGNS International, Inc: www.fastsigns.com/#sle.
   4. Inpro Corporation: www.inprocorp.com/#sle.
   5. Takeform: www.takeform.net/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 DIMENSIONAL LETTERS

A. Applications: Interior signage as indicated on drawings.
   1. Use individual plastic letters.

B. Plastic Letters:

1. Material: Injection molded plastic.
2. Thickness: Manufacturer's standard for letter size.
3. Letter Height: As indicated on drawings.
4. Text and Typeface:
   a. Character Font: Helvetica, Arial, or other sans serif font.
5. Finish: Semi-gloss.
6. Color: As selected.
7. Mounting: Concealed screws.

2.04 ACCESSORIES

A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate dimensional letter signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until date of Substantial Completion; repair or replace damaged items.

END OF SECTION 101419

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solid plastic toilet compartments (**TP-1**).

B. Urinal screens (**TP-2**).

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

D. Samples: Submit two samples of partition panels, 12 by 12 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide 25-year manufacturer warranty for HDPE material against breakage, corrosion, and delamination.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Toilet Compartments:
   1. Scranton Products; Eclipse Partitions: www.scrantonproducts.com/#sle.
   2. Substitutions: Section 016000 - Product Requirements.

2.02 PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Compartments (**TP-1**): Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
   1. Color: *"Bronze."*
   2. Texture: Orange peel.
   3. Doors:
      a. Thickness: 1 inch.
      b. Width: 24 inch.
      c. Width for Handicapped Use: 36 inch, out-swinging.

d. Height: 62 inch.

4. Panels:
   a. Thickness: 1 inch.
   b. Height: 62 inch.
   c. Depth: As indicated on drawings.
5. Pilasters: Heavy duty extruded aluminum (6063-T5) stantion posts; clear anodized finish.
   a. Size: 1.5 inch square.
6. Urinal Screens (**TP-2**): Without doors; to match compartments; mounted to wall with continuous panel brackets.

2.03 ACCESSORIES

A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Extruded aluminum, anti-grip profile.
   1. Size: Manufacturer's standard size.

C. Wall and Pilaster Brackets: Stainless steel; continuous type.

D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Hinges: Stainless steel, manufacturer's standard finish.
   1. Continuous-type hinge, self closing.

F. Door Hardware: Stainless steel, manufacturer's standard finish.
   1. Door Latch: Thumbturn type with occupancy indicator.
   2. Provide door pull for outswinging doors.

G. Coat Hook with Rubber Bumper: One per compartment, mounted on door.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain high privacy, no sight design spacing between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust adjacent components for consistency of line or plane.

END OF SECTION 102113.19

SECTION 102239 - FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Top-supported folding panel partitions, horizontal opening on existing track system.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
   1. Require attendance by representatives of installer.
   2. Notify Architect four calendar days in advance of scheduled meeting date.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide data on partition materials, hardware and accessories, and colors and finishes available.

C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, confirming loads at points of attachment to the existing building structure.

D. Shop Drawings: Indicate opening sizes, static and dynamic loads, adjacent construction and finish trim, stacking depth, and coordination with existing track layout.

E. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.

F. Samples for Review: Submit two samples of surface finish, 12 by 12 inches size, illustrating quality, colors selected, texture, and weight.

G. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.

H. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention, and installation sequence.

I. Designer's qualification statement.

J. Installer's qualification statement.

K. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.06 WARRANTY

A. See Section 017700 - Closeout Procedures, for additional warranty requirements.

B. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Folding Panel Partitions - Horizontal Opening:
   1. Moderco, Inc; Signature 800 Series Model 841: www.moderco.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Folding Panels: Side opening; individual panels; center stacking; manually operated.

B. Panel Construction:
   1. Frame: 16 gauge, 0.0598 inch thick steel-reinforced aluminum frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
   2. Panel Substrate Facing: Steel sheet, manufacturer's standard thickness.
   3. Hardware: Latching door handles of cast steel, satin chrome finish; lock cylinder keyed to building keying system.
   4. Panel Properties:
      a. Thickness With Finish: 4 inches.
      b. Width: Up to 48 inches (1219 mm), as required to match existing panels.

C. Panel Finishes:
   1. Facing: Vinyl coated fabric.
   2. Exposed Metal Trim: Clear anodized.

D. Panel Seals:
   1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
   2. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, 4-inch retractable floor seals, and above track to structure acoustic seal.

E. Suspension System:
   1. Track: Existing.
   2. Carriers: Custom trolley carrier at top of every panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.

F. Performance:
   1. Acoustic Performance:
      a. Sound Transmission Class (STC): 48 to 52 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.

2. Surface Burning Characteristics of Panel Finish: Flame spread/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

G. Accessories:
1. Pass Door: Single door, 36 inch wide by 84 inch high opening; same design and construction as panel; fit door with perimeter acoustic gaskets, concealed closer, keyed lock, and tool operated floor seal.
2. Acoustic Sealant: As recommended by partition manufacturer.

2.03 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Vinyl Coated Fabric: ASTM F793 Category VI, polyvinyl fluoride (PVC) finish for washability and improved flame retardance; color as selected by Architect from manufacturer's standard range.

C. Acoustic Insulation:
1. Type: As required for acoustic performance indicated.
2. Thickness: As required for acoustic performance indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Verify existing track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

C. Verify existing floor flatness of 1/8 inch in 10 feet, non-cumulative.

D. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

3.02 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Lubricate moving components.

C. Install acoustic sealant to achieve required acoustic performance.

3.03 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

A. Clean finish surfaces and partition accessories.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION 102239

SECTION 102800 - TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Under-lavatory pipe supply covers.

C. Diaper changing stations.

D. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Concealed supports for accessories, including in wall framing and plates.

B. Section 102113.19 - Plastic Toilet Compartments.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

B. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
   1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   2. Include electrical characteristics.

C. Samples: Submit two samples of each accessory, illustrating color and finish.

D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

E. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify accessories using designations indicated.

1.05 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.

2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
   1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
   2. Shower Seats: Installed units are able to resist 250 lbf applied in any direction and at any point.

2.02 MANUFACTURERS

A. Accessories: Provide products indicated, or approved equivalent by one of the following.
   1. AJW Architectural Products: www.ajw.com/#sle.
   2. American Specialties, Inc: www.americanspecialties.com/#sle.
   3. Bobrick: www.bobrick.com/#sle.
   4. Bradley Corporation: www.bradleycorp.com/#sle.
   5. GAMCO: www.gamcousa.com.

B. Under-Lavatory Pipe Supply Covers: Provide products indicated, or approved equivalent by one of the following.
   1. McGuire Manufacturing: www.mcguiremfg.com.
   2. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
   3. TRUBRO.

C. Diaper Changing Stations: Provide products indicated, or approved equivalent by one of the following.
   1. American Specialties, Inc: www.americanspecialties.com/#sle.
   2. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
   3. Bradley Corporation: www.bradleycorp.com/#sle.
   4. Koala Kare Products: www.koalabear.com/#sle.

D. Provide products of each category type by single manufacturer.

2.03 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide two (2) keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

F. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

G. Adhesive: Two component epoxy type, waterproof.

H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.04 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.

2.05 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser: Double roll, surface mounted, for 1 inch (25 mm) core type rolls.
   1. Products:
      a. Bobrick; (**TA-2**) Model #B-3588 stainless steel dispenser.
      b. Substitutions: Section 016000 - Product Requirements.

B. Combination Towel Dispenser/Waste Receptacle: Recessed flush with wall, stainless steel; seamless wall flanges, continuous piano hinges, ____.
   1. Waste receptacle liner: Reusable, heavy-duty vinyl.
   2. Towel dispenser capacity: 800 multifold.
   3. Waste receptacle capacity: 6.3 gallons.
   4. Products:
      a. Bobrick; (**TA-3d**) TrimLineSeries #B-3803 Recess-Mounted; stainless steel, satin finish.

C. Mirrors: Stainless steel framed, 1/4 inch thick tempered safety glass; ASTM C1048.
   1. Size: As indicated.
   2. Frame: Angle or channel shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
   4. Fixed Tilt Mirrors: Minimum 3 inches tilt from top to bottom.
   5. Products:
      a. Bobrick; (**TA-11**) Model #B-2908 Angle Frame Mirror; 18 x 30 inches (46 x 76 cm).
      b. Substitutions: Section 016000 - Product Requirements.

D. Grab Bars:
   1. Standard Duty Grab Bars: Stainless steel, smooth slip-resistant surface.
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings and below.
      e. Products:
         1) Bobrick; (**TA-1b**) Model B-6806x18, with #252-30 mounting kits.
         2) Bobrick; (**TA-1d**) Model B-6806x36, with #252-30 mounting kits.
         3) Bobrick; (**TA-1e**) Model B-6806x42, with #252-30 mounting kits.
         4) Substitutions: Section 016000 - Product Requirements.

E. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted or back-to-back partition mounting with adjustable flanges, self-closing door, removable receptacle.
   1. Products:
      a. Bobrick; (**TA-5b**) TrimLineSeries Model #B-35139 (surface-mount); satin finish.
      b. Substitutions: Section 016000 - Product Requirements.

F. Clothes Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for exposed attachment, satin finish, unless otherwise indicated.
   1. Products:
      a. Bobrick; (**TA-13a**) Model #B-233.
      b. Substitutions: Section 016000 - Product Requirements.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
   1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
   2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
   3. Construction: 1/8 inch flexible PVC.
      a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
      b. Microbial and Fungal Resistance: Comply with ASTM G21.
   4. Color: White.
   5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.
   6. Products: Provide products by one of the following, or approved equivalent.
      a. McGuire Manufacturing: www.mcguiremfg.com.
      b. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
      c. TRUBRO.

2.07 DIAPER CHANGING STATIONS

A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
   1. Minimum Rated Load: 250 pounds.
   2. Products:
      a. Koala Kare Products; (**TA-22d**) Model #KB310-SSWM Horizontal Wall Mount.
         1) Material: Stainless steel.
         2) Mounting: Surface.
      b. Substitutions: 016000 - Product Requirements.

2.08 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Drying rod: Stainless steel, 1/4 inch diameter.
   2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
   3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
   4. Length: 36 inches.
   5. Products:
      a. Bobrick; (**TA-14**) Model #B-224x36; satin finish.
      b. Substitutions: 016000 - Product Requirements.

2.09 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
   1. Remove temporary labels and protective coatings.
   2. Grab Bars: Install to comply with specified structural-performance requirements.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces according to manufacturer's written instructions.

3.05 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.03 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
   2. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
   3. Potter-Roemer: www.potterroemer.com/#sle.

B. Fire Extinguisher Cabinets and Accessories:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
   2. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
   3. Potter-Roemer: www.potterroemer.com/#sle.

C. Substitutions: Not permitted.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Cartridge Operated: Spun shell.
   2. Class: A:B:C type.

3. Size: 5 pound.
4. Finish: Baked polyester powder coat, red color.
5. Temperature range: Minus 65 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

A. Basis-of-Design: Larsen's Manufacturing Company; Architectural Series 2409-R3, or approved equivalent.

B. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

C. Cabinet Construction: Non-fire rated.

D. Cabinet Configuration: Semi-recessed type.
1. Exterior nominal dimensions of 13 inch wide by 27.5 inch high by 5 inch deep.
2. Projected Trim: Returned to wall surface, with 2.5 inch projection, and 1.75 inch wide face.

E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

F. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.

G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

H. Fabrication: Weld, fill, and grind components smooth.

I. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.

J. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 48 inches from finished floor to center of cabinet door handle.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

END OF SECTION 104400

SECTION 107316.13 - METAL CANOPIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Attached metal canopies.

1.02 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Submit product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.

C. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing profiles, sections of components, finishes, and fastening details.

D. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.

E. Designer's Qualification Statement.

F. Erector's Qualification Statement.

G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
   1. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.

B. Erector Qualifications: Company specializing in performing the work of this section.
   1. Not less than three years of documented experience and approved by canopy manufacturer.

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.2/D1.2M and no more than 12 months before start of scheduled welding work.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site ready for erection.

B. Package using methods that prevent damage during shipping and storage on site.

C. Store materials under cover and elevated above grade.

1.05 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Metal Canopies: Correct defective work within a two year period after Date of Substantial Completion.

C. Finish Warranty: Provide manufacturer's five year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Metal Canopy:
   1. Mapes Industries; Super Lumideck: www.mapes.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 METAL CANOPIES

A. Shop Fabricated Aluminum Canopy.

B. Configuration: Layout and dimensions, canopy clearance, fascia profile, and roof covering design as indicated on drawings.
   1. Installation: Cantilever-mounted to building structure with tension members.
   2. Structural Framing System: Aluminum.
   3. Covering Material: Aluminum.
   4. Drainage Concept: Water collected in decking conducted into perimeter drain beams and discharged through downspouts.

C. Performance Requirements:
   1. Design and fabricate metal canopy system to resist wind, snow, and live loads without failure, damage, or permanent deflection in accordance with ASCE 7:
   2. Thermal Movement: Design canopy system to accommodate thermal movement caused by ambient temperature range of 120 degrees F and surface temperature range of 180 degrees F without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
   3. Electrical Components, Devices, and Accessories: Listed and labeled by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction and installed in compliance with NFPA 70, and marked for intended application.

2.03 COMPONENTS

A. Structural Aluminum Framing: Alloy and temper 6063-T5, 6063-T6, or 6061-T6.
   1. Extruded Shapes and Tubes: ASTM B221 (ASTM B221M).
   2. Rolled or Extruded Structural Shapes: ASTM B308/B308M.
   3. Sheet and Plate: Alloy 5052, 5005, or 6061-T651, ASTM B209/B209M.

B. Covering:
   1. Aluminum Decking:
      a. Interlocking extruded aluminum decking modules.
         1) Extruded Decking: ASTM B221 (ASTM B221M), Alloy and temper 6005-T5, 6061-T6, or 6063-T6.
      b. Decking Orientation: Perpendicular to sidewalk.
   2. Overhang: As indicated on drawings.

C. Fascia: Same material as structural framework, 6 inches high.

D. Anchor Bolts: ASTM A307 or ASTM A572/A572M, formed with bent shank, assembled with template for casting into concrete.
   1. Minimum exposed thread of 7 inches above footing and 23 inch minimum embedment.
   2. Provide nuts and washers as required for column leveling and plumbing.

E. Exposed Gutters and Downspouts: Galvanized steel with baked enamel finish, color to match canopy covering, manufacturer's recommended size for canopy specified.

2.04 SHOP FABRICATION

A. Provide a complete system ready for erection at project site.

B. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

C. Weld aluminum members in accordance with AWS D1.2/D1.2M.

D. Fabricate connections for bolt, nut, and washer connectors.

2.05 FINISHES

A. Aluminum Framing and Decking:
   1. Superior Performing Organic Coatings: AAMA 2605, multiple coats, thermally cured, polyvinylidene fluoride system.
   2. Color: As selected by Architect from manufacturer's full range..

B. Fascia: Fluoropolymer finish; color as selected from manufacturer's standard range.

2.06 ACCESSORIES

A. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as sheet metal decking; factory-fabricated to required profiles.
   1. Exposed Fasteners: Not permitted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and site area for conditions that might prevent satisfactory installation.

B. Verify that foundation, electrical utilities, and placed anchors are in correct position.

C. Verify that bearing surfaces are ready to receive this work.

D. Do not proceed with installation until all conditions are satisfactory.

3.02 INSTALLATION - FRAMING

A. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation.

B. Do not field cut or alter structural members without approval.

C. After erection, prime welds, abrasions, and surfaces not shop primed.

3.03 INSTALLATION - CANOPY COVERING

A. Install in accordance with manufacturer's instructions.

B. Fasten metal decking to metal support members, aligned level and plumb.

C. Install fascia panels, trim, and flashing.

D. Separate dissimilar metals using concealed bituminous paint.

E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.04 TOLERANCES

A. Maximum Variation from Level: Plus/Minus 1/8 inch.

3.05 CLEANING

A. Clean surfaces of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.06 PROTECTION

A. Protect canopy after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION 107316.13

SECTION 122400 - WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

B. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.03 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Selection Samples: Include fabric samples in full range of available colors and patterns.

E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of this type with minimum 3 years of documented experience with shading systems of similar size and type.
   1. Manufacturer's authorized representative.
   2. Factory training and demonstrated experience.

1.05 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.
   1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
   2. Full-sized mock-up will become the property of the Owner to be used for spare parts.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.07 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades (**WT-1**):
   1. Basis of Design: Aperture Contract; Manual Roller Shade: wwwaperturecontract.com, or approved equivalent.
   2. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: Window jamb mounted - inside, between jambs.
      d. Sizes: As indicated below, field verify.
         1) **WT-1**: 60 inches wide by 84 inches high.
         2) **WT-2**: 64 inches wide by 64 inches high.
      e. Fabric: As indicated under Shade Fabric article.
   3. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Hardware Color: Gray Anodized.
   4. Roller Tubes: As required for type of shade operation.
      a. Material: Extruded aluminum, clear anodized finish.
      b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
   5. Hembars: Designed to maintain bottom of shade straight and flat.
      a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
   6. Manual Operation for Interior Shades:
      a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
      b. Drive Chain: Continuous loop, beaded ball chain with restraining device, 95 lb minimum breaking strength; comply with WCMA A100.1. Provide upper and lower limit stops.
   7. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.02 SHADE FABRIC

A. Fabric (**WT-1**): Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Basis-of-Design: Aperture Contract; Tivoli Sheer: www.aperturecontract.com, or approved equivalent.
      a. Substitutions: See Section 016000 - Product Requirements.
   2. Material: Vinyl coated polyester.
   3. Performance Requirements:
      a. Flammability: Pass NFPA 701 large and small tests.
   4. Colors: As selected by Architect from manufacturer's full range of colors.
   5. Fabrication:
      a. If height of opening requires multiple panels of railroaded fabric, use manufacturer's standard sewn seams.
      b. Battens: Full width of shade, enclose in welded shade fabric pocket.

2.03 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
   2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.

C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

B. Training: Train Owner's personnel on operation and maintenance of system.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 122400

SECTION 210500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Above ground piping.
- B Escutcheons.
- C Expansions - hose and braid.
- D Mechanical couplings.
- E Pipe hangers and supports.
- F Pipe sleeves.
- G Pipe sleeve-seal systems.
- H Piping specialties.
- I Pressure gauges.
- J Pressure relief valves.

1.02 RELATED REQUIREMENTS
- A Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.03 REFERENCE STANDARDS
- A ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- B ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
- C ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- D ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- E ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- F ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- G ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- H ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2021.
- I ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- J ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- K ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- L ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- M ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- N ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- O ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- P ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- Q AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- R AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- S AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- T AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- U AWWA C606 - Grooved and Shouldered Joints; 2015.

V FM (AG) - FM Approval Guide; Current Edition.
W ITS (DIR) - Directory of Listed Products; Current Edition.
X NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
Y NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2022.
Z NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2019, with Amendment.
AA UL (DIR) - Online Certifications Directory; Current Edition.
BB UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A See Division 01 -Submittal Procedures.
B Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
C Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
D Manufacturer's qualification statement.
E Installer's qualification statement.
F Project Record Documents: Record actual locations of components and tag numbering.
G Operation and Maintenance Data: Include installation instructions and spare parts lists.
H Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Division 01 - Product Requirements for additional provisions.
2. Extra Valve Stem Packings: Two for each type and size of valve.

1.05 QUALITY ASSURANCE
A Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
B Installer Qualifications: Company specializing in performing work of the type specified in this section.
1. Minimum three years experience.
2. Approved by manufacturer.
C Comply with FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey requirements.
D Valves: Bear FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
E Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
F Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING
A Deliver and store valves in shipping containers, with labeling in place.
B Provide temporary protective coating on cast iron and steel valves.
C Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.07 WARRANTY
A Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS
A Sprinkler-based System:

1. Comply with NFPA 13.
2. See Section 211300.

B Standpipe and Hose System:
1. Comply with NFPA 14.

C Combined Sprinkler, Standpipe, and Hose System:
1. Comply with NFPA 13 and NFPA 14.
2. See Sections 211300.

D Welding Materials and Procedures: Comply with ASME BPVC-IX.

E Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.02 ABOVE GROUND PIPING

A Steel Pipe: ASTM A795 Schedule 40, black.
1. Steel Fittings: ASME B16.11 forged steel socket welded and threaded. Suitable for service.
2. Joints: Welded in accordance with ASTM B.16.9.
3. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
4. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
5. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
   a. Manufacturers:
   b. Fire Protection Products, Inc: www.fppi.com.
   c. Tyco Fire Protection Products: www.tyco-fire.com.
   d. Viking Group Inc: www.vikinggroupinc.com.
   e. Victaulic: www.victaulic.com
   f. Substitutions: See Division 01 - Product Requirments
6. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

B Copper Tube: ASTM B88 (ASTM B88M), Type K (A), H58 drawn.
1. Fittings: ASME B16.18, cast copper alloy, grooved.
2. Mechanical Grooved Couplings: Ductile iron housing with alkyd enamel paint coating clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers.

C Ductile Iron Pipe: AWWA C151/A21.51.
1. Fittings: AWWA C110/A21.10, standard thickness.
2. Joints: AWWA C111/A21.11, SBR or vulcanized styrene-butadiene rubber gasket.
3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.03 PIPE SLEEVES

A Vertical Piping:
1. Sleeve Length: 1 inch above finished floor.
2. Provide sealant for watertight joint.
3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

B Plastic, Sheet Metal, or Moisture-Resistant Fiber: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

C Pipe Passing Through Below Grade Exterior Walls:
1. Zinc-coated or cast-iron pipe.
2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

D Pipe Passing Through Quarry Tile, Terrazzo, or Ceramic Tile Floors:
1. Brass pipe.
2. Connect sleeve with floor plate.

E Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
2. Connect sleeve with floor plate except in mechanical rooms.

F Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
2. Connect sleeve with floor plate except in mechanical rooms.

G Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect/Engineer.

H Clearances:
1. Provide allowance for insulated piping.
2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
3. Rated Openings: Caulked tight with firestopping material complying with ASTM E814 to prevent the spread of fire, smoke, and gases.
4. Rated Openings: Caulked tight with firestopping material complying with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.

2.04 PIPE SLEEVE-SEAL SYSTEMS

A Manufacturers:
1. Advance Products & Systems, Inc: www.apsonline.com.
2. GPT, a company of Enpro Industries, Inc: www.gptindustries.com.
3. Link Seal: www.garlock.com
4. Substitutions: See Division 01 - Product Requirments

B Modular Mechanical Seals:
1. Elastomer-based interlocking links to continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Service Requirements:
   a. Corrosion resistant.
   b. Oil, fuel, gas, and solvent resistant.
   c. Underground, buried, and wet conditions.
5. Glass-reinforced plastic pressure end plates.

C Wall Sleeve: PVC material with waterstop collar, and nailer end caps.

D Sleeve-Forming Disk: Nonconductive plastic-based material, 3 inch thick.

E Pipeline-Casing Seals:
1. Coated-metallic boltless casing-spacer for 4 inch carrier pipe.
2. Coated-metallic boltless modular seal for 6 inch carrier pipe.
3. Carbon steel band with riser for 12 inch carrier pipe.
4. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

2.05 ESCUTCHEONS

A Manufacturers:
1. Fire Protection Products, Inc: www.fppi.com.
2. Tyco Fire Protection Products: www.tyco-fire.com.
3. Viking Group Inc: www.vikinggroupinc.com.
4. Substitutions: See Division 01 Product Requirements.

B Material:
1. Fabricate from nonferrous metal.
2. Chrome-plated.
3. Metals and Finish: Comply with ASME A112.18.1.

C Construction:
1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.06 PIPE HANGERS AND SUPPORTS

A Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
1. Manufacturers:
a. AFCON, a brand of Anvil International: www.anvilintl.com.
b. FNW: www.fnw.com.
c. Substitutions: See Division 01 Product Requirements.

B Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
1. Manufacturers:
a. AFCON, a brand of Anvil International: www.anvilintl.com.
b. FNW: www.fnw.com.

C Nonmetallic Piping Hangers:
1. Manufacturers:
a. DecoShield Systems, Inc; Snap-2 Hangers: www.decoshield.com.

D Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
1. Manufacturers:

E Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

F Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

G Vertical Support: Steel riser clamp.
1. Manufacturers:
a. Anvil International: www.anvilintl.com.
b. Substitutions: See Division 01 Product Requirements.

H Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
1. Manufacturers:
a. Anvil International: www.anvilintl.com.
b. Substitutions: See Division 01 Product Requirements.

I Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

J Seismic Hangers and Couplings:
1. Provide coupling with a factory set disengagement rating of 140 percent to 160 percent of the static weight.
2. Provide resettable and reusable, break away couplings.
3. Provide tether cables to avoid excessive seismic joint movement.
4. Coupling to be manufactured from non-corrosive materials.
5. Manufacturers:
a. The Metraflex Company: www.metrafire.com.

b. Substitutions: See Division 01 Product Requirements.

2.07 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

A Manufacturers:
1. The Metraflex Company; FireLoop: www.metrafire.com.
2. Flex-Weld, Inc: www.kelcoind.com.
3. Substitutions: See Division 01 Product Requirements.

B Provide flexible loops with two flexible sections of hose and braid, two 90-degree elbows, and 180-degree return with support bracket and air release or drain plug.

C Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.

D Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
2. End Connections: Threaded; complying with ASME B16.11.
3. Provide necessary accessories including, but not limited to, swivel joints.

2.08 MECHANICAL COUPLINGS

A Manufacturers:
1. Anvil International: www.anvilintl.com.
2. Shurjoint Piping Products, Inc: www.shurjoint.com.
3. Tyco Fire Protection Products: www.tyco-fire.com.
4. Victaulic Company: www.victaulic.com.
5. Substitutions: See Division 01 - Product Requirments

B Rigid Mechanical Couplings for Grooved Joints:
1. Dimensions and Testing: Comply with AWWA C606.
2. Minimum Working Pressure: 300 psig.
3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
4. Housing Coating: Factory applied orange enamel.
5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.
7. Provide stops for direct stab installation without field assembly.

2.09 PIPING SPECIALTIES

A Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
1. Activate electric alarm.
2. Test and drain valve.
3. Replaceable internal components without removing valve from installed position.
4. Manufacturers:
   a. Victaulic Company: www.victaulic.com.
   b. Substitutions: See Division 01 Product Requirements.

B Auxiliary Drains: Condensate collection drain for each section of trapped pipe in preaction or dry fire protection system.
1. Manufacturers:
   a. AGF Manufacturing: www.agfmfg.com.
   b. Substitutions: See Division 01 Product Requirements.

C Air Venting Valves:
1. Manufacturers:
   a. AGF Manufacturing: www.agfmfg.com.

b. Substitutions: See Division 01 Product Requirements.

D Backflow Preventer: Reduced-pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.

E Commercial Riser Manifold: Preassembled and tested riser manifold in accordance with NFPA 13.
1. Manufacturers:
   a. AGF Manufacturing: www.agfmfg.com.
   b. Substitutions: See Division 01 - Product Requirments

F Residential Risers Manifold: Preassembled and tested riser manifold in accordance with NFPA 13R.
1. Manufacturers:
   a. AGF Manufacturing: www.agfmfg.com.
   b. Substitutions: See Division 01 - Product Requirments

G Corrosion Monitors:
1. Manufacturers:
   a. AGF Manufacturing: www.agfmfg.com.
   b. Substitutions: See Division 01 Product Requirements.

H Test Connections:
1. Inspector's Test Connection for Preaction and Dry Pipe Systems:
   a. Provide test connections approximately 6 feet above floor for each or portion of each sprinkler system equipped with an alarm device, located at most remote part of each system.
   b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
   c. Supply discharge orifice with same size as corresponding sprinkler orifice.
   d. Limit vertical height of exterior wall penetration to 2 feet above finished grade.
   e. Manufacturers:
      1) AGF Manufacturing: www.agfmfg.com.
      2) Substitutions: See Division 01 Product Requirements.
2. Combination Inspector's Test Connection and Drain Valve:
   a. Provide test connections approximately 6 feet above floor for each or portion of each sprinkler system equipped with an alarm device, located at most remote part of each system.
   b. Route combination test connection and drain valve to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
   c. Supply discharge orifice with same size as corresponding sprinkler orifice.
   d. Limit vertical height of exterior wall penetration to 2 feet above finished grade.
   e. Manufacturers:
      1) AGF Manufacturing: www.agfmfg.com.
      2) Substitutions: See Division 01 Product Requirements.
3. Backflow Preventer Test Connection:
   a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5-inch National Standard male hose threads with cap and chain.
   b. Provide one valve for each 250 gpm of system demand or fraction thereof.
   c. Provide permanent sign reading "Test Valve." See Section 210553.

I Supervisory Switches:
1. Manufacturers:
   a. Potter Electric Signal Company, LLC; CoilKeeper Solenoid Supervisory Switch: www.pottersignal.com.

b. Substitutions: See Division 01 Product Requirements.

2.10 PRESSURE GAUGES

A Manufacturers:
1. AGF Manufacturing: www.agfmfg.com.
2. Dwyer Instruments, Inc: www.dwyer-inst.com.
3. Moeller Instrument Company, Inc: www.moellerinstrument.com.
4. Omega Engineering, Inc: www.omega.com.
5. Substitutions: See Division 01 Product Requirements.

B Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: Steel with brass bourdon tube.
2. Diameter: 4-1/2 inch.
3. Mid-Scale Accuracy: One percent.
4. Scale: Display in psi and kPa.

2.11 PRESSURE RELIEF VALVES

A Manufacturers:
1. AGF Manufacturing: www.agfmfg.com.
2. Cla-Val Co: www.cla-val.com.
3. Watts: www.watts.com.
4. Substitutions: See Division 01 Product Requirements.

B ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

PART 3 EXECUTION

3.01 PREPARATION

A Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B Remove scale and foreign material, from inside and outside, before assembly.
C Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
B Install standpipe piping, hangers, and supports in accordance with NFPA 14.
C Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
D Install piping to conserve building space, to not interfere with use of space and other work.
E Group piping whenever practical at common elevations.
F Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
G Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

H Pipe Hangers and Supports:

1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
2. Place hangers within 12 inches of each horizontal elbow.
3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
6. Provide copper plated hangers and supports for copper piping.
7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
   a. Painting of interior fire suppression systems is specified in Division 09.

I Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

J Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
1. Painting of interior fire suppression systems is specified in Division 09.

K Structural Considerations:
1. Do not penetrate building structural members unless indicated.
2. Locate flexible expansion loops at or near the building seismic joint.

L Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
2. Aboveground Piping:
   a. Pack solid using mineral fiber complying with ASTM C592.
   b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
3. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.
4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

M Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a watertight seal.
6. Install in accordance with manufacturer's recommendations.

N Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
3. Attach plates at the underside only of suspended ceilings.

4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

O When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

P Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

3.03 CLEANING

A Upon completion of work, clean all parts of the installation.

B Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 210500

SECTION 210523

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Two-piece ball valves with indicators.
- B Bronze butterfly valves with indicators.
- C Iron butterfly valves with indicators.
- D Check valves.
- E Bronze OS&Y gate valves.
- F Iron OS&Y gate valves.
- G NRS gate valves.
- H Indicator posts.
- I Trim and drain valves.

1.02 RELATED REQUIREMENTS
- A Section 210500 - Common Work Results for Fire Suppression: Pipe and fittings.
- B Section 210553 - Identification for Fire Suppression Piping and Equipment.
- C Section 211300 - Fire-Suppression Sprinkler Systems.

1.03 ABBREVIATIONS AND ACRONYMS
- A EPDM: Ethylene-propylene diene monomer.
- B NRS: Non-rising stem.
- C OS&Y: Outside screw and yoke.
- D PTFE: Polytetrafluoroethylene.

1.04 REFERENCE STANDARDS
- A ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B ASME B31.9 - Building Services Piping; 2020.
- C ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- D AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS; 2017.
- E AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.
- F AWWA C606 - Grooved and Shouldered Joints; 2015.
- G FM (AG) - FM Approval Guide; Current Edition.
- H NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2022.
- J UL (DIR) - Online Certifications Directory; Current Edition.
- K UL 262 - Gate Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- L UL 312 - Check Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- M UL 789 - Indicator Posts for Fire-Protection Service; Current Edition, Including All Revisions.
- N UL 1091 - Standard for Butterfly Valves for Fire-Protection Service; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS
- A Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 SUBMITTALS

A See Division 01 - Submittal Procedures.

B Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.07 QUALITY ASSURANCE

A Manufacturer Qualifications:

1. Obtain valves for each valve type from single manufacturer.
2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

B Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.

C Welding Materials and Procedures: Comply with ASME BPVC-IX.

D Qualifications:

1. Company specializing in performing the work of this section with minimum five years documented experience.
2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
3. Complies with manufacturer's certification requirements.
4. Complies with manufacturer's insurance requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads and flange faces.
3. Set valves open to minimize exposure of functional surfaces.

B Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.
   a. Provide temporary inlet and outlet caps.
   b. Maintain caps in place until installation.
2. Store valves in shipping containers and maintain in place until installation.
   a. Store valves indoors and maintain at higher than ambient dew point temperature.
   b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.

C Use the following precautions for handling:

1. Use sling to handle large valves, rigged to avoid damage to exposed parts.
2. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:

1. Main Level: HAMV - Fire Main Equipment.
   a. Level 1: HCBZ - Indicator Posts, Gate Valve.
   b. Level 1: HLOT - Valves.
   c. Level 3: HLUG - Ball Valves, System Control.
   d. Level 3: HLXS - Butterfly Valves.
   e. Level 3: HMER - Check Valves.

f. Level 3: HMRZ - Gate Valves.
2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
a. Level 1: VQGU - Valves, Trim, and Drain.

B FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
1. Automated Sprinkler Systems:
a. Indicator posts.
b. Valves:
1) Gate valves.
2) Single check valves.
3) Miscellaneous valves.

C ASME Compliance:
1. ASME B1.20.1 for threads on threaded-end valves.
2. ASME B31.9 for building services piping valves.

D Comply with AWWA C606 for grooved-end connections.

E Comply with NFPA 13 and NFPA 13R for valves.

F Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.

G Valve Sizes: Same as upstream piping unless otherwise indicated.

H Valve Actuator Types:
1. Worm-gear actuator with handwheel for quarter-turn valves, except trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Hand-lever: For quarter-turn trim and drain valves 2 NPS and smaller.

2.02 TWO-PIECE BALL VALVES WITH INDICATORS

A UL 1091, except with ball instead of disc and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 1112.

B Description:
1. Minimum Pressure Rating: 175 psig.
2. Body Design: Two piece.
3. Body Material: Forged brass or bronze.
4. Port Size: Full or standard.
5. Seat: PTFE.
6. Stem: Bronze or stainless steel.
7. Ball: Chrome-plated brass.
8. Actuator: Worm gear or traveling nut.
9. Supervisory Switch: Internal or external.
10. End Connections for Valves 1 NPS through 2 NPS: Threaded ends.
11. End Connections for Valves 2-1/2 NPS: Grooved ends.

2.03 BRONZE BUTTERFLY VALVES WITH INDICATORS

A Manufacturers:
1. FNW: www.fnw.com.
2. Substitutions: See Division 01 - Product Requirments

B UL 1091 and FM (AG) standard listing for indicating valves, (butterfly or ball type), Class Number 1112.

C Minimum Pressure Rating: 175 psig.

D Body Material: Bronze.

E Seat: EPDM.

F Stem: Bronze or stainless steel.

G Disc: Bronze with EPDM coating.
H Actuator: Worm gear or traveling nut.
I Supervisory Switch: Internal or external.
J End Connections for Valves 1 NPS through 2 NPS: Threaded ends.
K End Connections for Valves 2-1/2 NPS: Grooved ends.

2.04 IRON BUTTERFLY VALVES WITH INDICATORS

A Manufacturers:
1. FNW: www.fnw.com.
2. Kennedy Valve: www.kennedyvalve.com.
3.
B UL 1091 and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 112.
C Minimum Pressure Rating: 175 psig.
D Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
E Seat: EPDM.
F Stem: Stainless steel.
G Disc: Ductile iron, nickel plated.
H Actuator: Worm gear or traveling nut.
I Supervisory Switch: Internal or external.
J Body Design: Grooved-end connections.

2.05 CHECK VALVES

A Manufacturers:
1. FNW: www.fnw.com.
B UL 312 and FM (AG) standard listing for check valves, Class Number 1045.
C AWWA C508 compliant check valves.
D Minimum Pressure Rating: 175 psig.
E Type: Center guided check valve.
F Body Material: Cast iron, ductile iron.
G Center guided check with elastomeric seal.
H Hinge Spring: Stainless steel.
I End Connections: Flanged, grooved, or threaded.

2.06 BRONZE OS&Y GATE VALVES

A Manufacturers:
1. FNW: www.fnw.com.
2. Substitutions: See Division 01 - Product Requirments
B UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
C Minimum Pressure Rating: 175 psig.
D Body and Bonnet Material: Bronze or brass.
E Wedge: One-piece bronze or brass.
F Wedge Seat: Bronze.
G Stem: Bronze or brass.
H Packing: Non-asbestos PTFE.
I Supervisory Switch: External.
J End Connections: Threaded.

2.07 IRON OS&Y GATE VALVES

A Manufacturers:
1. FNW: www.fnw.com.

2. Kennedy Valve; Ken-Seal Series, AWWA Compliant ; Ken-Seal Series, AWWA Compliant: www.kennedyvalve.com.
3. Substitutions: See Division 01 Product Requirements.

B Listed and Body Marked: AWWA C509, FM (AG), and UL 262.
C End Connections: Flanged.
D Maximum Working Pressure: 175 psi.
E Working Temperature: 32 to 175 degrees F.
F Body and Bonnet Material: Cast or ductile iron.
G Wedge: Cast or ductile iron, or bronze with elastomeric coating.
H Stem: Brass, bronze, or stainless steel.
I Packing: Non-asbestos PTFE.
J Supervisory Switch: External.

2.08 NRS GATE VALVES

A Manufacturers:
1. FNW: www.fnw.com.
2. Substitutions: See Division 01 Product Requirements.

B UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
C Minimum Pressure Rating: 175 psig.
D Body and Bonnet Material: Cast or ductile iron.
E Wedge: Cast or ductile iron with elastomeric coating.
F Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
G Stem: Brass or bronze.
H Packing: Non-asbestos PTFE.
I Supervisory Switch: External.
J End Connections: Flanged.

2.09 INDICATOR POSTS

A Manufacturers:
1. Kennedy Valve: www.kennedyvalve.com.
2. Substitutions: See Division 01 Product Requirements.

B UL 789 and FM (AG) standard listing for indicator posts.
C Type: Underground.
D Base Barrel Material: Cast or ductile iron.
E Extension Barrel for Adjustable Length Indicator Posts: Cast or ductile iron.
F Cap: Cast or ductile iron.
G Operation: Wrench.

2.10 TRIM AND DRAIN VALVES

A Ball Valves:
1. Description:
a. Pressure Rating: 175 psig.
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.
d. Port Size: Full or standard.
e. Seat: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Hand-lever.
i. End Connections for Valves 1 NPS through 2-1/2 NPS: Threaded ends.

j. End Connections for Valves 1-1/4 NPS and 2-1/2 NPS: Grooved ends.

B Angle Valves:
1. Description:
a. Pressure Rating: 175 psig.
b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

C Globe Valves:
1. Description:
a. Pressure Rating: 175 psig.
b. Body Material: Bronze with integral seat and screw-in bonnet.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc Holder and Nut: Bronze.
f. Disc Seat: Nitrile.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.01 EXAMINATION
A Confirm valve interior to be free of foreign matter and corrosion.
B Remove packing materials.
C Examine guides and seats by operating valves from the fully open position to the fully closed position.
D Examine valve threads and mating pipe for form and cleanliness.
E Examine mating flange faces for conditions that might cause leakage.
1. Check bolting for proper size, length, and material.
2. Verify gasket for size, defects, damage, and suitable material composition for service.
3. Replace all defective valves with new valves.

3.02 INSTALLATION
A Comply with specific valve installation requirements and application in the following Sections:
1. Section 211300 for application of valves in wet and dry pipe, fire-suppression sprinkler systems.
B Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
1. Install permanent identification signs indicating portion of system controlled by each valve.
C Install check valve in water supply connections and backflow preventer at potable water supply connections.
D Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
E Valves in horizontal piping installed with stem at or above the pipe center.
F Position valves to allow full stem movement.
G Install valve tags. Comply with Section 210553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION 210523

SECTION 210533

HEAT TRACING FOR FIRE SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Self-regulating parallel resistance electric heating cable.

1.02 RELATED REQUIREMENTS
- A Section 210553 - Identification for Fire Suppression Piping and Equipment.
- B Section 210719 - Fire Suppression Piping Insulation.
- C Section 211300 - Fire-Suppression Sprinkler Systems.
- D Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- E Section 260526 - Grounding and Bonding for Electrical Systems.
- F Section 260533.13 - Conduit for Electrical Systems.
- G Section 260533.16 - Boxes for Electrical Systems.
- H Section 260583 - Wiring Connections.
- I Section 284600 - Fire Detection and Alarm.

1.03 REFERENCE STANDARDS
- A IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications; 2022.
- B NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.
- C Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.
- D Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.05 SUBMITTALS
- A See Division 01 - Submittal Procedures.
- B Product Data: Provide data for electric heat tracing.
- C Shop Drawings: Indicate layout, electrical terminations, thermostats, controls, and branch circuit connections.
- D Manufacturer's Installation Instructions: Indicate installation instructions and recommendations.
- E Field Quality Control Submittals: Indicate test reports and inspection reports.
- F Project Record Documents: Record actual locations of electric heat tracing lines and thermostats.
- G Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.
- H Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.
C Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 WARRANTY
A See Division 01 - Closeout Procedures
B Provide two year manufacturer warranty for cables, connection kits, accessories, and controls.

PART 2 PRODUCTS

2.01 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE
A Manufacturers:
1. Chromalox, Inc: www.chromalox.com.
2. Pentair: www.pentairthermal.com.
3. Thermon Manufacturing Company: www.thermon.com.
4. Raychem:
5. Substitutions: See Division 01 Product Requirements.
B Provide products listed, classified, and labeled by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction (AHJ) specifically for use on branch sprinkler lines in accordance with NFPA 13.
C Factory Rating and Testing: Comply with IEEE 515.1.
D Heating Element:
1. Provide pair of parallel No. 16 tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
3. Capable of crossing over itself without overheating.
E Insulated Jacket: Flame retardant polyolefin.
F Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.
G Maximum Power-On Operating Temperature: 150 degrees F.
H Maximum Power-Off Exposure Temperature: 185 degrees F.
I Electrical Characteristics:
1. Refer to Section 260583.

2.02 CABLE OUTER JACKET MARKINGS
A Name of manufacturer, trademark, or other recognized symbol of identification.
B Catalog number, reference number, or model.
C Month and year of manufacture, date coding, applicable serial number, or equivalent.
D Agency listing or approval.
E Applicable environmental or area use requirements, such as NEMA 4, Type 4, IP ratings, and hazardous (classified) location markings including temperature rating.
F Any applicable warning/caution statements such as "WARNING: De-energize circuit before removing cover.

2.03 CONNECTION KITS
A Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.
B Furnish with NEMA 4X rating for prevention of corrosion and water ingress.
C Provide UV stabilized components.

2.04 ACCESSORIES

A Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:

1. High temperature, glass filament tape for attachment of heating cable to metal piping.
2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
3. Heat-conductive putty.
4. Cable ties.
5. Silicone end seals and splice kits.
6. Installation clips.
7. Warning labels for attachment to exterior of piping insulation. Refer to Section 220553.

2.05 CONTROLS

A Pipe Mounted Thermostats:

1. Remote bulb unit with adjustable temperature range from 30 to 50 degrees F.
2. Snap-action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable.
3. Remote bulb on capillary, resistance temperature device (RTD) or thermistor for direct sensing of pipe wall temperature.
4. Control Enclosure: Corrosion resistant and waterproof.

B Multiple pipe segments may be controlled by a single controller using ambient control.

C Provide minimum 30 ampere contactor to indicate operational status and on/off control.

D Furnish the following alarms with contacts for remote alarm for each fire sprinkler line tracing circuit:

1. Low-Temperature Alarm: 35.6 degrees F set-point.
2. High-Temperature Alarm: 100.4 to 109.4 degrees F set-point.

E Programmable Controller:

1. Micro-processor based.
2. Capable of four separate schedules.
3. On/Off/Auto switch.
4. 365 day calendar with 20 programmable holidays.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that piping and equipment are ready to receive work.

B Verify field measurements are as indicated on shop drawings.

C Verify required power is available, in proper location, and ready for use.

3.02 PREPARATION

A Clean all surfaces prior to installation.

B Prepare surfaces using the methods recommended by the manufacturer.

3.03 INSTALLATION

A Install in accordance with manufacturer's recommendations.

B Comply with installation requirements of IEEE 515.1, NFPA 70, Article 427, and applicable requirements of NFPA 13.

C Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.

D Comply with applicable local code requirements.

E Grounding: Refer to Section 260526.

F Identification:

1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft including cladding over each valve or other equipment that may require maintenance.
2. Refer to Section 210553.

G Electronic Supervision:
1. Provide positive confirmation that circuit is energized in accordance with the requirements of NFPA 13.
2. Refer to Section 284600.

H Equipment Wiring: Refer to Section 260583.

I Electrical Connections: Refer to Section 260519.

3.04 FIELD QUALITY CONTROL

A See Division 01 - Quality Requirements for additional requirements.

B Perform start-up by factory technician or factory representative in accordance with Owner's requirements.

C Field Testing and Inspections:
1. Commission system in accordance with installation and operation manual.
2. Inspect for sources of water entry and proper sealing.
3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
4. Verify that thermal insulation around the sprinkler heads is in accordance with manufacturer's instructions and does not impede the water pattern emitted by the sprinkler head.
5. Insulation Resistance: 20 megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
6. Test heating cable integrity with megohmmeter at the following intervals:
   a. Before installing the cable.
   b. After cable has been installed onto the piping.
   c. After installing the connection kits.
   d. After the installation of thermal insulation onto the piping.
   e. Prior to initial start-up (commissioning).
7. Measure voltage and current at each unit.
8. Controls:
   a. Verify control parameters are set to the application requirements.
   b. Verify alarm contacts are correctly connected to the fire alarm panel.
   c. Verify factory provided digital temperature controller is correctly configured with the building automation system.
9. Submit written test report showing values measured on each test for each cable.

3.05 CLOSEOUT ACTIVITIES

A See Division 01 - Closeout Procedures.

B See Division 01 - Demonstration and Training, for additional requirements.

C Demonstrate operation of controls.

3.06 PROTECTION

A Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 210533

SECTION 210548

VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Vibration isolation requirements.
- B Vibration isolators.

1.02 RELATED REQUIREMENTS
- A See Division 03 - Cast-in-Place Concrete.
- B See Division 05 - Metal Fabrication: Materials and requirements for fabricated metal supports.

1.03 REFERENCE STANDARDS
- A ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- B ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
  2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  4. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B Sequencing:
  1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03.

1.05 SUBMITTALS
- A See Division 01 - Submittal Procedures.
- B Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
- D Shop Drawings - Vibration Isolation Systems:
  1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
- E Shop Drawings - Seismic Controls:
  1. Include dimensioned plan views and sections indicating proposed fire suppression component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
  2. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  3. Indicate proposed arrangement of distributed system trapeze support groupings.

4. Indicate proposed locations for distributed system flexible fittings and/or connections.
5. Indicate locations of seismic separations where applicable.
6. Include point load drawings indicating design loads transmitted to structure at each attachment location.

F Certification for seismically qualified equipment; identify basis for certification.

G Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

H Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I Evidence of qualifications for manufacturer.

J Manufacturer's detailed field testing and inspection procedures.

K Field quality control test reports.

1.06 QUALITY ASSURANCE

A Comply with applicable building code.

B Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.

1. Designer may be employed by the manufacturer of the seismic restraint products.

D Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing fire suppression equipment.

B Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C General Requirements:

1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.

D Piping Isolation:

1. Use flexible piping connections to vibration-isolated equipment.

2.02 VIBRATION ISOLATORS

A Manufacturers:

1. Vibration Isolators:
   a. Kinetics Noise Control, Inc: www.kineticsnoise.com.
   b. Mason Industries: www.mason-ind.com.
   c. Vibration Eliminator Company, Inc: www.veco-nyc.com.

d. Substitutions: See Division 01 Product Requirements.

2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
   a. Color code or otherwise identify springs to indicate load capacity.
   b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
   c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
   d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
   e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
   f. Selected to function without undue stress or overloading.

C Vibration Isolators for Nonseismic Applications:

1. Resilient Material Isolator Pads:
   a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
   b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
   c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Resilient Material Isolator Mounts, Nonseismic:
   a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
   b. Products:
      1) Substitutions: See Division 01 Product Requirements.
3. Open (Unhoused) Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
   b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
4. Housed Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
   b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
   c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
   d. Furnished with integral leveling device for positioning and securing supported equipment.
5. Restrained Spring Isolators, Nonseismic:

a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
b. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
c. Furnished with integral leveling device for positioning and securing supported equipment.
d. Provides constant free and operating height.

6. Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
7. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as shown on the drawings.
B Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.
B Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
C Secure fasteners according to manufacturer's recommended torque settings.
D Field-Welding (where approved by Architect/Engineer): Comply with Division 05.
E Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
F Vibration Isolation Systems:
   1. Spring Isolators:
      a. Position equipment at operating height; provide temporary blocking as required.
      b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
      c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
   2. Isolator Hangers:
      a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
      b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.

3. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
4. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
5. Adjust isolators to be free of isolation short circuits during normal operation.
6. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

A See Division 01 - Quality Requirements for additional requirements.

B Inspect vibration isolation and/or seismic control components for damage and defects.

C Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.

D Vibration Isolation Systems:
1. Verify isolator static deflections.
2. Verify required clearance beneath vibration-isolated equipment support bases.
3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

F Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 210548

SECTION 210553

IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Nameplates.
- B Tags.
- C Stencils.
- D Pipe markers.
- E Ceiling tacks.

1.02 RELATED REQUIREMENTS
- A See Division 09 - Interior Painting: Stencil paint.

1.03 REFERENCE STANDARDS
- A ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS
- A See Division 01 - Submittal Procedures.
- B List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D Product Data: Provide manufacturers catalog literature for each product required.
- E Samples: Submit two labels each in size.
- F Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- G Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS
- A Automatic Controls: Tags.
- B Control Panels: Nameplates.
- C Instrumentation: Tags.
- D Major Control Components: Nameplates.
- E Piping: Tags.
- F Pumps: Nameplates.
- G Relays: Tags.
- H Small-sized Equipment: Tags.
- I Thermostats: Nameplates.
- J Valves: Nameplates and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES
- A Manufacturers:
  1. Brimar Industries, Inc: www.pipemarker.com.
  2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
  3. Seton Identification Products, a Tricor Direct Company: www.seton.com.
  4. Substitutions: See Division 01 for Product Requirements.
- B Description: Laminated three-layer plastic with engraved letters.
  1. Letter Color: White.
  2. Letter Height: 1/4 inch.

3. Background Color: Black.
4. Thickness: 1/8 inch.
5. Plastic: Comply with ASTM D709.

2.03 TAGS

A Manufacturers:
1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com.
2. Brady Corporation: www.bradycorp.com.
3. Brimar Industries, Inc: www.pipemarker.com.
4. Craftmark Pipe Markers: www.craftmarkid.com.
5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
6. Seton Identification Products, a Tricor Direct Company: www.seton.com.
7. Substitutions: See Division 01 for Product Requirements.

B Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

A Manufacturers:
1. Brady Corporation: www.bradycorp.com.
2. Craftmark Pipe Markers: www.craftmarkid.com.
3. Insite Solutions, LLC: www.stop-painting.com.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
5. Seton Identification Products, a Tricor Direct Company: www.seton.com.
6. Substitutions: See Division 01 for Product Requirements.

B Stencils: With clean cut symbols and letters of following size:
1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
6. Equipment: 2-1/2 inch high letters.

C Paint for Stencils: As specified in Division 09, semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE MARKERS

A Manufacturers:
1. Brady Corporation: www.bradycorp.com.
2. Brimar Industries, Inc: www.pipemarker.com.
3. Craftmark Pipe Markers: www.craftmarkid.com.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
5. Seton Identification Products, a Tricor Company: www.seton.com.
6. Substitutions: See Division 01 for Product Requirements.

B Color: Comply with ASME A13.1.

C Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

E Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

F Color code as follows:

1. Fire Quenching Fluids: Red with white letters.

2.06 CEILING TACKS

A Manufacturers:

1. Craftmark Pipe Markers: www.craftmarkid.com.
2. Substitutions: See Division 01 for Product Requirements.

B Description: Steel with 3/4 inch diameter color coded head.

C Color code as follows:

PART 3 EXECUTION

3.01 PREPARATION

A Degrease and clean surfaces to receive adhesive for identification materials.

B Prepare surfaces in accordance with Division 09 for stencil painting.

3.02 INSTALLATION

A Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B Install tags with corrosion resistant chain.

C Apply stencil painting in accordance with Division 09.

D Install plastic pipe markers in accordance with manufacturer's instructions.

E Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G Use tags on piping 3/4 inch diameter and smaller.

1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

H Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 210553

SECTION 210719

FIRE SUPPRESSION PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Piping insulation.
- B Jacketing and accessories.

1.02 RELATED REQUIREMENTS
- A See Division 09 - Interior Painting: Painting insulation jacket.

1.03 REFERENCE STANDARDS
- A ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- D ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- E ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- F ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- G ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- H ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- I ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- J ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- K ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.
- L ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.
- M ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2022.
- N ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- O ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- P ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
- Q ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- R ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- S ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
- T ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.

U ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
V ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
W SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
X UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A See Division 01 - Submittal Procedures.
B Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
C Samples: Submit two samples of any representative size illustrating each insulation type.
D Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE
A Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
B Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING
A Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS
A Maintain ambient conditions required by manufacturers of each product.
B Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS
A Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER
A Manufacturers:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville Corporation: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com.
4. Owens Corning Corporation: www.ocbuildingspec.com.
5. Substitutions: See Division 01 - Product Requirements

B Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 650 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

D Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm inch.
E Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
F Vapor Barrier Lap Adhesive: Compatible with insulation.
G Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
H Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Blanket: 1.0 pcf density.
3. Weave: 5 by 5.
I Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Vinyl emulsion type acrylic, compatible with insulation, black color.
J Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
K Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
L Insulating Cement: ASTM C449.

2.03 CELLULAR GLASS
A Manufacturers:
1. Owens Corning Corporation: www.ocbuildingspec.com.
2. Substitutions: See Division 01 Product Requirements.
B Pipe and Tube Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F.
2. Service Temperature Range: From minus 450 degrees F to 800 degrees F.
3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.

2.04 EXPANDED POLYSTYRENE
A Insulation: ASTM C578; rigid closed cell.
1. K Value: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 165 degrees F.
3. Maximum Water Vapor Permeance: 5.0 perm inch.

2.05 EXPANDED PERLITE
A Manufacturers:
1. Schundler Company: www.schundler.com.
2. Substitutions: See Division 01 Product Requirements.
B Insulation: ASTM C610, molded.
1. Maximum Service Temperature: 1,200 degrees F.
2. Maximum Water Vapor Transmission: 0.1 perm.

2.06 HYDROUS CALCIUM SILICATE
A Manufacturers:
1. Johns Manville Corporation: www.jm.com.
2. Substitutions: See Division 01 Product Requirements.
B Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
1. K Value: ASTM C177 and ASTM C518; 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1,200 degrees F.
3. Density: 15 pcf.
C Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D Insulating Cement: ASTM C449.

2.07 POLYISOCYANURATE CELLULAR PLASTIC

A Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
1. Dimension: Comply with requirements of ASTM C585.
2. K Value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
3. Minimum Service Temperature: Minus 70 degrees F.
4. Maximum Service Temperature: 300 degrees F.
5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842.
6. Moisture Vapor Transmission: 4.0 perm inch.
7. Connection: Waterproof vapor barrier adhesive.

2.08 POLYETHYLENE

A Manufacturers:
1. Armacell LLC: www.armacell.us.
2. Substitutions: See Division 01 Product Requirements.

B Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
1. K Value: ASTM C177; 0.25 at 75 degrees F.
2. Maximum Service Temperature: 200 degrees F.
3. Density: 2 pcf.
4. Maximum Moisture Absorption: 1.0 percent by volume.
5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
6. Connection: Contact adhesive.

2.09 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A Manufacturers:
1. Armacell LLC: www.armacell.us.
2. K-Flex USA LLC: www.kflexusa.com.
3. Substitutions: See Division 01 - Product Requirements

B Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M, Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.10 JACKETING AND ACCESSORIES

A PVC Plastic.
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com.
b. Substitutions: See Division 01 Product Requirements.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.

B ABS Plastic:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a. Minimum Service Temperature: Minus 40 degrees F.
   b. Maximum Service Temperature of 180 degrees F.
   c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
   d. Thickness: 30 mil.
   e. Connections: Brush on welding adhesive.

C Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
1. Lagging Adhesive: Compatible with insulation.

D Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
2. Thickness: 0.016 inch sheet.
3. Finish: Smooth.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

E Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

F Aluminum-Foil Laminate Jacket:
1. Manufacturers:
   a. H.B. Fuller Construction Products, Inc: www.fosterproducts.com.
   b. Ideal Tape Co., Inc: www.idealtape.com.
   c. Substitutions: See Division 01 Product Requirements.
2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
3. Finish: Aluminum smooth.
4. Comply with ASTM C1775.

G Reinforced Tape:
1. Manufacturers:
   a. Ideal Tape Co., Inc: www.idealtape.com.
   b. Substitutions: See Division 01 Product Requirements.
2. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
3. Comply with UL 723 or ASTM E84.
4. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
5. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that piping has been tested before applying insulation materials.

B Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install in accordance with NAIMA National Insulation Standards.

C Exposed Piping: Locate insulation and cover seams in least visible locations.

D Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Division 07.

K Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

L Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

M Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

N Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

END OF SECTION 210719

SECTION 211300

FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Wet-pipe sprinkler system.
- B System design, installation, and certification.
- C Fire department connections.

1.02 RELATED REQUIREMENTS
- A Section 210500 - Common Work Results for Fire Suppression: Pipe and fittings.
- B Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- C Section 210553 - Identification for Fire Suppression Piping and Equipment.

1.03 REFERENCE STANDARDS
- A FM (AG) - FM Approval Guide; Current Edition.
- B ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- C ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- D ITS (DIR) - Directory of Listed Products; Current Edition.
- E NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F NFPA 1963 - Standard for Fire Hose Connections; 2019.
- G UL (DIR) - Online Certifications Directory; Current Edition.
- H UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS
- A See Division 01 - Submittal Procedures.
- B Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C Shop Drawings:
  1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
  2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
  3. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect/Engineer.
- D Samples: Submit two of each style of sprinkler specified.
- E Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- F Designer's qualification statement.
- G Manufacturer's qualification statement.
- H Installer's qualification statement.

I Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

J Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
2. Sprinkler Wrenches: For each sprinkler type.

K Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.06 QUALITY ASSURANCE

A Maintain one copy of referenced design and installation standard on site.

B Comply with FM (AG) requirements.

C Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

D Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

E Installer Qualifications: Company specializing in performing the work of this section with minimum Five years experience and approved by manufacturer.

F Equipment and Components: Provide products that bear FM (AG) label or marking.

G Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A Sprinklers, Valves, and Equipment:
1. Anvil International: www.anvilintl.com/#sle.
2. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
3. Viking Corporation: www.vikinggroupinc.com/#sle.
4. Substitutions: See Division 01 Product Requirements.

2.02 SPRINKLER SYSTEM

A Sprinkler System: Provide coverage for entire building unless otherwise noted.

B Occupancy: Light hazard; comply with NFPA 13.

C Water Supply: Determine volume and pressure from water flow test data.

D Interface system with building control system.

E Provide fire department connections where indicated.

F Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

G Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
6. Other Types: As required.
7. Manufacturers:
   a. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.

b. Powers Fasteners, Inc www.powers.com/#sle.
c. Substitutions: See Division 01 Product Requirements.

2.03 SPRINKLERS

A Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
1. Response Type: Quick.
2. Coverage Type: Standard.
3. Finish: Chrome plated.
4. Escutcheon Plate Finish: Antique Brass.
5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
6. Manufacturers:
a. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
b. Viking Company.
c. Victaulic Company.
d. Substitutions: See Division 01 Product Requirements.

B Suspended Ceiling Type: Concealed pendant type with matching push on escutcheon plate.
1. Finish: Enamel, color as selected.
2. Cover Plate Finish: Enamel, color Match Pendant.
3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
4. Manufacturers:
a. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
b. Viking Company.
c. Victaulic Company.
d. Substitutions: See Division 01 Product Requirements.

C Exposed Area Type: Pendant type with guard.
1. Response Type: Quick.
2. Coverage Type: Standard.
3. Finish: Chrome plated.
4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
5. Manufacturers:
a. Tyco Fire Protection Products
b. Viking Company
c. Victaulic Company
d. Substitutions: See Division 01 Product Requirements.

D Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
1. Response Type: Quick.
2. Coverage Type: Standard.
3. Finish: Chrome plated.
4. Escutcheon Plate Finish: Chrome plated.
5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
6. Manufacturers:
a. Tyco Fire Protection Products
b. Viking Company
c. Victaulic Company
d. Substitutions: See Division 01 - Product Requirements

E Dry Sprinklers: Concealed pendant type with matching push on escutcheon plate.
1. Response Type: Quick.
2. Coverage Type: Standard.

3. Finish: Chrome plated.
4. Cover Plate Finish: Chrome plated.
5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
6. Manufacturers:
   a. Tyco Fire Protection Products
   b. Viking Company
   c. Victaulic Company
   d. Substitutions: See Division 01 Product Requirements.

F Storage Sprinklers: Pendant type with guard.
1. Response Type: Standard.
2. Coverage Type: Standard.
3. Finish: Chrome plated.
4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
5. Manufacturers:
   a. Tyco Fire Protection Products
   b. Viking Company
   c. Victaulic Company
   d. Substitutions: See Division 01 Product Requirements.

G Guards: Finish to match sprinkler finish.

H Spray Nozzles: Brass with solid cone discharge, 30 degrees of arc with blow-off dust cap.
1. Finish: Nickel.
2. Manufacturers:
   a. Tyco Fire Protection Products
   b. Viking Company
   c. Victaulic Company
   d. Substitutions: See Division 01 Product Requirements.

I Flexible Drop System: Stainless steel, multiple use, open gate type.
1. Application: Use to properly locate sprinkler heads.
2. Include all supports and bracing.
3. Provide braided type tube as required for the application.
4. Manufacturers:
   a. FlexHead Industries, a brand of Anvil International: www.anvilintl.com/#sle.
   b. Victaulic Company; Vic-Flex: www.victaulic.com/#sle.
   c. Substitutions: See Division 01 Product Requirements.

2.04 PIPING SPECIALTIES

A Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
1. Activate electric alarm.
2. Test and drain valve.
3. Replaceable internal components without removing valve from installed position.
4. Manufacturers:
   a. Victaulic Company: www.victaulic.com/#sle.
   b. Tyco Fire Protection Products
   c. Viking Company
   d. Substitutions: See Division 01 Product Requirements.

B Backflow Preventer: Reduced pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.

C Test Connections:

1. Inspector's Test Connection for Preaction Systems:
   a. Provide test connections approximately 6 ft above floor for each or portion of each sprinkler system equipped with an alarm device, located at the most remote part of each system.
   b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
   c. Supply discharge orifice with same size as corresponding sprinkler orifice.
   d. Limit vertical height of exterior wall penetration to 2 ft above finished grade.
2. Backflow Preventer Test Connection:
   a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch National Standard male hose threads with cap and chain.
   b. Furnish one valve for each 250 gpm of system demand or fraction thereof.
   c. Provide permanent sign reading "Test Valve" in accordance with Section 210553.
   d. Manufacturers:
      1) AFG Manufacturing: agfmfg.com.
      2) Substitutions: See Division 01 - Product Requirements

D Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.

E Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.

F Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

G Fire Department Connections:
1. Type: Free standing made of corrosion resistant metal complying with UL 405.
   a. Inlets: Two way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
   b. Outlet: Bottom with pipe threads, 4 NPS.
   c. Rated Working Pressure: 175 psi.
   d. Finish: Chrome.
   e. Sleeve: Brass, 18 inches height.
   f. Signage: Raised or engraved lettering 1 inch minimum indicating system type.
   g. Manufacturers:
      1) Elkhart Brass Manufacturing Company, Inc: www.elkhartbrass.com/#sle.
      2) Fire End & Croker Corporation: www.croker.com/#sle.
      3) Substitutions: See Division 01 Product Requirements.

H Supervisory Switches:
1. Manufacturers:
   a. Potter Electric Signal Company, LLC; CoilKeeper Solenoid Supervisory Switch: www.pottersignal.com/#sle.
   b. Substitutions: See Division 01 Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with referenced NFPA design and installation standard.

B Install equipment in accordance with manufacturer's instructions.

C Install buried shut-off valves in valve box. Provide post indicator.

D Provide approved double check valve assembly at sprinkler system water source connection.

E Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

F Locate outside alarm gong on building wall as indicated.
G Place pipe runs to minimize obstruction to other work.
H Place piping in concealed spaces above finished ceilings.
I Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
J Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
K Flush entire piping system of foreign matter.
L Install guards on sprinklers where indicated.
M Hydrostatically test entire system.
N Require test be witnessed by Fire Marshal.

3.02 INTERFACE WITH OTHER PRODUCTS

A Ensure required devices are installed and connected as required to fire alarm system.

3.03 SCHEDULES

A System Hazard Areas:
1. Offices: Light Hazard.
2. Warehouse: Ordinary Hazard, Group 2.
3. Computer Room: Light Hazard, Preaction.

B The building shall be protected using sprinkler systems meeting NFPA 13 requirements as follows:
1. Gaming Areas, Public Spaces, and Back of House Areas (Wet)
2. MDF, Surveillance Areas, PBX and UPS room(s) (FM 200)
3. Diesel Generator Rooms (Dry)
4. All unheated Areas (Dry)
5. Food Service Coolers and Freesers (Non-Freeze Pendant)

END OF SECTION 211300

SECTION 220516

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Flexible pipe connectors.
- B Expansion joints and compensators.
- C Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS
- A Section 210500 - Common Work Results for Fire Suppression.
- B Section 221005 - Plumbing Piping.

1.03 REFERENCE STANDARDS
- A ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- B EJMA (STDS) - EJMA Standards; Tenth Edition.
- C FM (AG) - FM Approval Guide; Current Edition.
- D ITS (DIR) - Directory of Listed Products; Current Edition.
- E UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS
- A Refer to Division 01 Submittal Procedures.
- B Product Data:
  1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C Samples: Submit two low pressure compensators 3/4 inch in size.
- D Design Data: Indicate selection calculations.
- E Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- F Maintenance Data: Include adjustment instructions.
- G Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- H Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. Refer to Division 01 for additional provisions.
  2. Extra Packing for Packed Expansion Joints: One set for each joint.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS
- A Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING
- A Manufacturers:
  1. Flex-Weld, Inc: www.kelcoind.com.
  2. Mercer Rubber Company: www.mercer-rubber.com.
  3. The Metraflex Company: www.metraflex.com.
  4. Unisource Manufacturing, Inc: www.unisource-mfg.com.
  5. Substitutions: See Division 01 for Product Requirements.

B Inner Hose: Stainless steel.
C Exterior Sleeve: Single braided, stainless steel.
D Pressure Rating: 125 psi up to 12 inch.
E Maximum Service Temperature: 450 degrees F.
F End Connections: Threaded.
G Size: Use pipe sized units.
H Maximum offset: 3/4 inch on each side of installed center line.

2.03 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com.
2. Mercer Rubber Company: www.mercer-rubber.com.
3. The Metraflex Company: www.metraflex.com.
4. Unisource Manufacturing, Inc: www.unisource-mfg.com.
5. Substitutions: See Division 01 for Product Requirements
B Inner Hose: Bronze.
C Exterior Sleeve: Braided bronze.
D Pressure Rating: 125 psi up to 2 inch.
E Maximum Service Temperature: 450 degrees F.
F End Connections: Flanged.
G Size: Use pipe sized units.
H Maximum offset: 3/4 inch on each side of installed center line.
I Application: Copper piping.

2.04 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

A Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com.
2. Mercer Rubber Company: www.mercer-rubber.com.
3. Substitutions: See Division 01 for Product Requirements.
B Pressure Rating: 125 psi and 400 degrees F.
C Maximum Compression: 1-3/4 inches.
D Maximum Extension: 1/4 inch.
E Joint Type: Externally pressurized with flanged ends.
F Size: Use pipe sized units.
G Application: Steel piping 4 inches and under.

2.05 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

A Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com.
2. Substitutions: See Division 01 for Product Requirements.
B Pressure Rating: 125 psi and 400 degrees F.
C Maximum Compression: 15/16 inch.
D Maximum Extension: 5/16 inch.
E Maximum Offset: 1/8 inch.
F End Connections: Flanged.
G Size: Use pipe sized units.
H Accessories: Internal flow liner.
I Application: Steel piping over 2 inches.

2.06 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE CONNECTOR

A Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com.

2. The Metraflex Company: www.metraflex.com.
3. Unisource Manufacturing, Inc: www.unisource-mfg.com.
4. Substitutions: See Division 01 for Product Requirements.

B Body Construction: Nylon-reinforced rubber tube.
C End Connections: Carbon steel flanges.
D Cover and Tube Elastomer: EPDM and EPDM.
E Maximum Compression: 1/2 inch.
F Maximum Elongation: 3/8 inch.
G Maximum Offset: 3/8 inch.
H Maximum Angular Movement: 15 degrees.
I Accessories: Control rods.
J Service Rating: Up to 35 psi at 220 degrees F.

2.07 EXPANSION JOINTS - TWO-PLY BRONZE BELLOWS TYPE

A Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com.
2. Substitutions: See Division 01 for Product Requirements.

B Construction: Bronze with anti-torque device, limit stops, internal guides.
C Pressure Rating: 125 psi and 400 degrees F.
D Maximum Compression: 1-3/4 inches.
E Maximum Extension: 1/4 inch.
F Joint: Soldered.
G Size: Use pipe sized units.
H Application: Copper piping.

2.08 EXPANSION JOINTS - COMPENSATORS

A Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com.
2. Unisource Manufacturing, Inc; Series 416, Expansion Compensators: www.unisource-mfg.com.
3. Substitutions: See Division 01 Product Requirements.

B Type: Two-ply 304 stainless steel bellows with carbon steel shroud.
C Maximum Working Pressure: 200 psi.
D Maximum Working Temperature: 400 degrees F.
E Maximum Compression: 1/2 inch.
F Maximum Extension: 5/32 inch.
G End Connections: Female copper sweat.
H Application: Copper piping up to 3 inches in size or steel piping up to 4 inches in size.

2.09 EXPANSION JOINTS - STEEL WITH PACKED SLIDING SLEEVE

A Working Pressure and Temperature: Class 150.
B End Connections: Flanged.
C Size: Use pipe sized units.
D Application: Steel piping 2 inches and over.

2.10 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

A Working Pressure: 125 psi.
B Maximum Temperature: 250 degrees F.
C End Connections: Flanged.
D Size: Use pipe sized units.
E Application: Copper or steel piping 2 inches and over.

2.11 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

A Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com.
2. The Metraflex Company: www.metraflex.com.
3. Unisource Manufacturing, Inc: www.unisource-mfg.com.
4. Substitutions: See Division 01 Product Requirements.

B Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.

C Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure.

D Maximum Working Pressure: 150 psi at 800 degrees F.

E Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment.
1. Selected Product to Accommodate:
a. Angular Rotation: 15 degrees.
b. Force developed by 1.5 times specified maximum allowable operating pressure.
2. Provide necessary accessories including, but not limited to, swivel joints.

2.12 EXPANSION JOINTS - EXTERNALLY PRESSURIZED

A Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com.
2. The Metraflex Company: www.metraflex.com.
3. Unisource Manufacturing, Inc: www.unisource-mfg.com.
4. Substitutions: See Division 01 Product Requirements.

B Bellows Type: Two-ply, single bellows constructed of 304 stainless steel.

C Internal Liner: Carbon steel with internal and external guides.

D Specialty: Carbon steel anchor base, lifting lugs, and drain port with tapered plug.

E End Connections: Class 150, carbon steel, welded flange.

F Maximum Axial Compression: 4 inches.

G Maximum Working Pressure: 150 psi at 700 degrees F.

H Application: Steel piping 2 inches and over.

2.13 ACCESSORIES

A Stainless Steel Pipe: ASTM A269/A269M, seamless type, Grade TP304.

B Pipe Alignment Guides:
1. Manufacturers:
a. Flex-Weld, Inc: www.kelcoind.com.
b. The Metraflex Company: www.metraflex.com.
c. Substitutions: See Division 01 Product Requirements.
2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

C Swivel Joints:
1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

G Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION 220516

SECTION 220517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Pipe sleeves.
- B Pipe sleeve-seals.

1.02 RELATED REQUIREMENTS
- A Refer to Division 09 for additional requirements for painting.

1.03 REFERENCE STANDARDS
- A ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C FM (AG) - FM Approval Guide; Current Edition.
- D UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS
- A See Division 01 - Submittal Procedures
- B Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. Refer to Division 01 for additional requirements.
  2. Extra Valve Stem Packings: Two for each type and size of valve.

1.05 QUALITY ASSURANCE
- A Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B Installer Qualifications: Company specializing in performing work of the type specified this section.
  1. Minimum three years experience.
  2. Approved by manufacturer.
- C Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING
- A Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY
- A Refer to Division 01 - Closeout Procedure for additional requirements.
- B Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES
- A Manufacturers:
  1. Flexicraft Industries: www.flexicraft.com.
  2. Substitutions: See Division 01 Product Requirements.
- B Vertical Piping:
  1. Sleeve Length: 1 inch above finished floor.
  2. Provide sealant for watertight joint.

3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

C Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

D Pipe Passing Through Below Grade Exterior Walls:
1. Zinc coated or cast iron pipe.
2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

E Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
2. Connect sleeve with floor plate except in mechanical rooms.

F Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
2. Connect sleeve with floor plate except in mechanical rooms.

G Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect/Engineer.

H Clearances:
1. Provide allowance for insulated piping.
2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

A Manufacturers:
1. Advance Products & Systems, LLC: www.apsonline.com.
2. American Polywater Corporation: www.polywater-haufftechnik.com.
3. Flexicraft Industries: www.flexicraft.com.
4. Link Seal: www.garlock.com
5. Substitutions: See Division 01 - Product Requirements.

B Modular Mechanical Sleeve-Seal:
1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Service Requirements:
   a. Corrosion resistant.
   b. Oil, fuel, gas, and solvent resistant.
   c. Underground, buried, and wet conditions.
   d. Fire Resistant: 1 hour, UL (DIR) approved.
   e. High Temperature, up to 400 degrees F.
   f. Low temperature, down to minus 67 degrees F.
5. Glass-reinforced plastic pressure end plates.
6. Sealing Compounds:
   a. Provide packing and sealing compound to fill pipe to sleeve thickness.
   b. Combined packing and sealing compounding to match partition fire-resistance hourly rating.
7. Pipe Sleeve Material:

a. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
b. Masonry Structures: Sheet metal or fiber.

8. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.
9. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch thick.
10. Pipeline-Casing Seals:
    a. Coated boltless casing-spacer for 4 inch carrier pipe.
    b. Coated boltless modular seal for 6 inch carrier pipe.
    c. Carbon steel band with risers for 12 inch carrier pipe.
    d. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.01 PREPARATION

A Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
B Install piping to conserve building space, to not interfere with use of space and other work.
C Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
D Inserts:
    1. Provide inserts for placement in concrete formwork.
    2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
    3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
    4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
    5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
E Structural Considerations: Do not penetrate building structural members unless indicated.
F Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
    1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
    2. Aboveground Piping:
        a. Pack solid using mineral fiber complying with ASTM C592.
        b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
    3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.
    4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
G Manufactured Sleeve-Seal Systems:
    1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
    2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
    3. Locate piping in center of sleeve or penetration.
    4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.

5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

H When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

A Upon completion of work, clean all parts of the installation.

B Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

C Refer to Division 01 for additional requirements.

END OF SECTION 220517

SECTION 220519

METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Flow meters.
- B Pressure gauges.
- C Manometers.
- D Thermometers.
- E Pressure-temperature test plugs.

1.02 REFERENCE STANDARDS
- A ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2017).
- C ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- D ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- E AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters; 2022.
- F AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- G FM (AG) - FM Approval Guide; Current Edition.
- H UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- I UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS
- A Utility Service Metering: Coordinate and apply Utility Service Provider requirements in terms of meter type, size, physical location, pipe size, upstream/downstream pipe lengths required, and other installation details.

1.04 SUBMITTALS
- A See Division 01 - Submittal Procedures.
- B Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.
- C Project Record Documents: Record actual locations of components and instrumentation.
- D Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Division 01 for additional provisions.
  2. Extra Gauge Oil for Inclined Manometers: One bottle.
  3. Extra Pressure Gauges: One of each type and size.

PART 2 PRODUCTS

2.01 FLOWMETERS
- A Manufacturers:
  1. Dwyer Instruments, Inc: www.dwyer-inst.com.
  2. McCrometer, Inc: www.mccrometer.com.
  3. Omega Engineering a subsidiary of Spectris, Plc: www.omega.com.
  4. VWR International, LLC: us.vwr.com.
  5. Substitutions: See Division 01 Product Requirements.

B In-Line Monitor:
1. Material: Borosilicate glass.
2. Accuracy: Plus or minus five percent full scale.
3. Provide 10-point NIST Calibration Certificate.
4. Flow: Water, flow-range as indicated on drawings.
5. Connection Size: 1 inch NPT female.
6. Maximum Service Pressure: 200 psi.
7. Maximum Service Temperature: 100 degrees F.
8. Range marks to bear metric and English (dual) scale with gpm units.

C Flow Sensing Element.
1. In-Line Averaging Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
   a. Pressure rating: 275 psi.
   b. Maximum temperature: 400 degrees F.
   c. Accuracy: Plus 0.55 percent to minus 2.30 percent.
2. Venturi Fitting with Built-in Orifice Plate: Calibrated ASME MFC-3M venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.

2.02 PRESSURE GAUGES

A Manufacturers:
1. Ashcroft, Inc: www.ashcroft.com.
2. Dwyer Instruments, Inc: www.dwyer-inst.com.
3. Moeller Instrument Company, Inc: www.moellerinstrument.com.
4. Omega Engineering a subsidiary of Spectris,: www.omega.com.
5. Weksler Glass Thermometer Corp: www.wekslerglass.com.
6. Substitutions: See Division 01 Product Requirements.

B Bourdon Tube for Liquids and Gases:
1. Dial Size and Cover: 4-1/2 inch diameter scale with polycarbonate window.
2. Dial Text and Markings: Black color on white background with scaled kPa and psi units.
3. Accuracy: ASME B40.100, adjustable commercial grade (D) with 5 percent of span.
4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.
5. Gauge Wetted Materials: Painted steel case and brass socket rated to match process pressure and temperature range.
6. Comply with UL 393 when used for fire protection service or UL 404 when used for compressed gas service.

C Diaphragm Actuated for Gases:
1. Dial Size and Cover: 3-1/2 inch diameter scale with polycarbonate window.
2. Dial Text and Markings: Black color on white background with scaled cm (cm wg) and inch (in wg) units.
3. Accuracy: ASME B40.100, adjustable commercial grade (B) with 2 percent at mid-range of span.
4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.
5. Gauge Wetted Materials: Painted steel case and phosphor bronze socket rated to match process pressure and temperature range.
6. Comply with UL 404 when used for compressed gas service.

D Manometers: Inclined type, red oil on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

E Accessories:
1. Air or Gas Sensor: Static pressure with compression fittings for bulkhead mounting and 1/4 inch diameter tubing.
2. Gauge Cock: Carbon steel with tee or lever handle for maximum 150 psi.
3. Needle Valve: Carbon steel, 1/4 inch NPT female for noncorrosive service.
4. Coil Siphon: 213 seamless steel, 1/4 inch NPT male for rated capacity.
5. Pressure Snubber (Pulsation Damper): Brass, 1/4 inch NPT male.
6. Diaphragm Seal: 316L Stainless steel wetted material rated at 15 psi (1 bar), threaded. Select top size to match gauge size.

2.03 THERMOMETERS

A Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Moeller Instrument Company, Inc: www.moellerinstrument.com.
3. Watts Water Technologies, Inc: www.watts.com.
4. Weiss Instruments, LLC: www.weissinstruments.com.
5. Weksler Glass Thermometer Corp: www.wekslerglass.com.
6. Substitutions: See Division 01 Product Requirements.

B General:
1. Product Compliance: ASTM E1.
2. Lens: Clear glass, except where stated.
3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.

C Thermometers - Adjustable Angle: 7 inch v-shape aluminum case with clear glass window scale, 6 inch NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.

D Thermometers - Dial Type:
1. Fixed: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.
   a. Remote-Local Reading: Include built-in platinum RTD probe for remote reading.
2. Adjustable Angle: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.
3. Vapor (Gas) Actuated: 4-1/2 inch glass-reinforced phenolic case, aluminum dial with black pointer, recalibrating screw, 2 inch brass thermowell, adjustable joint with positive locking device allowing 180 degrees in vertical plane adjustment and capillary.
4. Manufacturers:
   a. Marshall Instruments, Inc: www.marshallinstruments.com.
   b. Reotemp Instruments Corp: reotemp.com.
   c. Wika Instrument, LP: www.wika.us.
   d. Substitutions: See Division 01 Product Requirements.

2.04 PRESSURE-TEMPERATURE TEST PLUGS:

A Size: 500 psi capacity; 1/2 inch MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch pressure gauge or temperature probe.

B Wetted Materials per Temperature Range:
1. Up to 200 degrees F: Brass probe with neoprene core.
2. 200 to 350 degrees F: Brass probe with EPDM core.

C Accessories: Brass, lever-handle cock and snubber-filter.

D Test Kit: Internally padded carrying case fitted with two 2-1/2 inch diameter pressure gauges, adapters, two 1/8 inch probes, and 1 inch dual-scale dial thermometers.

PART 3 EXECUTION

3.01 EXAMINATION

A Verification of Conditions: Verify Utility Service Provider piping readiness to receive meter.

B Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.02 INSTALLATION

A Install metering products in accordance with manufacturer's instructions for intended fluid type and service.

B Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.

C Install gas meters in accordance with Utility Service Provider instructions with required appurtenances.

D Install rotameters (flowmeters) between 4 to 6 ft above finished floor unless instructed otherwise to allow easy readability.

E Install pressure gauges as follows:

1. At Pumps: Place single gauge before strainer, suction side and discharge side.
2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
3. Include siphons on high temperature systems and select type according to service rating.
4. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.

F Install thermometers as follows:

1. Hot Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.
2. Piping: Install thermometers in branch butt weld connection fitting or socket-weld thermowell. Enlarge pipes smaller than 2-1/2 inch to accommodate sockets. Ensure sockets are above insulation clearance.

G Locate PT (pressure-temperature) test plugs adjacent to control device sockets.

END OF SECTION 220519

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Angle valves.
- B Ball valves.
- C Butterfly valves.
- D Check valves.
- E Flow limiting valves.
- F Gate valves.
- G Globe valves.
- H Lubricated plug valves.
- I Chainwheels.

1.02 RELATED REQUIREMENTS
- A Section 083100 - Access Doors an.
- B Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C Section 220553 - Identification for Plumbing Piping and Equipment.
- D Section 220716 - Plumbing Equipment Insulation.
- E Section 220719 - Plumbing Piping Insulation.
- F Section 221005 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS
- A CWP: Cold working pressure.
- B EPDM: Ethylene propylene copolymer rubber.
- C NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D NRS: Non-rising stem.
- E OS&Y: Outside screw and yoke.
- F PTFE: Polytetrafluoroethylene.
- G RS: Rising stem.
- H TFE: Tetrafluoroethylene.
- I WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS
- A API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.
- B ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- C ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- E ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- F ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- G ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- H ASME B31.9 - Building Services Piping; 2020.
- I ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- J ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- K ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).

L ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2021.
M ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts; 2018, with Editorial Revision (2019).
N ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
O ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
P ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
Q ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
R AWWA C606 - Grooved and Shouldered Joints; 2015.
S MSS SP-45 - Drain and Bypass Connections; 2020.
T MSS SP-67 - Butterfly Valves; 2022.
U MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
V MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
W MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
X MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
Y MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
Z MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
AA MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
BB MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.
CC NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
DD NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.05 SUBMITTALS

A See Division 01 Submittal Procedures.
B Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
C Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
1. See Division 01 Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

A Manufacturer:
1. Obtain valves for each valve type from single manufacturer.
2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
B Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

A Prepare valves for shipping as follows:
1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.
6. Adjust butterfly valves to closed or partially closed position.
B Use the following precautions during storage:
1. Maintain valve end protection and protect flanges and specialties from dirt.

a. Provide temporary inlet and outlet caps.
b. Maintain caps in place until installation.

2. Store valves in shipping containers and maintain in place until installation.
a. Store valves indoors in dry environment.
b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

A Handle large valves with sling, modified to avoid damage to exposed parts.

B Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A The product descriptions listed in the section may not all be used on this project. Refer to the piping Material Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

B See drawings for specific valve locations.

C Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

D Provide the following valves for the applications if not indicated on drawings:
1. Shutoff: Ball, butterfly, gate or plug.
2. Dead-End: Single-flange butterfly (lug) type.
3. Throttling: Provide globe, angle, ball, or butterfly.
4. Swing Check (Pump Outlet):
a. 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
b. 2-1/2 inch and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
c. 2-1/2 inch and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

E Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

F Required Valve End Connections for Non-Wafer Types:
1. Steel Pipe:
a. 2 inch and Smaller: Threaded ends.
b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
c. 5 inch and Larger: Grooved or flanged ends.
d. Grooved-End Copper Tubing and Steel Piping: Grooved.
2. Copper Tube:
a. 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
c. 5 inch and Larger: Grooved or flanged ends.

G Low Pressure, Compressed Air Valves 150 psi or Less:
1. 2 inch and Smaller:
a. Bronze: Provide with solder-joint ends.
b. Ball: One piece, full port, brass with brass trim.
c. Bronze Lift Check: Class 125, bronze disc.

d. Bronze Swing Check: Class 125, bronze disc.
e. Bronze Gate: Class 125, NRS.

2. 2-1/2 inch and Larger:
a. Iron, 2-1/2 inch to 4 inch: Provide with threaded ends.
b. Iron Single-Flange Butterfly: 200 CWP, NBR Seat, aluminum-bronze disc.
c. Iron Grooved-End Butterfly: 175 CWP.
d. Iron Swing Check: Class 125, metal seats.
e. Iron Grooved-End Swing Check: 300 CWP.
f. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
g. Iron Plate-Type Check: Class 125; single plate; metal seat.
h. Iron Gate: Class 125, NRS.

H High Pressure, Compressed Air Valves 150 psi to 200 psi:
1. 2 inch and Smaller:
a. Bronze: Provide with solder-joint ends.
b. Ball: One piece, full port, brass with brass trim.
c. Bronze Lift Check: Class 125, bronze disc.
d. Bronze Swing Check: Class 125, bronze disc.
e. Bronze Gate: Class 125, NRS.

2. 2-1/2 inch and Larger:
a. Iron Valves, 2-1/2 inch to 4 inch: Provide with threaded ends.
b. Iron Single-Flange Butterfly: 200 CWP, NBR seat, aluminum-bronze disc.
c. Iron Grooved-End Butterfly: 175 CWP.
d. Iron Swing Check: Class 125, metal seats.
e. Iron Grooved-End Swing Check: 300 CWP.
f. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
g. Iron Plate-Type Check: Class 125; single plate; metal seat.
h. Iron Gate: Class 125, NRS.

I Domestic, Hot and Cold Water Valves:
1. 2 inch and Smaller:
a. Bronze and Brass: Provide with solder-joint ends.
b. Bronze Angle: Class 125, bronze disc.
c. Ball: One piece, full port, brass with brass trim.
d. Bronze Swing Check: Class 125, bronze disc.
e. Bronze Gate: Class 125, NRS.
f. Bronze Globe: Class 125, bronze disc.

2. 2-1/2 inch and Larger:
a. Iron, 2-1/2 inch to 4 inch: Provide with threaded ends.
b. Iron Ball: Class 150.
c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
d. Iron Grooved-End Butterfly: 175 CWP.
e. Iron Swing Check: Class 125, metal seats.
f. Iron Swing Check with Closure Control: Class 125, lever and spring.
g. Iron Grooved-End Swing Check: 300 CWP.
h. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
i. Iron Plate-Type Check: Class 125; single plate; metal seat.
j. Iron Gate: Class 125, NRS.
k. Iron Globe: Class 125.

2.02 GENERAL REQUIREMENTS

A Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
B Valve Sizes: Match upstream piping unless otherwise indicated.
C Valve Actuator Types:
1. Gear Actuator: Quarter-turn valves 8 inch and larger.
2. Handwheel: Valves other than quarter-turn types.
3. Hand Lever: Quarter-turn valves 6 inch and smaller except plug valves.
4. Wrench: Plug valves with square heads.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
D Insulated Piping Valves: With 2 inch stem extensions and the following features:
1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.
E Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.
F General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Solder-joint Connections: ASME B16.18.
3. Building Services Piping Valves: ASME B31.9.
G Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
H Valve Bypass and Drain Connections: MSS SP-45.
I Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

A Class 125; CWP Rating: 200 psi:
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. End Connections: Pipe thread.
4. Stem: Bronze.
5. Disc: Bronze.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.

2.04 BRASS, BALL VALVES

A Two Piece, Full Port with Brass Trim and Female Thread, Male thread, or Solder Connections:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Vacuum Rating: 28.9 in-Hg.
5. Body: Forged brass.

6. Seats: PTFE.
7. Stem: Brass.
8. Ball: Chrome-plated brass.
9. Cap: Include cap-gasket and chain for 3/4 inch hose connection.
10. Operator: Lockable handle and memory stop.
11. Manufacturers:
    a. Apollo Valves: www.apollovalves.com.
    b. FNW: www.fnw.com.
    c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
    d. Kitz Corporation of America: www.kitzus-kca.com.
    e. Substitutions: See Division 01 Product Requirements.

B Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. CWP Rating: 600 psi.
4. Body: Bronze.
5. End Connections: Pipe threaded.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Manufacturers:
    a. Apollo Valves: www.apollovalves.com.
    b. FNW: www.fnw.com.
    c. Substitutions: See Division 01 Product Requirements.

2.05 BRONZE, BALL VALVES

A General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B Two Piece, Full Port with Bronze Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Bronze, blowout proof.
8. Ball: Chrome plated brass.
9. Manufacturers:
    a. Apollo Valves: www.apollovalves.com.
    b. FNW: www.fnw.com.
    c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
    d. Substitutions: See Division 01 Product Requirements.

C Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. CWP Rating: 600 psi.
4. Body: Bronze.
5. End Connections: Pipe threaded.
6. Seats: PTFE.

7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Manufacturers:
   a. Apollo Valves: www.apollovalves.com.
   b. Substitutions: See Division 01 Product Requirements.

2.06 CARBON STEEL, BALL VALVES

A Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. CWP Rating: 2,000 psi.
4. Seats: TFM.
5. Stem: Stainless steel, blowout proof.
6. Ball: Stainless steel, vented.
7. End Connections: Threaded or socket weld.
8. Operator: Lockable handle.
9. Pressure and Temperature Rating: ASME B16.34.
10. Manufacturers:
    a. FNW: www.fnw.com.
    b. Substitutions: See Division 01 - Product Requirements.

B Two Piece, Full Port, Fire Safe, Class 150, Flanged with Stainless Steel Trim:
1. WSP Rating: 150 psi.
2. Seats: TFM.
3. Stem: Stainless steel, blowout proof.
4. Ball: Stainless steel, vented.
5. Operator: Lockable handle with actuator-mounting pad.
6. Pressure and Temperature Rating: ASME B16.34.
7. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.

C Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 250 psi.
3. CWP Rating: 2,000 psi.
4. Vacuum Rating: Down to 29.3 in-Hg.
5. Seats: TFM.vcuum
6. Stem: Stainless steel, blowout proof.
7. Ball: Stainless steel, vented.
8. Bolts: Stainless steel.
9. End Connections: Threaded or socket weld.
10. Operator: Lockable handle.
11. Pressure and Temperature Rating: ASME B16.34.
12. Manufacturers:
    a. FNW: www.fnw.com.
    b. Substitutions: See Division 01 - Product Requirements.

2.07 IRON, BALL VALVES

A Class 125, Full Port, Stainless Steel Trim:
1. Comply with MSS SP-72.
2. CWP Rating: 200 psi.
3. Body: ASTM A536 Grade 65-45-12, ductile iron.

4. End Connections: Flanged.
5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.
8. Operator: Lever with locking handle.
9. Manufacturers:
   a. Apollo Valves: www.apollovalves.com.
   b. FNW: www.fnw.com.
   c. Substitutions: See Division 01 - Product Requirements.

2.08 IRON, SINGLE FLANGE BUTTERFLY VALVES

A Wafer Style:
1. Class 125, or Class 150 flanges.
2. Comply with MSS SP-67, Type I.
3. Wafer Style, Service Pressure Ratings:
   a. 150 psi for sizes 14 to 24 inch.
   b. 200 psi for sizes 2 to 12 inch.
   c. Vacuum down to 29.9 in-Hg.
4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
5. Stem: One or two-piece stainless steel.
6. Seat: EPDM.
7. Disc: Aluminum-bronze.
8. Finish: Epoxy coated.
9. Operator: Gear operator with handwheel over direct-mount actuator base.
10. Manufacturers:
    a. Apollo Valves: www.apollovalves.com.
    b. FNW: www.fnw.com.
    c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
    d. Kitz Corporation of America: www.kitzus-kca.com.
    e. Substitutions: See Division 01 Product Requirements.

2.09 IRON, GROOVED-END BUTTERFLY VALVES

A CWP Rating: 175 psi.
1. Comply with MSS SP-67, Type I.
2. Body: Coated ductile iron.
3. Stem: Two-piece stainless steel.
4. Disc: Coated ductile iron.
5. Disc Seal: EPDM.
6. Manufacturers:
   a. Kitz Corporation of America: www.kitzus-kca.com.
   b. Substitutions: See Division 01 Product Requirements.

2.10 BRONZE, LIFT CHECK VALVES

A General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B Class 125:
1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
2. CWP Rating: 200 psi.
3. Design: Vertical flow.
4. Body: Comply with ASTM B61 or ASTM B62, bronze.

5. End Connections: Threaded.
6. Disc (Type 1): Bronze.

2.11 BRASS, INLINE CHECK VALVES

A Class 150:
1. WOG Rating: 200 psi.
2. Maximum Service Temperature: 250 degrees F.
3. Body: Forged brass.
4. Disc: Forged brass.
5. Seal: PTFE, bubble-tight.
6. End Connections: Press.
7. Manufacturers:
   a. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
   b. FNW: www.fnw.com.
   c. Substitutions: See Division 01 Product Requirements.

2.12 BRASS, HORIZONTAL SWING CHECK VALVES

A Class 125, Threaded End Connections:
1. WOG Rating: 200 psi.
2. Body: Forged brass.
3. Disc: Forged brass.
4. Hinge-Pin, Screw, and Cap: Forged brass.
5. Manufacturers:
   a. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
   b. Substitutions: See Division 01 Product Requirements.

B Class 125, Press End Connections:
1. WOG Rating: 200 psi.
2. Body: Forged brass.
3. Disc: Forged brass.
4. Hinge-Pin, Screw, and Cap: Forged brass.
5. Manufacturers:
   a. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
   b. Substitutions: See Division 01 Product Requirements.

2.13 BRONZE, SWING CHECK VALVES

A General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B Class 125:
1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. WOG Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded.
6. Disc: Bronze.
7. Manufacturers:
   a. Apollo Valves: www.apollovalves.com.
   b. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
   c. Substitutions: See Division 01 - Product Requirements.

C Class 150:
1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.

3. WSP Rating: 150 psi.
4. WOG Rating: 300 psi.
5. Body: Bronze, ASTM B62.
6. End Connections: Threaded or soldered.
7. Disc: Bronze.
8. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 Product Requirements.

2.14 IRON, HORIZONTAL SWING CHECK VALVES

A Class 125:
1. Pressure and Temperature Rating: MSS SP-71, Type I.
2. Design: T-body style for clear or full waterways.
3. WOG Rating: 200 psi.
4. WSP Rating: 125 psi at 450 degrees F.
5. Body: ASTM A126, gray cast iron with bolted bonnet.
6. End Connections: Flanged.
7. Trim: Composition.
8. Seat Ring and Disc Holder: Bronze.
9. Disc: PTFE.
10. Gasket: Asbestos free.
11. Manufacturers:
    a. Apollo Valves: www.apollovalves.com.
    b. FNW: www.fnw.com.
    c. Flomatic Valves: www.flomatic.com.
    d. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
    e. Substitutions: See Division 01 Product Requirements.

B Class 250:
1. Comply with MSS SP-71, Type I.
2. CWP Rating: 500 psi.
3. Design: T-body style for clear or full waterway.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. End Connections: Flanged.
6. Trim: Bronze.
7. Metal Seat.
8. Gasket: Asbestos free.

2.15 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

A Class 125 with Lever and Spring-Closure Control.
1. Comply with MSS SP-71, Type I.
2. Description:
   a. CWP Rating: 200 psi.
   b. Design: Clear or full waterway.
   c. Body: ASTM A126, gray iron with bolted bonnet.
   d. Ends: Flanged as indicated.
   e. Trim: Bronze.
   f. Gasket: Asbestos free.
   g. Closer Control: Factory installed, exterior lever, and weight.
3. Manufacturers:
   a. Apollo Valves: www.apollovalves.com.
   b. Flomatic Valves: www.flomatic.com.

c. Substitutions: See Division 01 Product Requirements.

2.16 CARBON STEEL, SWING CHECK VALVES

A Class 150:

1. Design: T-pattern, horizontal or vertical flow.
2. Body and Disc: ASTM A216/A216M.
3. CWP Rating: 150 psi.
4. End Connections: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.
6. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 Product Requirements.

B Class 300:

1. Design: T-pattern, horizontal or vertical flow.
2. Body and Disc: ASTM A216/A216M.
3. CWP Rating: 300 psi.
4. End Connections: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.

2.17 STAINLESS STEEL, SWING CHECK VALVES

A Class 150:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. Design: T-pattern, horizontal or vertical flow.
3. CWP Rating: 150 psi.
4. Connection Ends: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.
6. Manufacturers:
   a. FNW: www.fnw.com.

B Class 300:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. Design: T-pattern, horizontal or vertical flow.
3. CWP Rating: 300 psi.
4. Connection Ends: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.
6. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.

2.18 IRON, GROOVED-END SWING CHECK VALVES

A Class 300:

1. CWP Rating: 300 psi.
2. Body: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM.
4. Disc: Ductile iron.
5. Coating: Black, non-lead paint.

2.19 IRON, CENTER-GUIDED CHECK VALVES

A Class 125, Compact-Wafer:

1. Comply with MSS SP-125.
2. CWP Rating: 200 psi.
3. Body: ASTM A126 gray iron.
4. Metal Seat: Unleaded bronze.
5. Manufacturers:

a. Apollo Valves: www.apollovalves.com.
b. Flomatic Valves: www.flomatic.com.
c. Substitutions: See Division 01 Product Requirements.

B Class 125, Globe:
1. Comply with MSS SP-125.
2. CWP Rating: 200 psi.
3. Style: Spring loaded.
4. End Connections: Flanged.
5. Metal Seat: Unleaded bronze.
6. Manufacturers:
a. Flomatic Valves; 402BTR Globe Check Valve: www.flomatic.com.
b. Substitutions: See Division 01 Product Requirements.

C Class 150, Compact-Wafer:
1. Comply with MSS SP-125.
2. CWP Rating: 300 psi.
3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
4. Metal Seat: Unleaded bronze.
5. Manufacturers:
a. Flomatic Valves: www.flomatic.com.

D Class 150, Globe:
1. Comply with MSS SP-125.
2. CWP Rating: 300 psi.
3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
4. Style: Spring loaded.
5. End Connections: Flanged.
6. Metal Seat: Unleaded bronze.
7. Manufacturers:
a. Flomatic Valves: www.flomatic.com.
b. Substitutions: See Division 01 Product Requirements.

E Class 250, Compact-Wafer:
1. Comply with MSS SP-125.
2. CWP Rating: 400 psi.
3. Body: ASTM A126, gray iron.
4. Style: Spring loaded.
5. Metal Seat: Unleaded bronze.

F Class 250, Globe:
1. Comply with MSS SP-125.
2. 2-1/2 inch to 12 inch; CWP Rating: 400 psi.
3. 14 inch to 24 inch; CWP Rating: 300 psi.
4. Body Material: ASTM A126, gray iron.
5. Style: Spring loaded.
6. End Connections: Flanged.
7. Metal Seat: Unleaded bronze.

G Class 300, Compact-Wafer:
1. Comply with MSS SP-125.
2. CWP Rating: 500 psi.
3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
4. Style: Spring loaded.

H Class 300, Globe:

1. Comply with MSS SP-125.
2. CWP Rating: 500 psi.
3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
4. Style: Spring loaded.
5. End Connections: Flanged.
6. Metal Seat: Unleaded bronze.

2.20 IRON, PLATE TYPE CHECK VALVES

A Class 125 Single-Plate:
1. Comply with API STD 594.
2. CWP Rating: 200 psi.
3. Design: Wafer, spring-loaded plate.
4. Body: ASTM A126, gray iron.
5. Resilient Seat: EPDM.

B Class 125, Dual-Plate:
1. Comply with API STD 594.
2. CWP Rating: 200 psi.
3. Design: Wafer, spring-loaded plates.
4. Body: ASTM A126, gray iron.
5. Resilient Seat: EPDM.

C Class 150, Dual-Plate:
1. Comply with API STD 594.
2. CWP Rating: 300 psi.
3. Design: Wafer, spring-loaded plates.
4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
5. Resilient Seat: NBR.

D Class 250, Single-Plate:
1. Comply with API STD 594.
2. CWP Rating: 400 psi.
3. Design: Wafer, spring-loaded plate.
4. Body: ASTM A126, gray iron.
5. Resilient Seat: NBR.

E Class 250, Dual-Plate:
1. Comply with API STD 594.
2. CWP Rating: 400 psi.
3. Design: Wafer, spring-loaded plates.
4. Body: ASTM A126, gray iron.
5. Resilient Seat: NBR.

F Class 300, Dual-Plate:
1. Comply with API STD 594.
2. CWP Rating: 500 psi.
3. Design: Wafer, spring-loaded plates.
4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
5. Metal Seat: Bronze.

2.21 FLOW LIMITING VALVES

A Manufacturers:
1. Nexus Valve, Inc: www.nexusvalve.com.
2. Substitutions: See Division 01 Product Requirements.

B Size: As indicated on drawings, female threaded.

C Flow Setting: As indicated on drawings.

D Flow Accuracy: Plus or minus 5 percent.
E Body and Cap: Lead-free brass.
F Cap and Plug: Lead-free brass.
G Cartridge: Stainless steel with replaceable EPDM seal.
H Maximum Service Pressure: 600 psi, WOG.
I Maximum Service Temperature: 250 degrees F.
J Accessories: Provide hanging tag and test-plug outlet extensions.

2.22 BRONZE, GATE VALVES

A General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B Rising Stem or OS&Y:
1. Pressure-Temperature Range: MSS SP-80, Type I.
2. Class 125:
a. WSP Rating: 125 psi, saturated.
b. CWP Rating: 200 psi.
3. Class 150: CWP Rating; 300 psi.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. End Connections: Threaded or solder.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron.
10. Manufacturers:
a. Apollo Valves: www.apollovalves.com.
b. FNW: www.fnw.com.
c. Substitutions: See Division 01 Product Requirements.

C Non-Rising Stem or NRS
1. Pressure-Temperature Range: MSS SP-80, Type I.
2. Class 125:
a. WSP Rating: 125 psi, saturated.
b. CWP Rating: 200 psi.
3. Class 150: CWP Rating; 300 psi.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. Ends Connections: Threaded or solder.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron.
10. Manufacturers:
a. Apollo Valves: www.apollovalves.com.
b. FNW: www.fnw.com.
c. Substitutions: See Division 01 Product Requirements.

2.23 IRON, GATE VALVES

A Bolted Bonnet: OS&Y; Rising Stem:
1. Pressure and Temperature Rating: MSS SP-70, Type I.
2. Class 125: WOG Rating; 200 psi.
3. Class 250: WOG Rating; 500 psi.
4. Body: ASTM A126, gray iron with bolted bonnet.

5. End Connections: Flanged.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.
9. Manufacturers:
   a. Apollo Valves: www.apollovalves.com.
   b. FNW: www.fnw.com.
   c. Substitutions: See Division 01 - Product Requirements.

2.24 CARBON STEEL, GATE VALVES

A Class 150:
1. Body and Disc: ASTM A216/A216M.
2. CWP Rating: 150 psi.
3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Pressure and Temperature Rating: ASME B16.34.
7. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 Product Requirements.

B Class 300:
1. Body and Disc: ASTM A216/A216M.
2. CWP Rating: 300 psi.
3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Pressure and Temperature Rating: ASME B16.34.
7. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.

2.25 STAINLESS STEEL, GATE VALVES

A Class 125:
1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 125 psi.
3. Bonnet: NRS; Non-rising Stem.
4. End Connections: Threaded.
5. Adjustable Stem Packing: PTFE.
6. Operator: Handwheel.
7. Working Service Temperature: Minus 4 to 356 degrees F.
8. Pressure and Temperature Rating: ASME B16.34.
9. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.

B Class 150:
1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 150 psi.
3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Handwheel.

7. Pressure and Temperature Rating: ASME B16.34.
8. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.

C Class 300:
1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 300 psi.
3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Handwheel.
7. Pressure and Temperature Rating: ASME B16.34.
8. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.

2.26 BRONZE, GLOBE VALVES

A General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B Class 125 and Class 250:
1. Class 125:
   a. WOG Rating: 200 psi.
   b. WSP Rating: 125 psi, saturated.
2. Class 250: WOG Rating; 300 psi.
3. Comply with MSS SP-80, Type 1.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. End Connections: Threaded or solder.
6. Bonnet: NRS; Non-rising Stem.
7. Non-Rising Stem: Bronze.
8. Disc: PTFE.
9. Packing: Asbestos free.
10. Handwheel Operator: Malleable iron.
11. Manufacturers:
    a. Apollo Valves: www.apollovalves.com.
    b. FNW; 1231, Federal: www.fnw.com.
    c. Substitutions: See Division 01 Product Requirements.

2.27 IRON, GLOBE VALVES

A Class 125 and Class 250:
1. Class 125, WOG Rating: 200 psi.
2. Class 250, WOG Rating: 500 psi.
3. Comply with MSS SP-85, Type I.
4. Body: Gray iron; ASTM A126, with bolted bonnet.
5. Bonnet: OS&Y; Rising Stem.
6. Connection Ends: Flanged.
7. Trim: Bronze.
8. Packing and Gasket: Asbestos free, adjustable.
9. Operator: Handwheel or chainwheel.
10. Temperature Range: Minus 20 to 150 degrees F.
11. Pressure and Temperature Rating: ASME B16.1.

12. Manufacturers:
    a. Apollo Valves: www.apollovalves.com.
    b. FNW; 661: www.fnw.com.
    c. Substitutions: See Division 01 - Product Requirements.

2.28 CARBON STEEL, GLOBE VALVES

A Class 150:
1. Body: ASTM A216/A216M.
2. WOG Rating: 150 psi.
3. Bonnet: NRS; Non-rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Malleable iron handwheel.
7. Pressure and Temperature Rating: ASME B16.34.
8. Manufacturers:
    a. FNW; 561: www.fnw.com.
    b. Substitutions: See Division 01 - Product Requirements.

B Class 300:
1. Body: ASTM A216/A216M.
2. WOG Rating: 300 psi.
3. Bonnet: NRS; Non-rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Malleable iron handwheel.
7. Pressure and Temperature Rating: ASME B16.34.
8. Manufacturers:
    a. FNW: www.fnw.com.
    b. Substitutions: See Division 01 - Product Requirements.

2.29 STAINLESS STEEL, GLOBE VALVES

A Class 125:
1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 200 psi.
3. Bonnet: NRS; Non-rising Stem.
4. End Connections: Threaded.
5. Stem Packing: PTFE.
6. Operator: Malleable iron handwheel.
7. Temperature Range: Minus 4 to 356 degrees F.
8. Pressure and Temperature Rating: ASME B16.34.
9. Manufacturers:
    a. FNW: www.fnw.com.
    b. Substitutions: See Division 01 - Product Requirements.

B Class 150:
1. Body and Disc: ASTM A351/A351M-CF8M.
2. Bonnet: NRS; Non-rising Stem.
3. WOG Rating: 150 psi.
4. End Connections: Flanged.
5. Trim: Stainless steel.
6. Packing and Gasket: Asbestos free.
7. Operator: Malleable iron handwheel.
8. Pressure and Temperature Rating: ASME B16.34.

9. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.

2.30 LUBRICATED PLUG VALVES

A Regular Gland with Flanged Ends:
1. Comply with MSS SP-78, Type II.
2. Class 125: CWP Rating: 200 psi.
3. Class 250: CWP Rating: 400 psi.
4. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
5. Pattern: Regular or short.
6. Plug: Cast iron or bronze with sealant groove.
7. Manufacturers:
   a. Flomatic Valves: www.flomatic.com.
   b. Substitutions: See Division 01 Product Requirements.

2.31 CHAINWHEELS

A Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron. Include zinc coating.
4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

A Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
B Verify valve parts to be fully operational in all positions from closed to fully open.
C Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
D Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
B Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
C Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
D Install check valves where necessary to maintain direction of flow as follows:
1. Lift Check: Install with stem plumb and vertical.
2. Swing Check: Install horizontal maintaining hinge pin level.
3. Orient plate-type into horizontal or vertical position, between flanges.
E Provide chainwheels on operators for valves 4 inch and larger where located 96 inch or more above finished floor, terminating 60 inch above finished floor.

END OF SECTION 220523

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Prefabricated trapeze-framed systems.
- B Strut systems for pipe or equipment support.
- C Beam clamps.
- D Pipe hangers.
- E Pipe rollers and roller supports.
- F Pipe supports, guides, shields, and saddles.
- G Nonpenetrating rooftop supports for low-slope roofs.
- H Anchors and fasteners.

1.02 RELATED REQUIREMENTS
- A Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B Section 055000 - Metal Fabrications.
- C Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS
- A ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- D ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- I ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- J ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- L ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
- M ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- N FM (AG) - FM Approval Guide; Current Edition.
- O MFMA-4 - Metal Framing Standards Publication; 2004.

P MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
Q NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
R UL (DIR) - Online Certifications Directory; Current Edition.
S UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03: Concrete.

1.05 SUBMITTALS

A See Division 01 - Submittal Procedures.
B Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
1. Fiberglass Strut Channel Framing Systems: Include requirements for strength derating according to ambient temperature.
C Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
D Derating Calculations for Fiberglass Strut Channel Framing Systems: Indicate load ratings adjusted for applicable service conditions.
E Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
F Installer's Qualifications: Include evidence of compliance with specified requirements.
G Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A Comply with applicable building code.
B Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
D Installer Qualifications for Field-Welding: As specified in Division 05.

E Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.

B Provide hardware products listed, classified, and labeled as suitable for intended purpose.

C Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.

D Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

E Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.

F Vibration Isolation and Seismic Restraint Requirements: See Section 220548.

G Materials for Metal Fabricated Supports: Comply with Division 05.

1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.

H Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.02 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

A Prefabricated Trapeze-Framed Metal Strut Systems:

1. Manufacturers:
   a. Anvil International, LLC: www.asc-es.com.
   b. Custom Strut and Roll Forming, LLC: www.customstrut.com.
   c. Gripple, Inc: www.gripple.com.
   d. Unistrut, a brand of Atkore International, Inc: www.unistrut.com.
   e. Substitutions: See Division 01 Product Requirements.
   f. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MFMA-4 compliant, pre-fabricated, MSS SP-58 Type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
3. MFMA-4 compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
4. Strut Channel or Bracket Material:
   a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

7. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

B Prefabricated Trapeze-Framed Fiberglass Strut Systems:
1. Manufacturers:
   a. Enduro Composites: www.endurocomposites.com.
   b. Unistrut, a brand of Atkore International, Inc: www.unistrut.com.
   c. Substitutions: See Division 01 Product Requirements.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. MSS SP-58 type 59, prefabricated continuous-slot fiberglass strut channel, associated fittings, and related accessories.
3. Channel Material: Use polyester resin or vinyl ester resin.
4. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
5. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.

2.03 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A Strut Channels:
1. Manufacturers:
   a. ABB Installation Products: electrification.us.abb.com.
   b. Gripple, Inc: www.gripple.com.
   c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where availible.
2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2 inch diameter.
   b. Piping up to 1 inch: 1/4 inch diameter.
   c. Piping larger than 1 inch: 3/8 inch diameter.
   d. Trapeze Support for Multiple Pipes: 3/8 inch in length.

C Channel Nuts:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. FNW: www.fnw.com.
   c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

D Cable Hanging System Kits:

1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. Ductmate Industries, Inc: ductmate.com.
   c. Gripple, Inc: www.gripple.com.
2. Provide cable-wire in bulk or pre-cut lengths with respective cable hangers as required to hold minimum weight of 120 lb.
3. Accessories: Provide brackets, clip or c-clip hangers, covers, and y-hook hangers.

2.04 BEAM CLAMPS

A Manufacturers:
1. B-Line, a brand of Eaton Corporation: www.eaton.com.
2. FNW: www.fnw.com.
3. Unistrut, a brand of Atkore International, Inc: www.unistrut.com.
4. Substitutions: See Division 01 Product Requirements.
5. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

B MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.

C C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.

D Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).

E Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.

F Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.

G FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.

H Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

I Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.05 PIPE HANGERS

A Band Hangers, Adjustable:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. Gripple, Inc: www.gripple.com.
   c. Substitutions: See Division 01 Product Requirements.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

B J-Hangers, Adjustable:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. FNW: www.fnw.com.
   c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
3. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.

C Swivel Ring Hangers, Adjustable:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. FNW; 7010: www.fnw.com.
   c. Substitutions: See Division 01 Product Requirements.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. MSS SP-58 type 10, epoxy-painted, zinc-colored.
3. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
4. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
5. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.

D Clevis Hangers, Adjustable:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. FNW: www.fnw.com.
   c. nVent Caddy, a brand of nVent: www.erico.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
3. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
4. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
5. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
6. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch.
7. FM (AG) listed: Pipe sizes 2-1/2 to 8 inch.

E Nonmetallic Pipe Hangers:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. DecoShield Systems, Inc: www.decoshield.com.
   c. Gregory Industries, Inc: www.gregorycorp.com.
   d. Substitutions: See Division 01 Product Requirements.
2. CPVC fabricated, snap-action hanger for pendant or sidewall applications. Not allowed in ceiling plenums.

2.06 PIPE CLAMPS

A Riser Clamps:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. FNW: www.fnw.com.
   c. nVent Caddy, a brand of nVent: www.erico.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.

4. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
5. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
6. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

B Extension Split Pipe Clamp:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. FNW: www.fnw.com.
   c. nVent Caddy, a brand of nVent: www.erico.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
3. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
4. Provide hanger rod and nuts of the same type and material for a given pipe run.
5. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

C Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

D Strut Clamps:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. FNW: www.fnw.com.
   c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com.
   d. Substitutions: See Division 01 - Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
4. Service Temperature Range: Minus 65 to 275 degrees F.

E Insulation Coupling:
1. Manufacturers:
   a. FNW: www.fnw.com.
   b. nVent Caddy, a brand of nVent: www.erico.com.
   c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. Two bolt-type clamps designed for installation under insulation.
3. Material: Carbon steel with epoxy copper or zinc finish.

2.07 PIPE ROLLERS AND ROLLER SUPPORTS

A Manufacturers:
1. ASC Engineered Solutions: www.asc-es.com.
2. FNW: www.fnw.com.
3. nVent Caddy, a brand of nVent: www.erico.com.
4. Substitutions: See Division 01 Product Requirements.

5. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

B MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

C Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.

D Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.08 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

A Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

B Stanchions:

1. Manufacturers:
   a. Anvil International: www.anvilintl.com.
   b. B-Line, a brand of Eaton Corporation: www.eaton.com.
   c. nVent Caddy, a brand of nVent: www.erico.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

C U-Bolts:

1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. FNW: www.fnw.com.
   c. nVent Caddy, a brand of nVent: www.erico.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.

D Intermediate Anchors and Pipe Alignment Guides:

1. Manufacturers:
   a. Anvil International, LLC: www.anvilintl.com.
   b. B-Line, a brand of Eaton Corporation: www.eaton.com.
   c. Gregory Industries, Inc: www.gregorycorp.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. Pipe Sizes 6 inch and Smaller: Minimum clearance of 0.16 inch.
3. Pipe Size 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
4. Pipe Size 10 inch: 0.75 inch U-bolt.
5. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
6. Pipe Sizes 18 to 30 inches: 1 inch U-bolt.
7. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

E Pipe Alignment Guides, Galvanized steel:

1. Manufacturers:
   a. Anvil International: www.anvilintl.com.
   b. B-Line, a brand of Eaton Corporation: www.eaton.com.
   c. Gregory Industries, Inc: www.gregorycorp.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
3. Pipe Sizes 10 inch and Larger: Roller type.
4. Pipe Sizes 18 to 30 inch: 1 inch U-bolt.

F Pipe Shields for Insulated Piping:
1. Manufacturers:
   a. Anvil International: www.anvilintl.com.
   b. FNW: www.fnw.com.
   c. Gregory Industries, Inc: www.gregorycorp.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.
2. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
3. General Construction and Requirements:
   a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
   b. Shields Material: UV-resistant polypropylene with glass fill.
   c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
   d. Service Temperature: Minus 40 to 178 degrees F.
   e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

G Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up to 122 degrees F:
   a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
   b. Support From Below: MSS SP-58 types 35 through 38.
3. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 type 1 or 3 through 12 clamps with appropriate saddle of MSS SP-58 type 40 for insulated pipe.
   b. Roller Chair: MSS SP-58 types 41 or 43 through 46 roller chair support with appropriate saddle of MSS SP-58 type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 types 35 through 38.

H Nonpenetrating Pipe Supports:
1. Manufacturers:
   a. Green Link, Inc: www.greenlinkengineering.com.
   b. Substitutions: See Division 01 Product Requirements.
   c. Source Limitations: Furnish channels/struts and associated fittings, accessories, and hardware produced by a single manufacturer.

I Pipe Supports, Thermal Insulated:
1. Manufacturers:
   a. Buckaroos, Inc: www.buckaroos.com.
   b. KB Enterprises: www.snappitz.com.

c. Substitutions: See Division 01 Product Requirements.

2. General Requirements:
   a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
   b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
   c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
   d. Provide pipe supports for 1/2 to 30 inch iron pipes.
   e. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
3. PVC Jacket:
   a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
   b. Minimum Service Temperature: Minus 40 degrees F.
   c. Maximum Service Temperature: 180 degrees F.
   d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
   e. Minimum Thickness: 60 mil, 0.06 inch.
   f. Connections: Brush-on welding adhesive.
4. Products:
   a. Buckaroos, Inc: www.buckaroos.com.
   b. Substitutions: See Division 01 Product Requirements.

J Copper Pipe Supports:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   c. Substitutions: See Division 01 Product Requirements.
   d. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.

K PEX Pipe Supports:
1. Manufacturers:
   a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   b. Substitutions: See Division 01 Product Requirements.
   c. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.

L CPVC Pipe Supports. Not allowed in return air plenums:
1. Manufacturers:
   a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   b. Substitutions: See Division 01 Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

M Thermal Insulated, Surface-Mounted Pipe Supports:
1. Manufacturers:
   a. FNW: www.fnw.com.
   b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   c. Substitutions: See Division 01 Product Requirements.

d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

2. Material: Carbon steel with epoxy copper or zinc finish.
3. Weather and UV light resistant foam, plastic, or rubber material with built-in strut. Maximum Load: 50 lb for single pipe or multiple landed on top strut.

N Overhead Pipe Supports:

1. Manufacturers:
   a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   b. nVent Caddy, a brand of nVent: www.erico.com.
   c. Substitutions: See Division 01 Product Requirements.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

O Plenum Pipe Supports:

1. Manufacturers:
   a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   b. nVent Caddy, a brand of nVent: www.erico.com.
   c. Substitutions: See Division 01 Product Requirements.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

P Telescoping Pipe Supports:

1. Manufacturers:
   a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   b. nVent Caddy, a brand of nVent: www.erico.com.
   c. Substitutions: See Division 01 Product Requirements.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

2.09 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

A Manufacturers:

1. Anvil International; H-Block: www.anvilintl.com.
2. B-Line, a brand of Eaton Corporation: www.eaton.com.
3. Green Link, Inc: www.greenlinkengineering.com.
4. nVent Erico, a brand of nVent: www.erico.com.
5. PHP Systems/Design: www.phpsd.com.
6. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
7. Substitutions: See Division 01 Product Requirements.
8. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

B Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

C Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

D Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

E Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.10 ANCHORS AND FASTENERS

A Manufacturers - Mechanical Anchors:

1. FNW: www.fnw.com.
2. Hilti, Inc: www.us.hilti.com.
3. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com.
4. Powers Fasteners, Inc: www.powers.com.
5. Simpson Strong-Tie Company Inc: www.strongtie.com.
6. Substitutions: See Division 01 Product Requirements.

B Manufacturers - Powder-Actuated Fastening Systems:
1. Hilti, Inc: www.us.hilti.com.
2. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com.
3. Powers Fasteners, Inc: www.powers.com.
4. Simpson Strong-Tie Company Inc: www.strongtie.com.
5. Substitutions: See Division 01 Product Requirements.

C Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

D Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.

E Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

F Hollow Masonry: Use toggle bolts.

G Hollow Stud Walls: Use toggle bolts.

H Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.

I Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.

J Sheet Metal: Use sheet metal screws.

K Wood: Use wood screws.

L Plastic and lead anchors are not permitted.

M Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

N Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
1. Channel Material: Use galvanized steel.
2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
3. Manufacturer: Same as manufacturer of metal strut channel framing system.

O Concrete Inserts:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   c. nVent Caddy, a brand of nVent: www.erico.com.
   d. Substitutions: See Division 01 Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer where available.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that mounting surfaces are ready to receive support and attachment components.

C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
C Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
D Unless specifically indicated or approved by Architect/Engineer, do not provide support from suspended ceiling support system or ceiling grid.
E Unless specifically indicated or approved by Architect/Engineer, do not provide support from roof deck.
F Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
G Field-Welding (where approved by Architect/Engineer): Comply with Division 05.
H Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
I Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Division 0.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
J Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
K Secure fasteners according to manufacturer's recommended torque settings.
L Remove temporary supports.
M For horizontal cast-iron pipe and fittings greater than four (4) inches in nominal diameter, piping shall be suitably restrained to prevent horizontal movement. Provide bracing at every branch opening or change in direction. For additional information on blocking, bracing, rodding, or other suitable methods of horizontal and vertical movement prevention, refer to CISPI 310 for approved means of restraint.
N For hubless couplings in cast-iron piping greater than four (4) inches in diameter, heavy-duty couplings shall be required.
O Vertical piping shall be secured and supported in sufficient intervals to maintain the alignment as well as to support the weight of the pipe and its contents. The base of each stack shall be supported as well as vertical piping in an interval adhering to code minimum requirements.

3.03 FIELD QUALITY CONTROL

A See Division 01 - Quality Requirements for additional requirements.
B Inspect support and attachment components for damage and defects.
C Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
D Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 220529

SECTION 220548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Vibration isolation requirements.
- B Vibration-isolated equipment support bases.
- C Vibration isolators.
- D External seismic snubber assemblies.
- E Vibration-isolated and/or seismically engineered roof curbs.

1.02 RELATED REQUIREMENTS
- A See Division 03: Cast-in-Place Concrete.
- B See Division 05 for Materials and requirements for fabricated metal supports.
- C Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS
- A ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
  2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  4. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B Sequencing:
  1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03.

1.05 SUBMITTALS
- A See Division 01: Submittal Procedures.
- B Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
- D Shop Drawings - Vibration Isolation Systems:
  1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
  2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E Shop Drawings - Seismic Controls:

1. Include dimensioned plan views and sections indicating proposed plumbing component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
3. Indicate proposed arrangement of distributed system trapeze support groupings.
4. Indicate proposed locations for distributed system flexible fittings and/or connections.
5. Indicate locations of seismic separations where applicable.
6. Include point load drawings indicating design loads transmitted to structure at each attachment location.

F Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed plumbing components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
   a. Component operating weight and center of gravity.
   b. Component elevation in the building in relation to the roof elevation (z/h).
   c. Component importance factor (Ip).
   d. For distributed systems, component materials and connection methods.
   e. Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
   f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

G Certification for seismically qualified equipment; identify basis for certification.

H Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

I Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

J Evidence of qualifications for seismic controls designer.

K Evidence of qualifications for manufacturer.

L Manufacturer's detailed field testing and inspection procedures.

M Field quality control test reports.

1.06 QUALITY ASSURANCE

A Comply with applicable building code.

B Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
1. Designer may be employed by the manufacturer of the seismic restraint products.

D Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.

B Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C General Requirements:
1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.

D Piping Isolation:
1. Provide vibration isolators for piping supports:
   a. Located in equipment rooms.
   b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
   c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.
2. Minimum Static Deflection:
   a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
   b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
7. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
   a. Kinetics Noise Control, Inc: www.kineticsnoise.com.
   b. Mason Industries: www.mason-ind.com.
   c. Vibration Eliminator Company, Inc: www.veco-nyc.com.
   d. Substitutions: See Division 01 Product Requirements.
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier where available.

B Vibration-Isolated Structural Steel Bases:
1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

C Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Division 03.
6. Pump Applications: Size and configure bases for piping elbow supports as required.

2.03 VIBRATION ISOLATORS

A Manufacturers:
1. Vibration Isolators:
a. Kinetics Noise Control, Inc: www.kineticsnoise.com.
b. Mason Industries: www.mason-ind.com.
c. Vibration Eliminator Company, Inc: www.veco-nyc.com.
d. Substitutions: See Division 01 Product Requirements.
2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier where available.

B General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
a. Color code or otherwise identify springs to indicate load capacity.
b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
f. Selected to function without undue stress or overloading.
3. Seismic Snubbing Elements for Seismic Isolators:
a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

C Vibration Isolators for Nonseismic Applications:
1. Resilient Material Isolator Pads:
a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Resilient Material Isolator Mounts, Nonseismic:
a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
3. Open (Unhoused) Spring Isolators:

a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
c. Furnished with integral leveling device for positioning and securing supported equipment.

4. Housed Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
   b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
   c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
   d. Furnished with integral leveling device for positioning and securing supported equipment.
5. Restrained Spring Isolators, Nonseismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
   b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

D Vibration Isolators for Seismic Applications:
1. Resilient Material Isolator Mounts, Seismic:
   a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.

2. Restrained Spring Isolators, Seismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
   b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.04 ACOUSTICAL AND VIBRATION ISOLATORS

A Manufacturers:
   1. Acoustical and Vibration Isolators:
      a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
      b. Substitutions: See Division 01 - Product Requirements.
   2. Source Limitations: Furnish isolators and associated accessories produced by a single manufacturer and obtained from a single supplier where available.

B General Requirements:
   1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A Manufacturers:
   1. External Seismic Snubber Assemblies:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com.
      b. Mason Industries: www.mason-ind.com.

c. Vibration Eliminator Company, Inc: www.veco-nyc.com.
d. Substitutions: See Division 01 Product Requirements.

2. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier where available.

B Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

C Seismic Snubbing Elements:

1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.06 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

A Manufacturers:

1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:
   a. Kinetics Noise Control, Inc: www.kineticsnoise.com.
   b. Mason Industries: www.mason-ind.com.
   c. Vibration Eliminator Company, Inc: www.veco-nyc.com.
   d. Substitutions: See Division 01 Product Requirements.
2. Source Limitations: Furnish vibration-isolated roof curbs and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier where available.

B Vibration Isolation Curbs:

1. Nonseismic Curb Rail:
   a. Location: Between existing roof curb and rooftop equipment.
   b. Construction: Aluminum.
   c. Integral vibration isolation to comply with requirements of this section.
   d. Weather exposed components consist of corrosion resistant materials.
2. Nonseismic Curb:
   a. Location: Between structure and rooftop equipment.
   b. Construction: Aluminum.
   c. Integral vibration isolation to comply with requirements of this section.
   d. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as shown on the drawings.

B Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C Secure fasteners according to manufacturer's recommended torque settings.

D Field-Welding (where approved by Architect/Engineer): Comply with Division 05.

E Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

F Vibration Isolation Systems:

1. Vibration-Isolated Equipment Support Bases:
   a. Provide specified minimum clearance beneath base.
2. Spring Isolators:
   a. Position equipment at operating height; provide temporary blocking as required.
   b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
   c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
3. Isolator Hangers:
   a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
   b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

A See Division 01: Quality for additional requirements.

B Inspect vibration isolation and/or seismic control components for damage and defects.

C Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.

D Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify required clearance beneath vibration-isolated equipment support bases.
   3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

F Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 220548

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Nameplates.
- B Tags.
- C Stencils.
- D Pipe markers.
- E Underground warning tape.
- F Ceiling tacks.

1.02 RELATED REQUIREMENTS
- A See Division 09 - Interior Painting for Identification painting.

1.03 REFERENCE STANDARDS
- A ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Schedules:
  1. Submit plumbing component identification schedule listing equipment, piping, and valves.
  2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
  3. Valve Data Format: Include id-number, location, function, and model number.
- C Product Data: Provide manufacturers catalog literature for each product required.
- D Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE
- A Nameplates:
  1. Heat exchangers, water heaters, and other heat transfer products.
  2. Control panels, transducers, and other related control equipment products.
  3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B Tags:
  1. Piping: 3/4 inch diameter and smaller.
  2. Manual operated and automated control valves.
  3. Instrumentation, relays, gauges, and other related control equipment products.
  4. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.
- C Stencil:
  1. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.
- D Pipe Markers: 3/4 inch diameter and higher.

2.02 NAMEPLATES
- A Manufacturers:
  1. Brimar Industries, Inc: www.pipemarker.com.
  2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
  3. Seton Identification Products: www.seton.com.
  4. Substitutions: See Division 01 Product Requirements.

B Description: Laminated piece with up to three lines of text.
1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Nameplate Height: 3/4 inch.
5. Nameplate Material:
a. Flexible: Vinyl with adhesive backing per ASTM D709.
b. Metal: Brass with center-side holes for screw fastening.

2.03 TAGS
A Manufacturers:
1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Brady Corporation: www.bradycorp.com.
3. Brimar Industries, Inc: www.pipemarker.com.
4. Craftmark Pipe Markers: www.craftmarkid.com.
5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
6. Seton Identification Products: www.seton.com.
7. Substitutions: See Division 01 Product Requirements.
B Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch in diameter.
C Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
D Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.
E Piping: 3/4 inch diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

2.04 STENCILS
A Manufacturers:
1. Brady Corporation: www.bradycorp.com.
2. Craftmark Pipe Markers: www.craftmarkid.com.
3. Insite Solutions, LLC: www.stop-painting.com.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
5. Seton Identification Products: www.seton.com.
6. Substitutions: See Division 01 Product Requirements.
B Pipe: Stencil size required per external insulated or uninsulated pipe diameter.
1. 3/4 to 1-1/4 inch Range: 1/2 inch text over 8 inch long background.
2. 1-1/2 to 2 inch Range: 3/4 inch text over 8 inch long background.
3. 2-1/2 to 6 inch Range: 1-1/4 inch text over 12 inch long background.
4. 8 to 10 inch Range: 2-1/2 inch text over 24 inch long background.
5. Over 10 inches: 3-1/2 inch text over 32 inch long background.
C Equipment: Use 2-1/2 inch text using Owner defined scheme.
D Background Paint: Semi-gloss enamel in compliance with Division 09.
E Stencil Paint: As specified in Division 09: semi-gloss enamel, colors complying with ASME A13.1.
F Fluid Service Identification Scheme, ASME A13.1:
1. Combustible Fluids: White text on brown background.
2. Compressed Air: White text on blue background.
3. Fire Quenching Fluids: White text on red background.
4. Flammable and Oxidizing Fluids: Black text on yellow background.
5. Toxic and Corrosive Fluids: Black text on orange background.

6. Owner Defined No.1: White text on purple background.
7. Owner Defined No.2: Black text on white background.
8. Owner Defined No.3: White text on gray background.
9. Owner Defined No.4: White text on black background.
10. Water; Potable, Cooling, Boiler Feed and Other: White text on green background.

2.05 PIPE MARKERS

A Manufacturers:
1. Brady Corporation: www.bradycorp.com.
2. Brimar Industries, Inc: www.pipemarker.com.
3. Craftmark Pipe Markers: www.craftmarkid.com.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
5. Seton Identification Products: www.seton.com.
6. Substitutions: See Division 01 Product Requirements.

B Comply with ASME A13.1.

C Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.

D Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

E Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

F Identification Scheme, ASME A13.1:
1. Primary: External Pipe Diameter, Uninsulated or Insulated.
   a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
   b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
   c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.
   d. 8 to 10 inches: Use 24 inch field-length with 2-1/2 inch text height.
   e. Over 10 inches: Use 32 inch field-length with 3-1/2 inch text height.
2. Secondary: Color scheme per fluid service.
   a. Combustible Fluids: White text on brown background.
   b. Compressed Air: White text on blue background.
   c. Fire Quenching Fluids: White text on red background.
   d. Flammable and Oxidizing Fluids: Black text on yellow background.
   e. Toxic and Corrosive Fluids: Black text on orange background.
   f. Owner Defined No. 1: White text on purple background.
   g. Owner Defined No. 2: Black text on white background.
   h. Owner Defined No. 3: White text on gray background.
   i. Owner Defined No. 4: White text on black background.
   j. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
3. Tertiary: Other Details.
   a. Directional flow arrow.
   b. Line pressure.
   c. Line temperature.
   d. To/From as indicated on drawings.

2.06 UNDERGROUND WARNING TAPE

A Manufacturers:
1. Brady Corporation: www.bradyid.com.
2. Brimar Industries, Inc: www.brimar.com.
3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.

4. Seton Identification Products: www.seton.com.
5. Substitutions: See Division 01 Product Requirements.

B Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
1. Exception: Use foil-backed detectable type tape where required by serving utility.

C Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil, 0.004 inch.

D Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, 0.005 inch, unless otherwise required for proper detection.

E Legend: Type of service, continuously repeated over full length of tape.

F Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.07 CEILING TACKS

A Manufacturers:
1. Craftmark Pipe Markers: www.craftmarkid.com.
2. Substitutions: See Division 01 Product Requirements.

B Description: Steel with 3/4 inch diameter color coded head.

C Color code as follows:
1. Plumbing Equipment: Yellow.
2. Plumbing Valves: Green.
3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A Degrease and clean surfaces to receive identification products.

B Prepare surfaces for stencil painting, see Division 09.

3.02 INSTALLATION

A Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B Install tags in clear view and align with axis of piping

C Apply stencil painted identification in compliance with Division 09 requirements. Identify unit with assigned id-number and area being served using pipe marking rules.

D Install plastic pipe markers in accordance with manufacturer's instructions.

E Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.

F Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G Apply ASME A13.1 Pipe Marking Rules:
1. Place pipe marker adjacent to changes in direction.
2. Place pipe marker adjacent each valve port and flange end.
3. Place pipe marker at both sides of floor and wall penetrations.
4. Place pipe marker every 25 to 50 feet interval of straight run.

H Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 220553

SECTION 220716

PLUMBING EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Cellular glass insulation.
- B Flexible elastomeric cellular insulation.
- C Flexible removable and reusable blanket insulation.
- D Flexible glass fiber insulation.
- E Rigid glass fiber insulation.
- F Hydrous calcium silicate insulation.
- G Weather barrier coatings.
- H Jacketing and accessories.

1.02 RELATED REQUIREMENTS
- A Division 09 - Interior Painting: Painting insulation covering.
- B Section 220553 - Identification for Plumbing Piping and Equipment.
- C Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS
- A ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- C ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- D ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- E ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- F ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- G ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- H ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- I ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- J ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- K ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- L ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2022.
- M ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
- N ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).

O ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
P ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
Q SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
R UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A See Division 01 Submittal Procedures.
B Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
C Samples: Submit two samples of any representative size illustrating each insulation type.
D Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE
A Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
B Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING
A Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
B Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS
A Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
B Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS
A Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 APPLICATION
A The material descriptions listed in the section may not all be used on this project. Refer to the Insulation Material Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

2.03 FLEXIBLE GLASS FIBER INSULATION
A Manufacturers:
1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville Corporation: www.jm.com/#sle.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
5. Substitutions: See Division 01 Product Requirements.
B Insulation: ASTM C553; flexible, noncombustible.

1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
2. Secure with self-sealing longitudinal laps and butt strips.

D Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E Vapor Barrier Lap Adhesive: Compatible with insulation.

F Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.04 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

A Manufacturers:
1. Auburn Manufacturing Inc: www.auburnmfg.com/#sle.
2. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C553 Type V; flexible, noncombustible.
1. Comply with ASTM C1695.
2. K Value: 0.37 at 100 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
3. Minimum Service Temperature: 32 degrees F.
4. Maximum Service Temperature: 500 degrees F.
5. Maximum Water Vapor Absorption: Less than 5.0 percent by weight.
6. Weight: 7.65 oz/sq ft.
7. Effective Thickness: 1.25 plus/minus 0.25 inch.

2.05 RIGID GLASS FIBER INSULATION

A Manufacturers:
1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville Corporation: www.jm.com/#sle.
3. Knauf Insulation; Earthwool Insulation Board: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
5. Substitutions: See Division 01 Product Requirements.

B Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.
4. Maximum Density: 8.0 pcf.

C Vapor Barrier Jacket:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with self-sealing longitudinal laps and butt strips.

D Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.

E Vapor Barrier Lap Adhesive: Compatible with insulation.

F Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.06 CELLULAR GLASS INSULATION

A Manufacturers:
1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com/#sle.
2. Substitutions: See Division 01 Product Requirements.

B Pipe and Tube Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Service Temperature Range: From 250 degrees F to 800 degrees F.
3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.
5. Density: 6.12 pcf, minimum.

2.07 HYDROUS CALCIUM SILICATE INSULATION
A Manufacturers:
1. Johns Manville Corporation: www.jm.com/#sle.
2. Substitutions: See Division 01 Product Requirements.
B Insulation: ASTM C533; rigid molded, asbestos free, gold color.
1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1200 degrees F.
3. Density: 15 pcf.
C Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.
D Insulating Cement: ASTM C449.
E High Temperature Adhesive: Fire-retardant, sodium silicate based adhesive with fibers treated in compliance with ASTM D93.
1. Manufacturers:
a. Vimasco Corporation: www.vimasco.com/#sle.
b. Substitutions: See Division 01 Product Requirements.

2.08 FLEXIBLE ELASTOMERIC CELLULAR INSULATION
A Manufacturers:
1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
2. Armacell LLC; AP Armaflex: www.armacell.us/#sle.
3. K-Flex USA LLC: www.kflexusa.com/#sle.
4. Substitutions: See Division 01 Product Requirements.
B Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.
C Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.09 WEATHER BARRIER COATINGS
A Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc: www.fosterproducts.com/#sle.
b. Substitutions: See Division 01 Product Requirements.
2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
3. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
4. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
5. Color: As selected by Architect.

2.10 JACKETING AND ACCESSORIES
A PVC Plastic:

1. Manufacturers:
   a. Johns Manville Corporation: www.jm.com/#sle.
   b. Substitutions: See Division 01 Product Requirements.
2. Jacket: Sheet material, off-white color.
   a. Minimum Service Temperature: Minus 40 degrees F.
   b. Maximum Service Temperature: 150 degrees F.
   c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   d. Thickness: 10 mil, 0.010 inch.
   e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.

B Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive: Compatible with insulation.
   a. Manufacturers:
      1) Vimasco Corporation: www.vimasco.com/#sle.
      2) Substitutions: See Division 01 Product Requirements.

C Aluminum Jacket:
1. Manufacturers:
   a. GLT: www.gltproducts.com
   b. Johns Manville Corporation: www.jm.com/#sle.
   c. Substitutions: See Division 01 Product Requirements.
2. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
3. Thickness: 0.016 inch sheet.
4. Finish: Smooth.
5. Joining: Longitudinal slip joints and 2 inch laps.
6. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
7. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

D Reinforced Tape:
1. Manufacturers:
   a. Ideal Tape Co., Inc: www.idealtape.com/#sle.
   b. Substitutions: See Division 01 - Product Requirements.
2. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
3. Comply with UL 723 or ASTM E84.
4. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
5. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that equipment has been tested before applying insulation materials.

B Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Factory Insulated Equipment: Do not insulate.

C Exposed Equipment: Locate insulation and cover seams in least visible locations.

D Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F Insulated equipment containing fluids below ambient temperature: Insulate entire system.

G For fiberglass insulated equipment containing fluids below ambient temperature, provide vapor barrier jackets, factory-applied or field-applied, and finish with glass cloth and vapor barrier adhesive.

H For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

I For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

J Fiberglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

K Inserts and Shields:

1. Application: Equipment 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between hangers and inserts.
3. Insert location: Between support shield and equipment and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

L Finish insulation at supports, protrusions, and interruptions.

M Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

N Exterior Applications:

1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
2. Cover with aluminum or stainless steel.

O Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

P Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

Q Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULES

A Heat-exchanger (water-to-water for domestic water heating service) insulation shall be one of the following:

1. Cellular Glass: 3 inches thick.

B Steam-to-hot-water converter insulation shall be one of the following:

1. Cellular Glass: 3 inches thick.

C Domestic water pump insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.

D Domestic hot-water pump insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.

E Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:

1. Cellular Glass: 1-1/2 inches thick.
2. Flexible Elastomeric: 1 inch thick.

F Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5.

1. Cellular glass 2" thick.

G Domestic water storage tank insulation shall be one of the following:
1. Cellular Glass: 2 inches thick.

H Domestic water filter-housing insulation shall be one of the following:
1. Cellular Glass: 3 inches thick.

I INDOOR, FIELD-APPLIED JACKET SCHEDULE
1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

J If more than one material is listed, selection from materials listed is Contractor's option.

K Equipment, Concealed:
1. PVC, Color-Coded by System: 30 mils thick.

L Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches
1. PVC, Color-Coded by System: 30 mils thick.

M Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

N Painted Aluminum, Stucco Embossed: 0.032 inch thick.

O OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

P 0.024-inch (0.61-mm) or heavier aluminum is recommended for outdoor applications.

Q Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

R If more than one material is listed, selection from materials listed is Contractor's option.

S Equipment, Concealed:
1. PVC, Color-Coded by System: 30 mils thick.

T Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
1. Stainless Steel, Type 304 or Type 316, Stucco Embossed with Z-Shaped Locking Seam: 0.024 inch thick.

U Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
1. Aluminum, Stucco Embossed: 0.032 inch thick.

END OF SECTION 220716

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Cellular glass insulation.
- B Flexible elastomeric cellular insulation.
- C Glass fiber insulation.
- D Jacketing and accessories.

1.02 RELATED REQUIREMENTS
- A See Division 07 - Firestopping.

1.03 REFERENCE STANDARDS
- A ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- D ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- E ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- F ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- G ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- H ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- I ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- J ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- K ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
- L ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- M SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- N UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C Samples: Submit two samples of any representative size illustrating each insulation type.
- D Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
B Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING
A Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS
A Maintain ambient conditions required by manufacturers of each product.
B Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 APPLICATION
A The material descriptions listed in the section may not all be used on this project. Refer to the Insulation Material Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

2.02 REGULATORY REQUIREMENTS
A Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.03 GLASS FIBER INSULATION
A Manufacturers:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville Corporation: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com.
4. Owens Corning Corporation: www.ocbuildingspec.com.
5. Owens Corning Corporation: www.ocbuildingspec.com.
6. Substitutions: See Division 01 Product Requirements.
B Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.
C Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
1. K Value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.
D Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
E Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
F Vapor Barrier Lap Adhesive: Compatible with insulation.
G Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
H Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Blanket: 1.0 pcf density.
3. Weave: 5 by 5.
I Indoor Vapor Barrier Finish:
1. Vinyl emulsion type acrylic, compatible with insulation, black color.

J Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

K Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

L Insulating Cement: ASTM C449.

2.04 CELLULAR GLASS INSULATION

A Manufacturers:
1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com.
2. Substitutions: See Division 01 Product Requirements.

B Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F.
2. Service Temperature Range: From 250 degrees F to 800 degrees F.
3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A Manufacturers:
1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT): www.aeroflexusa.com.
2. Armacell LLC; AP Armaflex: www.armacell.us.
3. K-Flex USA LLC; Insul-Tube: www.kflexusa.com.
4. Substitutions: See Division 01 Product Requirements.

B Insulation: Preformed flexible elastomeric closed cell cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D Weather Barrier: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.
1. Manufacturers:
a. Vimasco Corporation: www.vimasco.com.
b. Substitutions: See Division 01 Product Requirements.

2.06 JACKETING AND ACCESSORIES

A PVC Plastic Jacket:
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com.
b. Substitutions: See Division 01 Product Requirements.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil, 0.010 inch.
e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.

B ABS Plastic Jacket:
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: Minus 40 degrees F.
b. Maximum Service Temperature: 180 degrees F.

c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
d. Thickness: 30 mil, 0.03 inch.
e. Connections: Brush on welding adhesive.

C Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive: Compatible with insulation.
a. Manufacturers:
1) Vimasco Corporation: www.vimasco.com.
2) Substitutions: See Division 01 Product Requirements.

D Aluminum Jacket:
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com.
1) Substitutions: See Division 01 Product Requirements.
2) Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
3) Thickness: 0.016 inch sheet.
4) Finish: Smooth.
5) Joining: Longitudinal slip joints and 2 inch laps.
6) Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
7) Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

E Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

F Reinforced Tape:
1. Manufacturers:
a. Ideal Tape Co., Inc: www.idealtape.com.
b. Substitutions: See Division 01 Product Requirements.
2. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
3. Comply with UL 723 or ASTM E84.
4. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
5. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that piping has been tested before applying insulation materials.
B Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions.
B Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
C Exposed Piping: Locate insulation and cover seams in least visible locations.

D Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

K Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

L Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

M Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

N Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

END OF SECTION 220719

SECTION 221005

PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Sanitary waste piping, buried beyond 5 feet of building.
- B Sanitary waste piping, buried within 5 feet of building.
- C Sanitary waste piping, above grade.
- D Domestic water piping, buried beyond 5 feet of building.
- E Domestic water piping, buried within 5 feet of building.
- F Domestic water piping, above grade.
- G Storm drainage piping, buried beyond 5 feet of building.
- H Storm drainage piping, buried within 5 feet of building.
- I Storm drainage piping, above grade.
- J Natural gas piping, buried beyond 5 feet of building.
- K Natural gas piping, buried within 5 feet of building.
- L Natural gas piping, above grade.
- M Pipe flanges, unions, and couplings.
- N Pipe hangers and supports.
- O Pipe sleeve-seal systems.
- P Ball valves.
- Q Butterfly valves.
- R Balancing valves.
- S Flow-balancing valves.
- T Pressure reducing valves.
- U Pressure relief valves.
- V Control and service valves.
- W Pressure-temperature valves.
- X Strainers.

1.02 RELATED REQUIREMENTS
- A See Division 09 - Interior Painting.
- B Section 220516 - Expansion Fittings and Loops for Plumbing Piping.
- C Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.
- D Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- E Section 220553 - Identification for Plumbing Piping and Equipment.
- F Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS
- A ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.
- B ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- C ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- F ASME B31.1 - Power Piping; 2022.
- G ASME B31.9 - Building Services Piping; 2020.

H ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2023.
I ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
J ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Potable Water Distribution Systems; 2020.
K ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
L ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
M ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
N ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
O ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2022.
P ASTM B32 - Standard Specification for Solder Metal; 2020.
Q ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
R ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
S ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
T ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
U ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
V ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
W ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
X ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
Y ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
Z ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
AA ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2021.
BB ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
CC ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
DD ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
EE ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
FF ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
GG ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.

HH ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
II AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
JJ AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
KK AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
LL AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
MM AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.
NN AWWA C606 - Grooved and Shouldered Joints; 2015.
OO AWWA C651 - Disinfecting Water Mains; 2014, with Addendum (2020).
PP CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
QQ CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
RR FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential; 1989.
SS ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
TT ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
UU MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
VV MSS SP-67 - Butterfly Valves; 2022.
WW MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
XX NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
YY NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
ZZ NSF 372 - Drinking Water System Components - Lead Content; 2022.
AAA UL (DIR) - Online Certifications Directory; Current Edition.
BBB UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A See Division 01 Submittal Procedures.
B Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
C Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.
D Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
E Sustainable Design Documentation: For soldered copper joints, submit installer's certification that the specified installation method and materials were used.
F Sustainable Design Documentation: For products meeting regulatory lead-content restrictions.
G Project Record Documents: Record actual locations of valves.
H Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Substitutions: See Division 01 Product Requirements.
2. Valve Repacking Kits: One for each type and size of valve.

1.05 QUALITY ASSURANCE

A Perform work in accordance with applicable codes.
B Valves: Manufacturer's name and pressure rating marked on valve body.

C Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
D Welder Qualifications: Certified in accordance with ASME BPVC-IX.
E Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING
A Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B Provide temporary protective coating on cast iron and steel valves.
C Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
D Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS
A Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 APPLICATION
A The material descriptions listed in the section may not all be used on this project. Refer to the Piping Material Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

2.02 GENERAL REQUIREMENTS
A Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
B Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.03 SANITARY WASTE PIPING, BURIED BEYOND 5 FEET OF BUILDING
A Cast Iron Pipe: ASTM A74 extra heavy weight.
1. Fittings: Cast iron.
2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
B PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.
C Stainless Steel Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends., Schedule 40.
1. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

2.04 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING
A Cast Iron Pipe: ASTM A74 extra heavy weight.
1. Fittings: Cast iron.
2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
B PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.
C Stainless Steel Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends., Schedule 40.
1. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

2.05 SANITARY WASTE PIPING, BURIED - FORCED MAIN

A Ductile Iron Pipe: ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, service weight. Pipe shall be Pressure Class 350 for pipes 12 inches and smaller and Pressure Class 250 for pipes 14 inches and larger.
1. Fittings: Cement mortar lined and seal coated in accordance with ANSI/AWWA C104/A21.4.
2. Gaskets: ANSI/AWWA C111/A21.11
3. Mechanical Joints: ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11

2.06 SANITARY WASTE PIPING, ABOVE GRADE
A Cast Iron Pipe: ASTM A74, service weight.
1. Fittings: Cast iron.
2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
B PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 with not less than 150 psi pressure rating.
1. Fittings: ASTM D2466, PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.
C Stainless Steel Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends., Schedule 40.
1. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

2.07 DOMESTIC WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING
A Ductile Iron Pipe: AWWA C151/A21.51.
1. Fittings: AWWA C110/A21.10, ductile or gray iron, standard thickness.
2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket with 3/4-inch diameter rods.
B Copper Pipe: ASTM B42, hard drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.

2.08 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING
A Copper Pipe: ASTM B42, hard drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.

2.09 DOMESTIC WATER PIPING, ABOVE GRADE
A Copper Pipe: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.

2.10 STORM DRAINAGE PIPING, BURIED BEYOND 5 FEET OF BUILDING
A Cast Iron Pipe: ASTM A74 extra heavy weight.
1. Fittings: Cast iron.
2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
B PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.11 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING
A Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.
2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
B PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.12 STORM DRAINAGE PIPING, ABOVE GRADE

A Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.
2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

B PVC Pipe: ASTM D2665.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.13 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

A Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Manufacturers:
a. Wheatland Tube Company: www.wheatland.com.
b. Substitutions: See Division 01 Product Requirements.
2. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
3. Joints: ASME B31.1, welded.

B Polyethylene Pipe: ASTM D2513, SDR 11.
1. Fittings: ASTM D2683 or ASTM D2513 socket type.
2. Joints: Fusion welded.

2.14 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Manufacturers:
a. Wheatland Tube Company: www.wheatland.com.
b. Substitutions: See Division 01 Product Requirements.
2. Fittings: ASTM A234/A234M, wrought steel welding type.
3. Joints: ASME B31.1, welded.
4. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

B Polyethylene Pipe: ASTM D2513, SDR 11.
1. Fittings: ASTM D2683 or ASTM D2513 socket type.
2. Joints: Fusion welded.

2.15 NATURAL GAS PIPING, ABOVE GRADE

A Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
2. Joints: Threaded or welded to ASME B31.1.

B Flexible Gas Piping:
1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
2. Comply with ASTM E84.
3. Fittings: Provided by piping system manufacturer.
4. Provide piping with integral lightning protection.
5. Manufacturers:
a. Omega Flex, Inc; TracPipe CounterStrike: www.omegaflex.com.
b. Substitutions: See Division 01 - Product Requirements.

2.16 PIPE FLANGES, UNIONS, AND COUPLINGS

A Unions for Pipe Sizes 3 inch and Under:
1. Ferrous Pipe: Class 150 malleable iron threaded unions.
2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B Flanges for Pipe Sizes Over 1 inch:
1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
2. Housing Material: Provide , galvanized.
3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
6. Manufacturers:
   a. Anvil International: www.anvilintl.com.
   b. Apollo Valves: www.apollovalves.com.
   c. Grinnell Products: www.grinnell.com.
   d. Substitutions: See Division 01 Product Requirements.

D No-Hub Couplings:
1. Testing: In accordance with ASTM C1277 and CISPI 310.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.
5. Manufacturers:
   a. MIFAB, Inc; MI-QHUB: www.mifab.com.
   b. Substitutions: See Division 01 Product Requirements.

E Shielded, Heavy Duty No-Hub Couplings:
1. Testing: In accordance with ASTM C1540 and FM 1680.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.
5. Manufacturers:
   a. MIFAB, Inc; MI-QXHUB: www.mifab.com.
   b. Substitutions: See Division 01 Product Requirements.

F Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.17 PIPE HANGERS AND SUPPORTS

A See Section 220529 for additional requirements.

B Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   a. Cold and Hot Pipe Sizes 6 inch and Larger: Double hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.
5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
   a. Bases: High-density polypropylene.
   b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
d. Attachment and Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.
f. Manufacturers:
1) PHP Systems/Design: www.phpsd.com.
2) Substitutions: See Division 01 Product Requirements.

C Plumbing Piping - Drain, Waste, and Vent:
1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
3. Wall Support for Pipe Sizes to 3 inch: Cast iron hook.
4. Wall Support for Pipe Sizes 4 inch and Over: Welded steel bracket and wrought steel clamp.
5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D Plumbing Piping - Water:
1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 to 4 inch: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 6 inch and Larger: Adjustable steel yoke, cast iron pipe roll, double hanger.
5. Wall Support for Pipe Sizes Up to 3 inch: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inch and Larger: Welded steel bracket and wrought steel clamp.
7. Wall Support for Hot Pipe Sizes 6 inch and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Floor Support for Hot Pipe Sizes to 4 inch: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes 6 inch and Larger: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
12. PEX Piping: Support per manufacturer's recommendations.

E Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Comply with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Comply with ICC-ES AC01.
3. Concrete Screw Type Anchors: Comply with ICC-ES AC193.
4. Masonry Screw Type Anchors: Comply with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Comply with ICC-ES AC308.
6. Other Types: As required.
7. Manufacturers:
a. Powers Fasteners, Inc: www.powers.com.
b. Substitutions: See Division 01 Product Requirements.

2.18 PIPE SLEEVE-SEAL SYSTEMS

A Manufacturers:
1. BMW Company: www.bmwcompany.com.

2. GPT, a company of Enpro Industries, Inc: www.gptindustries.com.
3. The Metraflex Company: www.metraflex.com.
4. Link Seal
5. Substitutions: See Division 01 - Product Requirements.

B Modular Mechanical Seals:
1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance to service requirements.
4. Service Requirements:
   a. Corrosion resistant.
   b. Oil, fuel, gas, and solvent resistant.
   c. Underground, buried, and wet conditions.
   d. Fire Resistant: 1 hour, UL (DIR) approved.
   e. High Temperature, up to 400 deg F.
   f. Low temperature, down to minus 67 deg F.
5. Glass reinforced plastic pressure end plates.

C Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch thick.

D Pipeline-Casing Seals:
1. Coated metallic boltless casing-spacer for 4 inch carrier pipe.
2. Coated metallic boltless modular seal for 6 inch carrier pipe.
3. Carbon steel band with risers for 12 inch carrier pipe.
4. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

2.19 BALL VALVES

A Manufacturers:
1. Anvil International: www.anvilintl.com.
2. Apollo Valves: www.apollovalves.com.
3. Grinnell Products: www.grinnell.com.
4. Nibco, Inc: www.nibco.com.
5. SharkBite, a brand of Reliance Worldwide Corporation: www.sharkbite.com.
6. Uponor, Inc: www.uponorengineering.com.
7. Substitutions: See Division 01 Product Requirements.

B Construction, 4 inch and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.20 BUTTERFLY VALVES

A Manufacturers:
1. Anvil International: www.anvilintl.com.
2. Apollo Valves: www.apollovalves.com.
3. Crane Company: www.cranecpe.com.
4. Flomatic Valves: www.flomatic.com.
5. Grinnell Products: www.grinnell.com.
6. Substitutions: See Division 01 Product Requirements.

B Construction 1-1/2 inch and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.21 BALANCING VALVES

A Manufacturers:
1. Anvil International: www.anvilintl.com.
2. ITT Bell & Gossett: www.bellgossett.com.
3. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
4. Griswold Controls: www.griswoldcontrols.com.
5. Taco, Inc: www.taco-hvac.com.
6. Substitutions: See Division 01 Product Requirements.

B Construction: Class 125, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C Manual Operated Y-Pattern Globe, Size 1/2 to 2 inch:
1. Class 125, brass or bronze body, multi-turn handwheel, memory stop, variable orifice, soldered connections, dual PT (hot and cold pressure-temperature) test ports for 300 psi, minus 4 to 250 deg F WOG service.

D Automatic Flow Limiting Cartridge, Size 3/4 inch:
1. Class 125, brass or bronze body, stainless steel cartridge, threaded connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi, 0.5 gpm WOG service.

E Automatic Flow Limiting Cartridge with Ball Valve, Size 1/2 to 1 inch:
1. Class 125, brass or bronze body, stainless steel cartridge, leak-proof stem, threaded or soldered connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi, 0.25 to 1.5 gpm WOG service.

F Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.22 FLOW-BALANCING VALVES

A Manufacturers:
1. Anvil International: www.anvilintl.com.
2. Griswold Controls: www.griswoldcontrols.com.
3. ITT Bell & Gossett: www.bellgossett.com.
4. Taco, Inc: www.taco-hvac.com.
5. Substitutions: See Division 01 Product Requirements.

B Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.23 PRESSURE REDUCING VALVES

A Manufacturers:
1. Amtrol Inc: www.amtrol.com.
2. Apollo Valves: www.apollovalves.com.
3. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com.
4. Cla-Val Company: www.cla-val.com.
5. Flomatic Valves: www.flomatic.com.
6. Singer, a Mueller brand: www.singervalve.com.
7. Watts Regulator Company: www.wattsregulator.com.
8. Zurn Industries, LLC: www.zurn.com.
9. Substitutions: See Division 01 Product Requirements.

B 2 inch and Smaller:
1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

2. Pressure Reducing Pilot-Operator:
   a. Operating Range: 5 to 50 psi.
   b. Connected into brass or bronze pilot piping and fittings.
   c. Fixed flow restrictor, pressure gauges, and isolation valves.

C 2 inch and Larger:
1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.
2. Pressure Reducing Pilot-Operator:
   a. Operating Range: 5 to 50 psi.
   b. Connected into brass or bronze pilot piping and fittings.
   c. Fixed flow restrictor, strainer, pressure gauges, and isolation valves.

D Pilot Operated:
1. Cast bronze, 1-1/2 to 8 inch, NPS in size with flanged end connections. Rated for 300 psi inlet pressure with outlet discharge field-set to system inlet pressure.

E Pressure Reducing Valves with Integral Back-Up:
1. Manufacturers:
   a. Singer, a Mueller brand: www.singervalve.com.
   b. Substitutions: See Division 01 Product Requirements.
2. Size: 3 to 36 inch, Class 150 flange ends.
3. ASSE 1003 and AWWA C550 compliant cast iron body, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Pressure Reducing Pilot-Operator:
   a. Operating Range: 30 to 145 psi.
   b. Connected into brass, bronze, or stainless steel pilot piping and fittings.
   c. Precision fixed-flow restrictor, strainer, pressure gauges, and isolation valves,
   d. Include pilot-side strainer on valve sizes above 4 inch.

F Pressure Reducing Valves with Low-Flow By-Pass:
1. Manufacturers:
   a. Singer, a Mueller brand: www.singervalve.com.
   b. Substitutions: See Division 01 Product Requirements.
2. Size: 3 to 10 inch, Class 150 flange ends.
3. ASSE 1003 and AWWA C550 compliant cast iron body, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Pressure Reducing Pilot-Operator:
   a. Operating Range: 30 to 145 psi.
   b. Direct Acting By-Pass Range: 5 to 50 psi.
   c. Connected into brass, bronze, or stainless steel pilot piping and fittings.
   d. Precision fixed-flow restrictor, strainer, pressure gauges, and isolation valves.
   e. Include pilot-side strainer on valve sizes above 4 inch.

G Pressure Reducing and Pressure Sustaining Valves:
1. Manufacturers:
   a. Singer, a Mueller brand: www.singervalve.com.
   b. Substitutions: See Division 01 Product Requirements.
2. Size: 1/2 to 40 inch, Class 150 flange ends.
3. ASSE 1003 and AWWA C550 compliant cast iron body, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Pressure Reducing Pilot-Operator:
   a. Operating Range: 5 to 50 psi.
   b. Connected into brass, bronze, or stainless steel pilot piping and fittings.

c. Precision fixed-flow restrictor, pressure gauges, and isolation valves.
d. Include pilot-side strainer on valve sizes above 4 inch.

H Pressure Reducing and Sustaining Valves:
1. Manufacturers:
a. Singer, a Mueller brand: www.singervalve.com.
b. Substitutions: See Division 01 Product Requirements.
2. Size: 1/2 to 40 inch, Class 150 flange ends.
3. ASSE 1003 and AWWA C550 compliant cast iron body, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Dual Pressure Reducing Pilot-Operators:
a. Operating Range: 10 to 80 psi.
b. Connected into brass, bronze, or stainless steel piping and fittings.
c. Precision fixed-flow restrictor, pressure gauges, and isolation valves.
d. Include pilot-side strainer on valve sizes above 4 inch.

2.24 PRESSURE RELIEF VALVES

A Manufacturers:
1. Cla-Val Co: www.cla-val.com.
2. Watts Regulator Company: www.wattsregulator.com.
3. Substitutions: See Division 01 Product Requirements.

B ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

C Surge Anticipating, Pressure Relief Valves:
1. Manufacturers:
a. Singer, a Mueller brand: www.singervalve.com.
b. Substitutions: See Division 01 Product Requirements.
2. Size: 1/2 to 40 inch.
3. Class 150 flange ends; AWWA C550 compliant cast iron globe valve with elastomeric diaphragm, seat disc, and epoxy coated finish both internally and externally.
4. Differential Pressure Based Dual Pilot-Operator:
a. High-Surge Operating Range: 10 to 80 psi.
b. Connected into brass, bronze, or stainless steel pilot piping and fittings.
c. Precision fixed-flow restrictor, test needle-valve, strainer, swing check valve, pressure gauges, and isolation valves.

2.25 CONTROL AND SERVICE VALVES

A Flow Metered Valves:
1. Manufacturers:
a. Singer, a Mueller brand: www.singervalve.com.
b. Substitutions: See Division 01 Product Requirements.
2. Cast iron globe valve, elastomeric diaphragm, seat disc, flow insertion probe, and epoxy coated both internally and externally.
3. Size: 3 to 36 inch, Class 150 flange ends.
4. Pre-Inserted Flow Probe:
a. Fluid Service Rating: Up to 250 psi.
b. Electromagnetic, plus or minus two percent NIST traceable accuracy.
5. AC Powered Flow Converter:
a. NEMA EN 10250 Type 4X, local device with grounding ring and outdoor rated cables.
b. Digital display with pushbutton interface with reversible flow detection capability.
c. Indication: High and low alarms, faults, flow rate, totalized flow, flow range, and forward/reverse flow direction.

d. Output: Dual 4 to 20 mA VDC, programmable for remote monitoring.
e. Auxiliary Contacts: Four internal relays programmable to data or alarms.
f. Control: Provide solenoid valves to control valve at programmable setpoint.

B Flow Control Valves:
1. Manufacturers:
a. Singer, a Mueller brand: www.singervalve.com.
b. Substitutions: See Division 01 Product Requirements.
2. Size: 1/2 to 40 inch, Class 150 flange ends.
3. AWWA C550 compliant cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Differential Pressure Based Rate-of-Flow Pilot-Operator:
a. Operating Range: 25 to 50 psi.
b. Connected into brass, bronze, or copper pilot piping and fittings.
c. Precision fixed-flow restrictor, strainer, pressure gauges, and isolation valves.

C Level Control Valves:
1. Manufacturers:
a. Singer, a Mueller brand: www.singervalve.com.
b. Substitutions: See Division 01 Product Requirements.
2. Size: 3 to 40 inch, Class 150 flange ends.
3. AWWA C550 compliant 2-position operated, cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Pressure Based Rate-of-Flow Pilot-Operator:
a. Connected into brass, copper, ductile iron, or stainless steel pilot piping and fittings.
b. Fixed-flow restrictor, check valve, strainer, altitude gauge, and isolation valves.
c. Spring Operating Range: 10 to 60 ft with 1 to 3 ft reservoir head to supply pressure differential.

D Pump Control Valves:
1. Manufacturers:
a. Singer, a Mueller brand: www.singervalve.com.
b. Substitutions: See Division 01 Product Requirements.
2. Size: 2 to 20 inch, Class 150 flange ends.
3. AWWA C550 compliant, single chamber, cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Valve Pilot-Operator:
a. Watertight components connected into brass or ductile iron pilot piping and fittings.
b. Control: NEMA EN 10250 Type 4X, 120 VAC, 50/60 Hz solenoid valve.
c. Monitoring: NEMA EN 10250 Type 4X single-pole double-throw limit switch.
d. Fixed-flow restrictor, check valve, needle valve, strainer, pressure gauges, and isolation valves.

E Electronic Control Valves:
1. Manufacturers:
a. Singer, a Mueller brand: www.singervalve.com.
2. Size: 2 to 20 inch, Class 150 flange ends.
3. AWWA C550 compliant, single chamber, normally open cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. 2-Position Control:
a. Control Function: Energize solenoid to close valve.
b. Connected into brass or ductile iron pilot piping and fittings.
c. NEMA EN 10250 Type 4X, 120 VAC, 50/60 Hz pilot connected solenoid valve.

d. Watertight high and low speed adjusting valves, strainer, and isolation valves.

5. AC Powered Metered Flow Converter:
   a. NEMA EN 10250 Type 4X, local device with grounding ring and outdoor rated cables.
   b. Digital display with pushbutton interface with reversible flow detection capability.
   c. Indication: High and low alarms, faults, flow rate, totalized flow, flow range, and forward/reverse flow direction.
   d. Output: Dual 4 to 20 mA VDC, programmable for remote monitoring.
   e. Auxiliary Contacts: Four internal relays programmable to data or alarms.

F Pilot and Needle Valves:
1. Manufacturers:
   a. Singer, a Mueller brand: www.singervalve.com.
   b. Substitutions: See Division 01 Product Requirements.
2. 5 to 50 psi Pilot-Operator: Bronze body, 5 to 50 psi, top spring adjusting screw.
3. Needle Valve: Brass body, stainless steel stem with maximum service rating of 400 psi at 140 degrees F.

2.26 PRESSURE-TEMPERATURE VALVES

A Manufacturers:
1. Cla-Val Co: www.cla-val.com.
2. Watts Regulator Company: www.wattsregulator.com.
3. Substitutions: See Division 01 Product Requirements.

B ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.27 STRAINERS

A Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com.
2. Green Country Filter Manufacturing: www.greencountryfilter.com.
3. Jomar Valves, a division of Jomar Group: www.jomarvalve.com.
4. WEAMCO: www.weamco.com.
5. Substitutions: See Division 01 Product Requirements.

B Size 1/2 inch to 3 inch:
1. Class 150, threaded forged bronze Y-pattern body, stainless steel perforated mesh screen with cap, and rated for 150 psi, 250 deg F WOG service.

C Size 2 inch and Smaller:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

D Size 1-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

E Size 5 inch and Larger:
1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B Remove scale and dirt, on inside and outside, before assembly.
C Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A Install in accordance with manufacturer's instructions.
B Provide non-conducting dielectric connections wherever jointing dissimilar metals.
C Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
D Install piping to maintain headroom, conserve space, and not interfere with use of space.
E Group piping whenever practical at common elevations.
F Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.
G Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
    1. See Section 220719.
H Provide access where valves and fittings are not exposed.
I Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
J Provide support for utility meters in accordance with requirements of utility companies.
K Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
L Install bell and spigot pipe with bell end upstream.
M Install valves with stems upright or horizontal, not inverted. See Section 220523.
N Install water piping to ASME B31.9.
O Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
P PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
Q Sleeve pipes passing through partitions, walls, and floors.
R Inserts:
    1. Provide inserts for placement in concrete formwork.
    2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
    3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
    4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
    5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
S Pipe Hangers and Supports:
    1. Install in accordance with ASME B31.9.
    2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
    3. Place hangers within 12 inches of each horizontal elbow.
    4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
    5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
    6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
    7. Provide copper plated hangers and supports for copper piping.

8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
   a. Painting of interior plumbing systems and components is specified in Division 09.
9. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 220548.
10. Support cast iron drainage piping at every joint.

T Pipe Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a watertight seal.
6. Install in accordance with manufacturer's recommendations.

U When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.04 APPLICATION

A Use grooved mechanical couplings and fasteners only in accessible locations.
B Install unions downstream of valves and at equipment or apparatus connections.
C Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
D Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
E Install globe valves for throttling, bypass, or manual flow control services.
F Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
G Provide spring-loaded check valves on discharge of water pumps.
H Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

A Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.
B Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 FIELD TESTS AND INSPECTIONS

A Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
B Domestic Water Systems:
1. Perform hydrostatic testing for leakage prior to system disinfection.
2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
3. General:
   a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.

C Gas Distribution Systems:
1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.
2. General Systems:
   a. Inject a minimum of 10 psi of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.

b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound.

3. Welded Pipes or Systems with Service Pressures Above 14 in-wc:
   a. Inject a minimum of 60 psi of compressed air into the piping system for a duration of 30 minutes and verify with a gauge that no perceptible pressure drop is measured.
   b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound with 1 psi increments.

D Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A Disinfect water distribution system in accordance with Division 33.

B Prior to starting work, verify system is complete, flushed, and clean.

C Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

E Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F Maintain disinfectant in system for 24 hours.

G If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

A Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
   1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
   2. Provide 18 gauge, 0.0478-inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.09 SCHEDULES

A Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe Size: 1/2 inch to 1-1/4 inch:
         1) Maximum Hanger Spacing: 6.5 ft.
         2) Hanger Rod Diameter: 3/8 inches.
      b. Pipe Size: 1-1/2 inch to 2 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 3/8 inch.
      c. Pipe Size: 2-1/2 inch to 3 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 1/2 inch.
      d. Pipe Size: 4 inch to 6 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 5/8 inch.

e. Pipe Size: 8 inch to 12 inch:
   1) Maximum hanger spacing: 14 ft.
   2) Hanger Rod Diameter: 7/8 inch.
f. Pipe Size: 14 inch and Over:
   1) Maximum Hanger Spacing: 20 ft.
   2) Hanger Rod Diameter: 1 inch.

2. Plastic Piping:
   a. All Sizes:
      1) Maximum Hanger Spacing: 6 ft.
      2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION 221005

SECTION 221006

PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Drains.
- B Cleanouts.
- C Washing machine boxes and valves.
- D Water hammer arrestors.
- E Mixing valves.
- F Floor drain trap seals.
- G Exterior penetration accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
- A ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2022.
- B ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
- C NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- D NSF 372 - Drinking Water System Components - Lead Content; 2022.
- E PDI-WH 201 - Water Hammer Arresters; 2017.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D Certificates: Certify that grease interceptors meet or exceed specified requirements.
- E Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- F Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.
- G Manufacturer's qualification statement.
- H Operation Data: Indicate frequency of treatment required for interceptors.
- I Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- J Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.
- K Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Division 01 Product Requirements for additional provisions.
  2. Extra Loose Keys for Outside Hose Bibbs: One.
  3. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

1.05 QUALITY ASSURANCE
- A Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING
- A Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 APPLICATION
- A The specific products referenced in this section may not all be used on this project. Refer to the Equipment Schedules on the drawings for the specific application and Basis of Design for each product or material. Products not shown on the schedule for the specific application may not be

substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent. The Engineer will have final approval on alternate submittals to the Basis of Design product..

2.02 GENERAL REQUIREMENTS

A Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.03 DRAINS

A Manufacturers:
1. Acudor Platinum, a division of Acudor: www.acudorplatinum.com.
2. Jay R. Smith Manufacturing Company: www.jrsmith.com.
3. Josam Company: www.josam.com.
4. MIFAB, Inc: www.mifab.com.
5. Whitehall Manufacturing: www.whitehallmfg.com.
6. Zurn Industries, LLC: www.zurn.com.
7. Watts
8. Substitutions: See Division 01 Product Requirements.

B Roof Drains:
1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Removable polyethylene dome with vandal proof screws.
4. Accessories: Coordinate with roofing type:
   a. Membrane flange and membrane clamp with integral gravel stop.
   b. Adjustable under deck clamp.
   c. Roof sump receiver.
   d. Waterproofing flange.
   e. Controlled flow weir.
   f. Leveling frame.
   g. Adjustable extension sleeve for roof insulation.
   h. Perforated or slotted ballast guard extension for inverted roof.
   i. Perforated stainless steel ballast guard extension.
   j. O-ring seal between male and female connection pipes.
5. Manufacturers:
   a. Jay R. Smith Manufacturing Company: www.jrsmith.com.
   b. MIFAB, Inc: www.mifab.com.
   c. Zurn Industries, LLC: www.zurn.com.
   d. Substitutions: See Division 01 Product Requirements.

C Roof Overflow Drains:
1. Lacquered cast iron body and clamp collar and bottom clamp ring; pipe extended to above flood elevation.

D Downspout Nozzles:
1. Bronze round with straight bottom section.

E Area Drains:
1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Round nickel-bronze.
4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp.

F Floor Drains:
1. Manufacturers:

a. ACO, Inc: www.acobuildingdrainage.us.
b. Jay R. Smith Manufacturing Company: www.jrsmith.com.
c. MIFAB, Inc; FS1100-C Series: www.mifab.com.
d. Zurn Industries, LLC; Z415-BZ1: www.zurn.com.

2.04 CLEANOUTS

A Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jrsmith.com.
2. Josam Company: www.josam.com.
3. MIFAB, Inc: www.mifab.com.
4. Zurn Industries, LLC: www.zurn.com.
5. Substitutions: See Division 01 Product Requirements.

B Cleanouts at Exterior Surfaced Areas (CO-1):
1. Round cast nickel bronze access frame and non-skid cover.

C Cleanouts at Exterior Unsurfaced Areas (CO-2):
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

D Cleanouts at Interior Finished Floor Areas (CO-3):
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

E Cleanouts at Interior Finished Wall Areas (CO-4):
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

F Cleanouts at Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.05 WASHING MACHINE BOXES AND VALVES

A Box Manufacturers:
1. IPS Corporation/Water-Tite: www.ipscorp.com.
2. Oatey Supply Chain Services, Inc: www.oatey.com.
3. Substitutions: See Division 01 Product Requirements.

B Valve Manufacturers:
1. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com.
2. IPS Corporation/Water-Tite: www.ipscorp.com.
3. Zurn Industries, LLC: www.zurn.com.
4. Substitutions: See Division 01 Product Requirements.

C Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch waste, slip in finishing cover.

2.06 WATER HAMMER ARRESTORS

A Manufacturers:
1. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com.
2. Jay R. Smith Manufacturing Company: www.jrsmith.com.
3. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com.
4. Zurn Industries, LLC: www.zurn.com.
5. Substitutions: See Division 01 Product Requirements.

B Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.07 MIXING VALVES

A Thermostatic Mixing Valves:

1. Manufacturers:
   a. HAWS
   b. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com.
   c. ESBE: www.esbe.se/en.
   d. Honeywell International Inc: www.honeywellhome.com.
   e. Leonard Valve Company: www.leonardvalve.com.
   f. Substitutions: See Division 01 Product Requirements.
2. Valve: Chrome-plated cast brass or bronze body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
   a. Check valve on inlets.
   b. Volume control shut-off valve on outlet.
   c. Stem thermometer on outlet.
   d. Strainer stop checks on inlets.
4. Cabinet: 16 gauge, 0.0598 inch prime-coated steel, for recessed mounting with keyed lock.

B Pressure Balanced Mixing Valves:
1. Manufacturers:
   a. Delta Faucet Company: www.deltafaucet.com.
   b. Tacotherm Ltd: www.tacotherm.co.uk.
   c. Substitutions: See Division 01 Product Requirements.
2. Valve: Chrome-plated cast brass body, stainless steel cylinder, integral temperature adjustment.
3. Accessories:
   a. Volume control shut-off valve on outlet.
   b. Stem thermometer on outlet.
   c. Strainer stop checks on inlets.
   d. Cabinet: 16 gauge, 0.0598 inch prime-coated steel, for recessed mounting with keyed lock.

2.08 FLOOR DRAIN TRAP SEALS

A Manufacturers:
1. Green Drains: www.greendrains.com.
2. MIFAB, Inc: www.mifab.com.
3. Substitutions: See Division 01 Product Requirements.

B Description: Push-fit EPDM or silicone fitting with a one-way membrane.

2.09 EXTERIOR PENETRATION ACCESSORIES

A Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
1. Manufacturers:
   a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com.
   b. Substitutions: See Division 01 Product Requirements.

B Roof Drain Outlet Pipe Connection: Drain seal to connect roof drain to drain piping.
1. Products:
   a. Menzies Metal Products; Blue Drain Seal: www.menzies-metal.com.
   b. Substitutions: See Division 01 Product Requirements.

C Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for piping,

cables, and roofing system to be installed; designed to accommodate existing penetrations where applicable.

1. Products:
   a. Menzies Metal Products; Plumbing Stack Aluminum Welded: www.menzies-metal.com.
   b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com.
   c. Menzies Metal Products; Gas Retro Box: www.menzies-metal.com.
   d. Substitutions: See Division 01 Product Requirements.

D Plumbing Ventilation Thru Roof Accessories - Retrofit:

1. Plumbing Pipe Extension Kit: Extends roof plumbing pipes above minimum clearance from roof surface per local codes and Authority Having Jurisdiction (AHJ).
   a. Products:
      1) Menzies Metal Products; Plumbing Pipe Extension Kit: www.menzies-metal.com.
      2) Substitutions: See Division 01 Product Requirements.
2. Retrofit Cap: Spun aluminum cap for use with aluminum or PVC plumbing stack.
   a. Products:
      1) Menzies Metal Products; Econo Cap Spun Aluminum: www.menzies-metal.com.
      2) Substitutions: See Division 01 Product Requirements.
3. Vandal Resistant Cap: Spun aluminum cap for use with aluminum or PVC plumbing stack. Cap designed to be secured with pop-rivets to prevent removal.
   a. Products:
      1) Menzies Metal Products; Vandalproof Cap: www.menzies-metal.com.
      2) Substitutions: See Division 01 Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C Encase exterior cleanouts in concrete flush with grade.

D Install floor cleanouts at elevation to accommodate finished floor.

E Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F Pipe relief from backflow preventer to nearest drain.

G Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or washing machine outlets.

H Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

END OF SECTION 221006

SECTION 221123

DOMESTIC WATER PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Circulators.
- B Inline pump systems.
- C End-suction pump systems.
- D Inline pumps.
- E End-suction pumps.
- F Base- or frame-mount, close-coupled, end-suction pumps.
- G Base- or frame-mount, split-coupled, end-suction pumps.
- H Modular pressure booster systems.
- I Pressure booster systems.

1.02 RELATED REQUIREMENTS
- A Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS
- A ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data:
  1. Provide certified pump curve with duty point marked over pump and system operating conditions and NPSH curve and power requirement by pump tag.
  2. Manufacturer's catalog sheets for fixtures, fittings, accessories, and supplies.
- C Shop Drawings: Include dimensions and performance data.
- D Test Reports: Plumbing fixture operational tests.
- E Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- F Executed warranty.
- G Project Record Documents: Record actual locations of components.
- H Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- I Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Division 01 Product Requirements for additional provisions.
  2. Extra Pump Seals: One of each type and size.

1.05 QUALITY ASSURANCE
- A Manufacturer Qualifications: Company specializing in manufacturing type of products specified in this section, with minimum three years of documented experience.
- B Certifications: Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc, as suitable for purpose specified and indicated.
- C Identification: Provide pumps with manufacturer's name, model number, and rated capacity identified by permanently attached label.
- D Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 DELIVERY, STORAGE, AND HANDLING

A Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY

A See Division 01 Closeout Submittals for additional warranty requirements.

B Manufacturer Warranty: Provide 1-year manufacturer warranty for pumps except circulator type. Complete forms in Owner's name and register with manufacturer.

C Manufacturer Warranty: Provide 5-year manufacturer warranty for circulators. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 APPLICATION:

A The specific products referenced in this section may not all be used on this project. Refer to the Equipment Schedules on the drawings for the specific application and Basis of Design for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent. The Engineer will have final approval on alternate submittals to the Basis of Design product.

2.02 CIRCULATORS

A Manufacturers:

1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com.
2. Bell & Gossett, a Brand of Xylem, Inc: www.xylem.com.
3. Grundfos Pumps Corporation: www.grundfos.com.
4. Taco, Inc: www.tacocomfort.com.
5. Substitutions: See Division 01 Product Requirements.

B Casing: Bronze with bronze cast impeller, and stainless steel rotor assembly.

C Shaft: Alloy steel with integral thrust collar and two oil-lubricated bronze sleeve bearings.

D Mechanical Seal: Carbon rotating against a stationary ceramic seat.

E Pipe-End Connection: Union connection.

F Maximum Discharge Pressure: 145 psi.

G Motor: 1,750 rpm, ECM duty with flexible coupling.

H Service Temperature Range: Minus 30 to 250 degrees F.

I Controls: Provide aquastat set for high-temp cutoff, electric plug, and illuminated hand switch.

PART 3 EXECUTION

3.01 INSTALLATION

A Install products with related fittings, and accessories according to manufacturer instructions.

B Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).

C Electrical-Driven Pump Work:

1. Provide electric-motor-driven equipment specified complete with local disconnect switch and control panel with starter, controls, safety devices, and related wiring.
2. Provide automatic control and protective devices field-wired to interface-related devices required for specified operation.

D Ensure that small pressure gauges are installed on both upstream and downstream ends.

E Sump Pumps: Ensure shaft length of sump pump located minimum of 24 inches below lowest invert into sump pit with minimum of 6 inches clearance from bottom of sump pit.

F Base-Mount Pumps and Pressure Booster Pump Skids:

1. Provide air cock and drain connection. Align and verify alignment of base prior to start-up.
2. Provide line-sized isolating valve with strainer or triple-duty valve on suction end and line-sized, soft-seated check valve with balancing valve on discharge end.

3. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

G Hot Water Service: Ensure that small pressure-temperature gauges are installed on both upstream and downstream ends.

H Factory-Provided Pump Controls: Factory provided, tested for use.

I Cycle Duty Controlled Pumps: Set manually to ON for continuous operation.

J ECM, VSD, or VFD Controlled Motors: Configure unit to operate within manufacturer-listed pump curve points unless factory set to do so. Then adjust to operate in automatic to maintain downstream pressure setpoint.

K Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are nonoverloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3.02 FIELD QUALITY CONTROL

A See Division 01 - Quality Requirements for additional requirements.

B Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.03 CLEANING

A Thoroughly clean plumbing fixtures and equipment.

3.04 PROTECTION

A Protect installed products from damage due from subsequent construction operations.

B Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION 221123

SECTION 223000

PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Residential gas-fired water heaters.
- B Tankless gas-fired water heaters.
- C Rack-mounted, tankless, gas-fired water heaters.
- D Commercial gas-fired water heaters.
- E Commercial indirect-fired water heaters.
- F Residential electric water heaters.
- G Tankless electric water heaters.
- H Commercial electric water heaters.
- I Residential gas-fired water boilers.
- J Commercial gas-fired water boilers.
- K Packaged water heating systems.
- L Domestic-water heat exchangers.
- M Domestic hot water storage tanks.
- N Diaphragm-type compression tanks.
- O Water filters.
- P Water softeners.
- Q Acid-effluent neutralizers.
- R Deionization equipment.
- S Point-of-use water filters.
- T In-line circulator pumps.
- U Pressure booster systems.
- V Sump pumps.

1.02 RELATED REQUIREMENTS
- A Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS
- A AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.
- D UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS
- A See Division 01 Submittals Procedures.

B Product Data:
1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Indicate pump type, capacity, power requirements.
3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
4. Provide electrical characteristics and connection requirements.

C Shop Drawings:
1. Indicate heat exchanger dimensions, size of tappings, and performance data.
2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

D Project Record Documents: Record actual locations of components.

E Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

F Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G Project Record Documents: Record actual locations of components.

H Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Division 01 Product Requirements for additional provisions.
2. Extra Pump Seals: One of each type and size.
3. Extra Water Softener Salt: 50 pounds.

1.06 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B Certifications:
1. Water Heaters: NSF approved.
2. Gas Water Heaters: AHRI Directory of Certified Product Performance.
3. Electric Water Heaters: UL listed and labeled to UL 174.
4. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.
5. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
6. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

C Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

D Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 DELIVERY, STORAGE, AND HANDLING

A Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

A See Division 01 Closeout Submittals for additional warranty requirements.

B Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 APPLICATION

A The specific products referenced in this section may not all be used on this project. Refer to the Equipment Schedules on the drawings for the specific application and Basis of Design for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the

drawing schedule and specifications, the drawing schedule shall take precedent. The Engineer will have final approval on alternate submittals to the Basis of Design product.

2.02 WATER HEATERS

A Manufacturers:
1. A.O. Smith Water Products Co: www.hotwater.com.
2. Rheem Manufacturing Company: www.rheem.com.
3. Bradford White Corporation: www.bradfordwhite.com.
4. Substitutions: See Division 01 Product Requirements.

B Commercial Gas-Fired Water Heaters:
1. Manufacturers:
   a. Bradford White Corporation: www.bradfordwhite.com.
   b. A.O. Smith: www.hotwater.com/#sle
   c. Rheem: www.rheem.com/#sle
   d. PVI: www.pvi.com/#sle
   e. Substitutions: See Division 01 Product Requirements.
2. Type: Automatic, natural gas-fired, vertical storage.
3. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
4. Tank: Antimicrobial-infused, enamel-lined, welded steel, ASME labeled; multiple flue passages, 4-inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
5. Accessories:
   a. Water Connections: Brass.
   b. Dip Tube: Brass.
   c. Drain valve.
   d. Anode: Magnesium.
   e. Temperature and Pressure Relief Valve: ASME labeled.
6. Applications:
   a. Automatic storage water heater.
   b. Automatic circulating tank water heater.
   c. For operation at 180 degrees F.
   d. For operation on combustible floors.

C Commercial Electric Water Heaters:
1. Manufacturers:
   a. Bradford White Corporation; ElectriFLEX Series: www.bradfordwhite.com.
   b. A.O. Smith: www.aosmith.com/#sle
   c. Rheem: www.rheem.com/#sle
   d. PVI: www.pvi.com/#sle
2. Type: Factory-assembled and wired, electric, vertical storage.
3. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
4. Performance:
   a. Maximum Working Pressure: 150 psig.
5. Electrical Characteristics:
6. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
7. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.

8. Accessories:
   a. Water Connections: Brass.
   b. Dip Tube: Brass.
   c. Drain valve.
   d. Anode: Magnesium.
   e. Temperature and Pressure Relief Valve: ASME labeled.
9. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

PART 3 EXECUTION

3.01 INSTALLATION

A Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B Coordinate with plumbing piping and related fuel piping work to achieve operating system.

3.02 FIELD QUALITY CONTROL

A See Division 01 Quality Requirements for additional requirements.

END OF SECTION 223000

SECTION 224000

PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Flush valve water closets.
- B Wall hung urinals.
- C Lavatories.
- D Wall-hung, solid surface, multistation lavatory units.
- E Under-lavatory pipe supply covers.
- F Bi-level, electric water coolers.
- G Mop sinks.

1.02 REFERENCE STANDARDS
- A ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- C ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
- D ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- E ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018, with Errata.
- F ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- G ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- H ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.
- I ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
- J NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- K NSF 372 - Drinking Water System Components - Lead Content; 2022.
- L UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C Samples: Submit two lavatory supply fittings.
- D Manufacturer's Instructions: Indicate installation methods and procedures.
- E Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.
- F Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- G Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Division 01 Product Requirements for additional provisions.
  2. Extra Faucet Washers: One set of each type and size.
  3. Extra Lavatory Supply Fittings: One set of each type and size.
  4. Extra Shower Heads: One of each type and size.
  5. Extra Toilet Seats: One of each type and size.
  6. Flush Valve Service Kits: One for each type and size.

1.04 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 MOCK-UP

A Provide mock-up of typical bathroom group.

B Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A Accept fixtures on-site in factory packaging. Inspect for damage.

B Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.01 APPLICATION

A The specific products referenced in this section may not all be used on this project. Refer to the Equipment Schedules on the drawings for the specific application and Basis of Design for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent. The Engineer will have final approval on alternate submittals to the Basis of Design product.

2.02 GENERAL REQUIREMENTS

A Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.03 REGULATORY REQUIREMENTS

A Comply with applicable codes for installation of plumbing systems.

B Comply with UL (DIR) requirements.

C Perform work in accordance with local health department regulations.

D Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.04 FLUSH VALVE WATER CLOSETS

A Water Closets:

1. Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action, china bolt caps.
2. Manufacturers:
   a. American Standard, Inc; Baby Devoro, 2-Piece Gravity: www.americanstandard-us.com.
   b. Kohler Company: www.kohler.com.
   c. Zurn Industries, LLC: www.zurn.com.

B Flush Valves:

1. Manufacturers:
   a. American Standard, Inc: www.americanstandard-us.com.
   b. Sloan Valve Company: www.sloanvalve.com.
   c. Zurn Industries, LLC: www.zurn.com.
   d. Substitutions: See Division 01 Product Requirements.
2. Sensor-Operated:
   a. Type: ASME A112.19.5; chloramine-resistant clog-resistant dual-seat diaphragm valve complete with vacuum breaker, stops and accessories.
   b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.

C Toilet Seats:

1. Manufacturers:

a. American Standard, Inc: www.americanstandard-us.com.
b. Bemis Manufacturing Company: www.bemismfg.com.
c. Church Seat Company: www.churchseats.com.
d. Zurn Industries, LLC: www.zurn.com.
e. Substitutions: See Division 01 Product Requirements.

2.05 WALL HUNG URINALS

A Manufacturers:
1. American Standard, Inc: www.americanstandard-us.com.
2. Kohler Company: www.kohler.com.
3. Zurn Industries, LLC: www.zurn.com.
4. Toto USA
5. Substitutions: See Division 01 Product Requirements.

B Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
1. Consumption Volume: 1.0 gal per flush, maximum.
2. Flush Valve: Exposed (top spud).
3. Flush Operation: Sensor operated.
4. Trapway Outlet: Integral.

C Flush Valves:
1. Manufacturers:
a. American Standard, Inc: www.americanstandard-us.com.
b. Sloan Valve Company: www.sloanvalve.com.
c. Zurn Industries, LLC; ZEMS Series: www.zurn.com.
d. Toto USA
e. Substitutions: See Division 01 Product Requirements.
2. Sensor-Operated:
a. Type: ASME A112.19.5; chloramine-resistant, clog-resistant dual-seat diaphragm valve with vacuum breaker, stops and accessories.
b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.

D Urinal Carriers:
1. Manufacturers:
a. Jay R. Smith Manufacturing Company: www.jrsmith.com.
b. JOSAM Company: www.josam.com.
c. Zurn Industries, LLC; Z1221: www.zurn.com.
d. Substitutions: See Division 01 Product Requirements.

2.06 LAVATORIES

A Manufacturers:
1. American Standard, Inc: www.americanstandard-us.com.
2. Kohler Company: www.kohler.com.
3. Zurn Industries, LLC: www.zurn.com.
4. Toto USA
5. Bradley.
6. Substitutions: See Division 01 Product Requirements.

B Wall-Hung Basin:
1. Products:
a. Jay R. Smith Manufacturing Company: www.jrsmith.com.
b. JOSAM Company: www.josam.com.
c. Zurn Industries, LLC: www.zurn.com.

2. Carrier:
   a. Manufacturers:
      1) Jay R. Smith MFG. Co: www.jrsmith.com.
      2) JOSAM Company: www.josam.com.
      3) Zurn Industries: www.zurn.com.
      4) Substitutions: See Division 01 Product Requirements.

C Drop-In Basin:
1. Products:
   a. Jay R. Smith MFG. Co: www.jrsmith.com.
   b. JOSAM Company: www.josam.com.
   c. Zurn Industries: www.zurn.com.
   d. Substitutions: See Division 01 Product Requirements.

D Supply Faucet:
1. Wall Mounted Faucet Manufacturers:
   a. Kohler Company: www.kohler.com.
   b. Zurn Industries: www.zurn.com.
2. ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 2.2 gpm, indexed handles.

E Sensor Operated Faucet:
1. Power Supply:
   a. Wired: 6 VDC, field-wired into dedicated or common power supply.
   b. Wireless:
      1) Battery: Replaceable alkaline or lithium type with 200,000 cycles, minimum.
      2) Light Cell: Photovoltaic or infra-red cell that transforms both sunlight and artificial light into electrical energy for use and battery charging.
      3) Low Battery Warning: Provide red or yellow colored indicator to light periodically at 30 days of remaining capacity and continuously 2 weeks prior to get fully discharged.
2. Manufacturers:
   a. American Standard, Inc: www.americanstandard-us.com.
   b. Chicago Faucet Company: www.chicagofaucets.com.
   c. Moen Incorporated: www.moen.com.
   d. Powers Controls: www.powerscontrols.com.
   e. Sloan Valve Company: www.sloanvalve.com.
   f. Toto USA: www.totousa.com.
   g. Zurn Industries, LLC: www.zurn.com.
   h. Substitutions: See Division 01 Product Requirements.

F Thermostatic Mixing Valve:
1. ASSE 1070 listed with combination stop, strainer, and check valves, and flexible stainless steel connectors.
2. Manufacturers:
   a. Acorn Controls: www.acorneng.com.
   b. Haws Company
   c. Leonard Valve Company
   d. Substitutions: See Division 01 Product Requirements.

2.07 WALL-HUNG, SOLID SURFACE, MULTISTATION LAVATORY UNITS

A Manufacturers:
1. Zurn Industries, LLC: www.zurn.com.
2. Willoby Industries

3. Bradley Corporation
4. Substitutions: See Division 01 Product Requirements.

B Sensor-Operated Faucets:
1. High profile metering faucet with infrared and external temperature control.
2. Vandal-resistant meeting requirements of ASME A112.18.1 and ADA Standards compliant.
3. Body: Polished, chrome-plated commercial solid cast brass, with 4 inch (102 mm) centerset mounting with anti-rotation trim plate.
4. Tempered Water Supply: ADA Standards compliant lever on faucet body.
5. Aerator: Flow rate of 0.5 gpm at 20 to 80 psi operating range.
6. Sensor Module: Water conserving, vandal-resistant adjustable sensor unit with timing turn-off delay and stationary object automatic timed cutoff, with battery diagnostic light, serviceable from above deck.
7. Power Supply: 6 VDC lithium battery and single 115 VAC plug-in adapter.

2.08 UNDER-LAVATORY PIPE SUPPLY COVERS

A Manufacturers:
1. Plumberex Specialty Products, Inc: www.plumberex.com.
2. Substitutions: See Division 01 Product Requirements.

B General:
1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
2. Adhesives, sewing threads and two ply laminated materials are prohibited.
3. Exterior Surfaces: Smooth nonabsorbent with no finger recessed indentations for easy cleaning.
4. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
   a. Provide one piece injected molded design with internal bridge at top of J-bend to prevent separating.
   b. Comply with ASTM E84 for flame and smoke development.
   c. Comply with ASTM C1822 Type III for covers on accessible lavatory piping.
   d. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
   e. Comply with ICC A117.1.
5. Color: High gloss white.
6. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.

2.09 BI-LEVEL, ELECTRIC WATER COOLERS

A Manufacturers:
1. Elkay Manufacturing Company: www.elkay.com.
2. Oasis International: www.oasiscoolers.com.
3. Substitutions: See Division 01 Product Requirements.

B Water Cooler: Bi-level, electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

C Bottle Filler: Materials to match fountain.

D Products:

1. Haws Corporation; Dual Wall Mount Fountains: www.hawsco.com.
2. Oasis International: www.oasiscoolers.com.

2.10 MOP SINKS

A Manufacturers:
1. Acorn Engineering Company: www.acorneng.com.
2. Just Manufacturing Company: www.justmfg.com.
3. Metcraft Industries, Inc: metcraftindustries.com.
4. Zurn Industries, LLC: www.zurn.com.
5. Substitutions: See Division 01 Product Requirements.

B Terrazzo Mop Sink Manufacturers:
1. Acorn Engineering Company: www.acorneng.com.
2. American Bath Group: www.americanbathgroup.com.
3. Just Manufacturing Company: www.justmfg.com.
4. Zurn Industries, LLC: www.zurn.com.
5. Fiat Products
6. Substitutions: See Division 01 Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that walls and floor finishes are prepared and ready for installation of fixtures.
B Verify that electric power is available and of the correct characteristics.
C Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

A Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A Install each fixture with trap, easily removable for servicing and cleaning.
B Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
C Install components level and plumb.
D Install and secure fixtures in place with wall supports and bolts.
E Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

A Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A Clean plumbing fixtures and equipment.

3.07 PROTECTION

A Protect installed products from damage due to subsequent construction operations.
B Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 224000

SECTION 230130.51

HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Cleaning of HVAC duct system, equipment, and related components.

1.02 DEFINITIONS
- A HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.

1.03 REFERENCE STANDARDS
- A ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
- B NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System; 2021.
- C UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- D UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT
- A Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

2.02 REPLACEMENT PRODUCTS
- A Fibrous Glass Insulation: Provide material complying with UL 181 equivalent to existing material in quality and thickness.

2.03 SURFACE TREATMENTS
- A Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.
- B Surface Coating for Fibrous Glass Materials: Water-based, zero VOC; flame spread index less that 25, smoke developed index less than 450, Class A, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS
- A Comply with applicable federal, state, and local requirements.

B Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
C Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
D Obtain Owner's approval of proposed temporary locations for large equipment.
E Designate a decontamination area and obtain Owner's approval.
F If unforeseen mold or other biological contamination is encountered, notify Architect/Engineer immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

A When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
B Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
C Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
D Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
E Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

A Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
B Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
C Ducts: Mechanically clean all portions of ducts.
D Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
E Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
F Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.
G Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
H Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

A Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.

B At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
C Reseal new openings in accordance with NADCA Standard 05.
D Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
E When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

A Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
B Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
C Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
D Notify Architect/Engineer when cleaned components are ready for inspection.
E When directed, re-clean components until they pass.
F Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ANTI-MICROBIAL TREATMENT

A When directed, apply anti-microbial treatment to internal surfaces.
B Apply anti-microbial agent after removal of surface deposits and debris.
C Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.
D Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

3.07 ADJUSTING

A After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.08 WASTE MANAGEMENT

A Double-bag waste and debris in 6 mil, 0.006 inch thick polyethylene plastic bags.
B Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 230130.51

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A General construction and requirements.
- B Applications.
- C Single phase electric motors.
- D Three phase electric motors.
- E Electronically Commutated Motors (ECM).

1.02 RELATED REQUIREMENTS
- A Division 26 - Wiring Connections: Electrical characteristics and wiring connections.
- B Division 26 - Enclosed Controllers

1.03 REFERENCE STANDARDS
- A ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.
- C NEMA MG 00001 - Motors and Generators; 2024.
- D NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E Operation Data: Include instructions for safe operating procedures.
- F Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE
- A Manufacturer Qualifications: Company specializing in manufacture of electric motors, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B Comply with NFPA 70.
- C Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING
- A Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY
- A See Dev 017700 Closeout Procedures for additional warranty requirements.
- B Provide three year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

A Electrical Service:
1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
2. Motors Larger than 1/2 Horsepower: Refer to drawings for voltage, phase, and Hertz.

B Nominal Efficiency:
1. Open Motor with Two Poles: 82.5.
2. Open Motor with Four Poles: 82.5.
3. Open Motor with Six Poles: 50.0.
4. Enclosed Motor with Two Poles: 75.5.
5. Enclosed Motor with Four Poles: 82.5.
6. Enclosed Motor with Six Poles: 50.0.

C Construction:
1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 104 degrees F environment.
3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.
4. Motors with frame sizes 254T and larger: Energy efficient type.
5. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D Motor Characteristics:
1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

E Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

F Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

G Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

H Wiring Terminations:
1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

A The equipment descriptions listed in the section may not all be used on this project. Refer to the Schedules on the drawings for the specific application for each type of motor. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

B Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

C Single phase motors for shaft mounted fans, oil burners, and centrifugal pumps: Split phase type.

D Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.

E Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.
F Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.
G Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.
H Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.
I Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS
A Starting Torque: Less than 150 percent of full load torque.
B Starting Current: Up to seven times full load current.
C Breakdown Torque: Approximately 200 percent of full load torque.
D Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
E Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.15 Service Factor, prelubricated ball bearings.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS
A Starting Torque: Exceeding one fourth of full load torque.
B Starting Current: Up to six times full load current.
C Multiple Speed: Through tapped windings.
D Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.15 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.05 SINGLE PHASE POWER - CAPACITOR START MOTORS
A Starting Torque: Three times full load torque.
B Starting Current: Less than five times full load current.
C Pull-up Torque: Up to 350 percent of full load torque.
D Breakdown Torque: Approximately 250 percent of full load torque.
E Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
F Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
G Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.15 Service Factor, prelubricated ball bearings.

2.06 THREE PHASE POWER - SQUIRREL CAGE MOTORS
A Starting Torque: Between 1 and 1-1/2 times full load torque.
B Starting Current: Six times full load current.
C Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
D Design, Construction, Testing, and Performance: Comply with NEMA MG 00001 for Design B motors.
E Insulation System: NEMA Class B or better.
F Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
G Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 26.

I Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J Sound Power Levels: To NEMA MG 00001.

K Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

L Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

M Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

N Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

2.07 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A Applications:

1. As indicated on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 230513

SECTION 230516

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Flexible pipe connectors.
- B Expansion joints and compensators.
- C Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS
- A Section 232300 - Refrigerant Piping.

1.03 REFERENCE STANDARDS
- A ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- B ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- C EJMA (STDS) - EJMA Standards; Tenth Edition.
- D UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data:
  1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C Samples: Submit two low pressure compensators 3/4 inch in size.
- D Design Data: Indicate selection calculations.
- E Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- F Maintenance Data: Include adjustment instructions.
- G Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- H Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Division 01 - Product Requriements for additional provisions.
  2. Extra Packing for Packed Expansion Joints: One set for each joint.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS
- A Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING
- A Manufacturers:
  1. Flex-Weld, Inc: www.kelcoind.com.
  2. Mercer Rubber Company: www.mercer-rubber.com.
  3. The Metraflex Company: www.metraflex.com.
  4. Unisource Manufacturing, Inc; Series 401, Stainless Steel Threaded Connectors: www.unisource-mfg.com.
  5. Substitutions: See Section 016000 - Product Requirements.
- B Inner Hose: Bronze.

C Exterior Sleeve: Single braided, stainless steel.
D Pressure Rating: 125 psi up to 12 inch.
E Maximum Service Temperature: 450 degrees F.
F End Connections: Flanged.
G Size: Use pipe sized units.
H Maximum offset: 3/4 inch on each side of installed center line.

2.03 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com.
2. The Metraflex Company: www.metraflex.com.
3. Unisource Manufacturing, Inc; Series 411, Bronze Braided Flex Connectors: www.unisource-mfg.com.
4. Substitutions: See Division 01 - Product Requirements.

B Inner Hose: Bronze.
C Exterior Sleeve: Braided bronze.
D Pressure Rating: 125 psi up to 2 inch.
E Maximum Service Temperature: 450 degrees F.
F End Connections: Flanged.
G Size: Use pipe sized units.
H Maximum offset: 3/4 inch on each side of installed center line.
I Application: Copper piping.

2.04 EXPANSION JOINTS - METAL BELLOWS TYPE

A Manufacturers:
1. Flex-Weld, Inc; Keflex 308/311 Series: www.kelcoind.com.
2. Substitutions: See Division 01 - Product Requirements.

B Provide shroud to protect from external damage and allows for the application of external insulation.
C Provide with tie rods to prevent over-compression or over-elongation.
D Pressure Rating: 125 psi and 400 degrees F.
E Maximum Compression: 1-3/4 inches.
F Maximum Extension: 1/4 inch.
G End Connections: Flanged.
H Size: Use pipe sized units.
I Application: Steel piping 2 inches and larger.

2.05 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

A Manufacturers:
1. Flex-Weld, Inc; Keflex 7Q Series - Quadra-Side: www.kelcoind.com.
2. Mercer Rubber Company: www.mercer-rubber.com.
3. The Metraflex Company: www.metraflex.com.
4. Substitutions: See Division 01 - Product Requirements.

B Pressure Rating: 125 psi and 400 degrees F.
C Maximum Compression: 1-3/4 inches.
D Maximum Extension: 1/4 inch.
E End Connections: Externally pressurized with welded ends.
F Size: Use pipe sized units.
G Application: Steel piping 3 inches and under.

2.06 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

A Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com.

2. The Metraflex Company: www.metraflex.com.
3. Substitutions: See Division 01 - Product Requirements.

B Pressure Rating: 125 psi and 400 degrees F.
C Maximum Compression: 15/16 inch.
D Maximum Extension: 5/16 inch.
E Maximum Offset: 1/8 inch.
F End Connections: Flanged.
G Size: Use pipe sized units.
H Accessories: Internal flow liner and external shroud.
I Application: Steel piping over 2 inches.

2.07 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE CONNECTOR

A Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com.
2. The Metraflex Company; Cablesphere: www.metraflex.com.
3. Unisource Manufacturing, Inc; Series 301, Single Sphere Connectors: www.unisource-mfg.com.
4. Substitutions: See Division 01 - Product Requirements.

B Body Construction: Nylon-reinforced rubber tube.
C Cover and Tube Elastomer: EPDM and EPDM.
D End Connections: Carbon steel flanges.
E Maximum Compression: 1/2 inch.
F Maximum Elongation: 3/8 inch.
G Maximum Offset: 3/8 inch.
H Maximum Angular Movement: 15 degrees.
I Accessories: Control cables.
J Service Rating: Up to 150 psi at 200 degrees F.

2.08 EXPANSION JOINTS - TWO-PLY BRONZE BELLOWS TYPE

A Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com.
2. Mercer Rubber Company: www.mercer-rubber.com.
3. Substitutions: See Division 01 - Product Requirements.

B Construction: Bronze with anti-torque device, limit stops, internal guides.
C Pressure Rating: 125 psi and 400 degrees F.
D Maximum Compression: 1-3/4 inches.
E Maximum Extension: 1/4 inch.
F End Connections: Soldered.
G Size: Use pipe sized units.
H Application: Copper piping.

2.09 EXPANSION JOINTS - COMPENSATORS

A Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com.
2. The Metraflex Company: www.metraflex.com.
3. Unisource Manufacturing, Inc; Series 416, Expansion Compensators: www.unisource-mfg.com.
4. Substitutions: See Division 01 - Product Requirements.

B Type: Two-ply 304 stainless steel bellows with carbon steel shroud.
C Maximum Working Pressure: 200 psi.
D Maximum Working Temperatures: 400 degrees F.
E Maximum Compression: 1/2 inch.

F Maximum Extension: 5/32 inch.
G End Connections: Female copper sweat.
H Application: Copper piping up to 3 inches in size or steel piping up to 4 inches in size.

2.10 EXPANSION JOINTS - STEEL WITH PACKED SLIDING SLEEVE

A Manufacturers:
1. The Metraflex Company; MetraPak: www.metraflex.com.
2. Substitutions: See Division 01 - Product Requirements.
B Working Pressure and Temperature: Class 150.
C End Connections: Flanged.
D Size: Use pipe sized units.
E Application: Steel piping 2 inches and over.

2.11 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

A Working Pressure: 125 psi.
B Maximum Temperature: 250 degrees F.
C End Connections: Flanged.
D Size: Use pipe sized units.
E Application: Copper or steel piping 2 inches and over.

2.12 EXPANSION JOINTS - HOSE AND BRAID

A Manufacturers:
1. Flex-Weld, Inc; Keflex Ke-Loop: www.kelcoind.com.
2. The Metraflex Company; Metraloop: www.metraflex.com.
3. Unisource Manufacturing, Inc; V-Loop: www.unisource-mfg.com.
4. Substitutions: See Division 01 - Product Requirements.
B Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.
C Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure
D Maximum Working Pressure: 150 psi at 800 degrees F.
E Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment
1. Selected Product to Accommodate:
a. Compression and Expansion Axial Deflection: .
b. Angular Rotation: 15 degrees.
c. Force developed by 1.5 times specified maximum allowable operating pressure.
2. Provide necessary accessories including, but not limited to, swivel joints.

2.13 EXPANSION JOINTS - EXTERNALLY PRESSURIZED

A Manufacturers:
1. Flex-Weld, Inc; Keflex Externally-Pressurized Expansion Joints: www.kelcoind.com.
2. The Metraflex Company; Metragator: www.metraflex.com.
3. Unisource Manufacturing, Inc; Series EP: www.unisource-mfg.com.
4. Substitutions: See Division 01 - Product Requirements.
B Bellows Type: Two-ply, single bellows constructed of 304 stainless steel.
C Internal Liner: Carbon steel with internal and external guides.
D Specialty: Carbon steel anchor base, lifting lugs, and drain port with tapered plug.
E End Connections: Class 150, carbon steel, welded flange.
F Maximum Axial Compression: 4 inch.
G Maximum Working Pressure: 150 psi at 700 degrees F.
H Size: Use pipe sized units.
I Application: Steel piping 2 inches and over.

2.14 ACCESSORIES

A Stainless Steel Pipe: ASTM A269/A269M, seamless type, Grade TP304.

B Pipe Alignment Guides:

1. Manufacturers:
   a. Flex-Weld, Inc: www.kelcoind.com.
   b. The Metraflex Company; PGQ Glide Riser Guide: www.metraflex.com.
   c. Substitutions: See Division 01 - Product Requirements.
2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

C Engineered Riser Anchor Clamps:

1. Manufacturers:
   a. The Metraflex Company; Engineered Riser Anchor Clamp: www.metraflex.com.
   b. Substitutions: See Division 01 - Product Requirements.
2. Applications:
   a. Provide one clamp to serve as a riser clip.
      1) Verify the total load of filled pipe to be supported will be a safety factor of one less than the maximum loading of the clamp per the manufacturer's instructions.
   b. Provide one clamp above and one clamp below the slab to anchor pipe.
      1) Coordinate with the structural engineer to determine the maximum thrust loading calculated for the slab or floor structure. Use the maximum thrust loading calculations to verify the clamps will be a safety factor of one less than the maximum loading of clamp per the manufacturer's instructions.
3. Provide two piece, ductile iron in compliance with ASTM A536. Use with metal pipes with an outer diameter of 2.5 inches to 8 inches.

D Swivel Joints:

1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

G Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION 230516

SECTION 230517

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Pipe sleeves.
- B Stack-sleeve fittings.
- C Pipe-sleeve seals.
- D Sleeve-seal fittings.
- E Grout.
- F Silicone sealants.

1.02 RELATED REQUIREMENTS
- A Division 09 - Interior Painting: Preparation and painting of interior piping systems.
- B Section 230523 - General-Duty Valves for HVAC Piping.
- C Section 230553 - Identification for HVAC Piping and Equipment: Piping identification.
- D Section 230716 - HVAC Equipment Insulation.
- E Section 230719 - HVAC Piping Insulation.

1.03 REFERENCE STANDARDS
- A ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C FM (AG) - FM Approval Guide; Current Edition.
- D UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS
- A See Division 01 - Submittal Procedures.
- B Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor, roof, and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Division 01 - Product Requirements, for additional provisions.
  2. Extra Valve Stem Packings: Two for each type and size of valve.

1.05 QUALITY ASSURANCE
- A Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B Installer Qualifications: Company specializing in performing work of the type specified this section.
  1. Minimum three years experience.
  2. Approved by manufacturer.
- C Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING
- A Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY
- A See Division 01 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

B Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.

C Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

D PVC Pipe Sleeves: ASTM D1785, Schedule 40.

E Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

F Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G Vertical Piping:

1. Sleeve Length: 1 inch above finished floor.
2. Provide sealant for watertight joint.
3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

H Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

I Pipe Passing Through Below Grade Exterior Walls:

1. Zinc coated or cast iron pipe.
2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

J Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:

1. Galvanized steel pipe or black iron pipe with asphalt coating.
2. Connect sleeve with floor plate except in mechanical rooms.

K Pipe Passing Through Mechanical, Laundry, and Mechanical Room Floors above Basement:

1. Galvanized steel pipe or black iron pipe with asphalt coating.
2. Connect sleeve with floor plate except in mechanical rooms.

L Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect/Engineer.

M Clearances:

1. Provide allowance for insulated piping.
2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814.

2.02 STACK-SLEEVE FITTINGS

A Description: Manufactured, Dura-coated or duco-coated galvanized cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.03 PIPE-SLEEVE SEALS

A Manufacturers:

1. Link Seal: www.garlock.com
2. Substitutions: None

B Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
   a. Sealing Elements: EPDM-rubber, High-temperature-silicone, Nitrile (Buna N)] interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
   b. Pressure Plates: Stainless steel, Type 316.
   c. Connecting Bolts and Nuts: Stainless steel, Type 316, of length required to secure pressure plates to sealing elements.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening, 20 psi.
3. Size and select seal component materials in accordance with service requirements.
4. Service Requirements:
   a. Corrosion resistant.
   b. Oil, fuel, gas, and solvent resistant.
   c. Underground, buried, and wet conditions.
   d. Fire Resistant: 1 hour, UL (DIR) approved.
   e. High Temperature, up to 400 degrees F.
   f. Low temperature, down to minus 67 degrees F.
5. Glass-reinforced plastic pressure end plates.

C Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
2. Combined packing and seal compound is to match partition fire-resistance hourly rating.

D Pipe Sleeve Material:
1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
2. Masonry Structures: Sheet metal or fiber.

E Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

F Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch thick.

G Pipeline-Casing Seals:
1. Coated boltless casing-spacer for 4 inch carrier pipe.
2. Coated boltless modular seal for 6 inch carrier pipe.
3. Carbon steel band with risers for 12 inch carrier pipe.
4. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

2.04 SLEEVE-SEAL FITTINGS

A Description:
1. Manufactured plastic, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
2. Plastic or rubber waterstop collar with center opening to match piping OD.

2.05 GROUT

A Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

B Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C Design Mix: 5000-psi, 28-day compressive strength.

D Packaging: Premixed and factory packaged.

2.06 SILICONE SEALANTS

A Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.

B Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM

C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

C Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 EXECUTION

3.01 PREPARATION

A Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B Install piping to conserve building space, to not interfere with use of space and other work.

C Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

E Structural Considerations:

1. Do not penetrate building structural members unless indicated.

F Provide sleeves when penetrating footings, floors, walls, partitions, and roofs. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
2. Aboveground Piping:
   a. Pack solid using mineral fiber in compliance with ASTM C592.
   b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.
4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

G Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

H Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

I Manufactured Sleeve-Seal Systems:

1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   a. Sleeves are not required for core-drilled holes.
4. Locate piping in center of sleeve or penetration.
5. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
6. Tighten bolting for a water-tight seal.
7. Install in accordance with manufacturer's recommendations.

J When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

A Upon completion of work, clean all parts of the installation.

B Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 230517

SECTION 230519

METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Positive displacement meters.
- B Flow meters.
- C Electromagnetic flow meters.
- D Pressure gauges and pressure gauge taps.
- E Thermometers and thermometer wells.
- F Static pressure gauges.
- G Filter gauges.

1.02 RELATED REQUIREMENTS
- A Section 230923 - Direct-Digital Control System for HVAC.

1.03 REFERENCE STANDARDS
- A ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).
- B ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- C ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2017).
- D ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- E ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- F AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
- G AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- H Modbus (PS) - The Modbus Organization Communications Protocol.; Latest Update.
- I NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- J UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C Project Record Documents: Record actual locations of components and instrumentation.
- D Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.05 FIELD CONDITIONS
- A Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)
- A Manufacturers:
  1. Dwyer Instruments, Inc: www.dwyer-inst.com.
  2. FMC Technologies: www.fmctechnologies.com.

3. Venture Measurement, a Danaher Corporation Company: www.venturemeasurement.com.
4. Substitutions: See Division 01 - Product Requirements.

B AWWA C700, positive displacement disc type suitable for fluid with metal alloy main case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading.

C Meter: Brass body turbine meter with magnetic drive register.

2.02 HEAT CONSUMPTION METERS

A Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. FMC Technologies: www.fmctechnologies.com.
3. Venture Measurement, a Danaher Corporation Company: www.venturemeasurement.com.
4. Substitutions: See Division 01 - Product Requirements.

B Meter: Brass body turbine meter with magnetic drive register, platinum temperature sensors.
1. Maximum Service Temperature: 200 degrees F.

2.03 LIQUID FLOW METERS

A Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. McCrometer: www.mccrometer.com.
3. Venture Measurement, a Danaher Company: www.venturemeasurement.com.
4. Veris Industries: www.veris.com.
5. Substitutions: See Division 01 - Product Requirements.

B Calibrated ASME MFC-3M Venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.

C Annular element flow stations with meter set.
1. Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
   a. Pressure rating: 275 psi.
   b. Maximum temperature: 400 degrees F.
   c. Accuracy: Plus 0.55 percent to minus 2.30 percent.

2.04 ELECTROMAGNETIC FLOW METERS

A Manufacturers:
1. Badger Meter, Inc: www.badgermeter.com.
2. Foxboro, a brand of Schneider Electric: www.schneider-electric.us.
3. Onicon, Inc: www.onicon.com.
4. Substitutions: See Division 01 - Product Requirements.

B Inline Type: Class 150 flanged with hard rubber liner, 1 inch.

C Insertion Type: Include ball valve and threadolet.

D Liquid Flow Capacity Range: As indicated on drawings.

E Construction: Stainless steel or aluminum sensor with integral NEMA EN 10250 Type 4 or 4X stainless steel or aluminum enclosure to hold thermal mass sensor and circuits with numeric display for consumption reading.

F Liquid Conductivity: 5 mS/cm, minimum.

G Accuracy: 0.02 percent of value applied to manufacturer-specified velocity range.

H Output: Two-wire, 0 to 10 VDC, non-loop powered.

I Network Communications Link: Modbus (PS) Modbus RTU.

J BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.

K Service Pressure and Temperature: Up to 400 psi and 15 to 250 degrees F liquid side, 150 degrees F ambient.

2.05 PRESSURE GAUGES

A Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Moeller Instrument Company, Inc: www.moellerinstrument.com.
3. Omega Engineering, Inc: www.omega.com.

B Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

2.06 PRESSURE GAUGE TAPPINGS

A Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

B Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.07 STEM TYPE THERMOMETERS

A Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Omega Engineering, Inc: www.omega.com.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com.

B Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Calibration: Degrees F.

C Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.

2.08 DIAL THERMOMETERS

A Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Omega Engineering, Inc: www.omega.com.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
4. Substitutions: See Division 01 - Product Requirements.

B Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
1. Size: 5 inch diameter dial.
2. Lens: Clear glass.
3. Accuracy: 1 percent.
4. Calibration: Degrees F.

C Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
1. Size: 3 inch diameter dial.
2. Lens: Clear glass.
3. Accuracy: 1 percent.
4. Calibration: Degrees F.

D Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.
1. Size: 4-1/2 inch diameter dial.
2. Lens: Clear glass.
3. Length of Capillary: Minimum 5 feet.
4. Accuracy: 2 percent.
5. Calibration: Degrees F.

2.09 THERMOMETER SUPPORTS

A Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.10 TEST PLUGS

A Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

B Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

C Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Viton core for temperatures up to 400 degrees F.

2.11 STATIC PRESSURE GAUGES

A Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Omega Engineering, Inc: www.omega.com.
3. Veris Industries: www.veris.com.
4. Weksler Glass Thermometer Corp: www.wekslerglass.com.
5. Substitutions: See Division 01 - Product Requirements.

B 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

C Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.

C Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

D Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.

E Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
F Install thermometers in air duct systems on flanges.
G Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 230943. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
H Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
I Coil and conceal excess capillary on remote element instruments.
J Provide instruments with scale ranges selected according to service with largest appropriate scale.
K Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
L Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
M Locate test plugs adjacent thermometers and thermometer sockets.

3.02 SCHEDULE

A Positive Displacement Meters, Location:
1. Condensate return.
2. Expansion tank make-up.
3. Cooling tower make-up.

B Flow Meters, Location:
1. Heating water system.
2. Condensate water system.
3. Chilled water system.

C Pressure Gauges, Location and Scale Range:
D Refer to Drawing Schedules for capacity range for each application.
E Pressure Gauge Tappings, Location:
1. Control valves 3/4 inch & larger - inlets and outlets.
2. Major coils - inlets and outlets.
3. Heat exchangers - inlets and outlets.
4. Chiller - inlets and outlets.
5. Boiler - inlets and outlets.

F Stem Type Thermometers, Location and Scale Range:
G Refer to Drawing Schedules for capacity range for each application.
H Thermometer Sockets, Location:
I Dial Thermometers, Location and Scale Range:
J Refer to Drawing Schedules for capacity range for each application.
K Static Pressure and Filter Gauges, Location and Scale Range:
L Refer to Drawing Schedules for capacity range for each application.

END OF SECTION 230519

SECTION 230523

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Angle valves.
- B Globe valves.
- C Ball valves.
- D Butterfly valves.
- E Check valves.
- F Gate valves.
- G Plug valves.
- H Chainwheels.

1.02 RELATED REQUIREMENTS
- A Section 230553 - Identification for HVAC Piping and Equipment.
- B Section 230716 - HVAC Equipment Insulation.
- C Section 230719 - HVAC Piping Insulation.

1.03 ABBREVIATIONS AND ACRONYMS
- A CWP: Cold working pressure.
- B EPDM: Ethylene propylene copolymer rubber.
- C NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D NRS: Nonrising stem.
- E OS&Y: Outside screw and yoke.
- F PTFE: Polytetrafluoroethylene.
- G RS: Rising stem.
- H TFE: Tetrafluoroethylene.
- I WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS
- A ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- E ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- F ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- G ASME B31.1 - Power Piping; 2022.
- H ASME B31.9 - Building Services Piping; 2020.
- I ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- J ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).
- K ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2021.
- L ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts; 2018, with Editorial Revision (2019).

M ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
N ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
O ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
P AWWA C606 - Grooved and Shouldered Joints; 2015.
Q MSS SP-45 - Drain and Bypass Connections; 2020.
R MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
S MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
T MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
U MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
V MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
W MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.

1.05 SUBMITTALS

A See Division 01 Submittal Procedures.
B Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
C Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
D Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
E Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
1. See Division 01 - Prodcut Requirements for additional provisions.

1.06 QUALITY ASSURANCE

A Manufacturer:
1. Obtain valves for each valve type from single manufacturer.
2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
B Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

A Prepare valves for shipping as follows:
1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.
6. Adjust butterfly valves to closed or partially closed position.
B Use the following precautions during storage:
1. Maintain valve end protection and protect flanges and specialties from dirt.
a. Provide temporary inlet and outlet caps.
b. Maintain caps in place until installation.
2. Store valves in shipping containers and maintain in place until installation.
a. Store valves indoors in dry environment.
b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
C Exercise the following precautions for handling:

1. Handle large valves with sling, modified to avoid damage to exposed parts.
2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

B Provide the following valves for the applications if not indicated on drawings:
1. Throttling (Hydronic): Butterfly, Ball, Globe, and Angle.
2. Throttling (Steam): Butterfly, Gate, Ball, and Plug.
3. Isolation (Shutoff): Butterfly, Gate, Ball, and Plug.
4. Swing Check (Pump Outlet):
   a. Size 2 inch and Smaller: Bronze with bronze disc.
   b. Size 2-1/2 inch and Larger: Iron with lever and weight, lever and spring, center-guided metal, or center-guided with resilient seat.

C Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

D Required Valve End Connections for Non-Wafer Types:
1. Steel Pipe:
   a. Size 2 inch and Smaller: Threaded ends.
   b. Size 2-1/2 inch and Larger: Grooved ends.
2. Copper Tube:
   a. Size 2 inch and Smaller: Threaded ends, except solder-joint valve-ends.
   b. Size 2-1/2 inch and Larger: Grooved ends.
3. Steam and Steam Condensate Pipe: Grooved ends not acceptable.

E Chilled Water Valves:
1. Size 2 inch and Smaller, Brass and Bronze Valves:
   a. Threaded ends.
   b. Globe: Bronze disc, Class 125.
2. Size 2-1/2 inch and Larger, Iron Valves:
   a. 2-1/2 inch to 4 inch: Threaded ends.
   b. Ball: 2-1/2 NPS to 10 inch, Class 150.
   c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
   d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
   e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
   f. Butterfly: High performance, single flange, Class 300.
   g. Swing Check: Metal seats, Class 250.
   h. Swing Check with Closure Control: 2-1/2 inch to 12 inch, lever and spring, Class 125.
   i. Grooved-End Check: 3 inch to 12 inch, 300 CWP.
   j. Center-Guided Check: Compact-wafer, metal seat, Class 125.
   k. Plate-Type Check: Single plate, metal seat, Class 125.
   l. Gate: NRS, Class 125.
   m. Globe: Class 125.
   n. Lubricated Plug: Regular gland, threaded, Class 125.
   o. Eccentric Plug: Resilient seating, 175 CWP.

F Heating Hot Water Valves:
1. Size 2 inch and Smaller, Brass and Bronze Valves:
   a. Threaded ends.

b. Angle: Bronze disc, Class 125.
c. Ball: Full port, one piece, brass trim.
d. Swing Check: Bronze disc, Class 125.
e. Gate: NRS, Class 125.

2. Size 2-1/2 inch and Larger, Iron Valves:
a. 2-1/2 inch to 4 inch: Threaded ends.
b. Ball: 2-1/2 inch to 10 inch, Class 150.
c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
f. Butterfly: High performance, single flange, Class 150.
g. Swing Check: Metal seats, Class 125.
h. Swing Check: 2-1/2 inch to 12 inch, lever and spring closure control, Class 125.
i. Grooved-End Swing Check: 3 inch to 12 inch, 300 CWP.
j. Center-Guided Check: Compact-wafer, metal seat, Class 125.
k. Plate-Type Check: Single plate, metal seat, Class 125 .
l. Gate: NRS, Class 125.
m. Globe: 2-1/2 inch to 12 inch, Class 125.

2.02 GENERAL REQUIREMENTS

A Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B Valve Sizes: Match upstream piping unless otherwise indicated.

C Valve Actuator Types:
1. Gear Actuator: Quarter-turn valves NPS 4 and larger.
2. Handwheel: Valves other than quarter-turn types.
3. Hand Lever: Quarter-turn valves NPS 4 and smaller.
4. Wrench: Plug valves with square heads.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.

E Memory Stops: Fully adjustable after insulation is installed.

F Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.

G General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Power Piping Valves: ASME B31.1.
3. Building Services Piping Valves: ASME B31.9.

H Bronze Valves:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

I Valve Bypass and Drain Connections: MSS SP-45.

J Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

A CWP Rating: Class 125: 200 psi and Class 150: 300 psi:
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded.
4. Stem: Bronze.
5. Disc: Bronze.
6. Packing: Asbestos free.
7. Handwheel: Malleable iron or bronze.

2.04 BRONZE, GLOBE VALVES

A CWP Rating: Class 125: 200 psi:
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded or solder joint.
4. Stem and Disc: Bronze.
5. Packing: Asbestos free.
6. Handwheel: Malleable iron or bronze.

B CWP Rating: Class 150: 300 psi:
1. Comply with MSS SP-80, Type 2.
2. Body: Bronze; ASTM B62, with integral seat and union ring bonnet.
3. Ends: Threaded.
4. Stem and Disc: Bronze.
5. Packing: Asbestos free.
6. Handwheel: Malleable iron or bronze.

2.05 BRONZE, GLOBE VALVES

A Ratings for Class 125 and Class 250:
1. Class 125:
   a. WOG Rating: 200 psi.
   b. WSP Rating: 125 psi, saturated.
2. Class 250: WOG Rating; 300 psi.
3. Comply with MSS SP-80, Type 1.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. End Connections: Threaded or solder.
6. Bonnet: NRS; Nonrising Stem.
7. Nonrising Stem: Bronze.
8. Disc: PTFE.
9. Packing: Asbestos free.
10. Handwheel Operator: Malleable Iron.

2.06 IRON, GLOBE VALVES

A CWP Ratings: Class 125: 200 psi and Class 250: 500 psi:
1. Comply with MSS SP-85, Type I.
2. Body: Gray iron; ASTM A126, with bolted bonnet.
3. Ends: Flanged.
4. Trim: Bronze.

5. Packing and Gasket: Asbestos free.
6. Operator: Handwheel or chainwheel.

2.07 CARBON STEEL, GLOBE VALVES

A Class 150:

1. Body: ASTM A216/A216M.
2. WOG Rating: 150 psi.
3. Bonnet: NRS; Nonrising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Malleable Iron handwheel.
7. Pressure and Temperature Rating: ASME B16.34.

2.08 STAINLESS STEEL, GLOBE VALVES

A Class 125:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 200 psi.
3. Bonnet: NRS; Nonrising Stem.
4. End Connections: Threaded.
5. Stem Packing: PTFE.
6. Operator: Malleable Iron handwheel.
7. Temperature Range: Minus 4 to 356 degrees F.
8. Pressure and Temperature Rating: ASME B16.34.

B Class 150:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. Bonnet: NRS; Nonrising Stem.
3. WOG Rating: 150 psi.
4. End Connections: Flanged.
5. Trim: Stainless steel.
6. Packing and Gasket: Asbestos free.
7. Operator: Maleable Iron handwheel.
8. Pressure and Temperature Rating: ASME B16.34.

2.09 BRASS, BALL VALVES

A Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. CWP Rating: 600 psi.
4. Body: Forged brass.
5. Ends: Threaded.
6. Seats: PTFE or TFE.
7. Ball: Stainless steel, vented.
8. Manufacturers:

2.10 BRONZE, BALL VALVES

A General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. CWP Rating: 600 psi.
4. End Connections: Pipe thread.

5. Seats: PTFE.

2.11 STAINLESS STEEL, BALL VALVES

A Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 1,000 psi.
4. Vacuum Rating: 26.9 in-Hg.
5. Seats: PFTE.
6. Stem: Stainless steel, blowout proof.
7. Ball: Stainless steel, vented.
8. Bolts: Stainless steel.

2.12 CARBON STEEL, BALL VALVES

A Class 150, Full Port, Stainless Steel Trim, Flanged:

1. Comply with MSS SP-72.
2. WOG Rating: 300 psi.
3. WSP Rating: 150 psi.
4. Body: Carbon steel, ASTM A216/A216M, Type WCB.
5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel, vented.
8. Size: 1/2 to 12 inches.

B Class 150, Full Port, Stainless Steel Trim, Threaded with Lockable Handle:

1. WOG Rating: 125 psi.
2. WSP Rating: 150 psi.
3. Vacuum Rating: 14.2 psi.
4. Body: Carbon steel, ASTM A216/A216M.
5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.
8. Size: 1/4 to 2 inches.

C Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 250 psi.
3. CWP Rating: 2,000 psi.
4. Vacuum Rating: Down to 29.3 in-Hg.
5. Seats: TFM.
6. Stem: Stainless steel, blowout proof.
7. Ball: Stainless steel, vented.
8. Bolts: Stainless steel.
9. End Connections: Threaded or socket weld.
10. Operator: Lockable handle.
11. Pressure and Temperature Rating: ASME B16.34.

2.13 IRON, BALL VALVES

A Split Body, Full Port:

1. Comply with MSS SP-72.
2. CWP Rating: 200 psi.
3. Body: ASTM A126, gray iron.
4. Ends: Flanged.
5. Seats: PTFE.

6. Stem: Stainless steel.
7. Ball: Stainless steel.

2.14 IRON, GROOVED-END BALL VALVES

A Class 200:

1. CWP Rating: 600 psi.
2. Body: Ductile iron; ASTM A536, Grade 65-45-12.
3. Ends: Grooved.
4. Seats: Teflon.
5. Stem: Nickel plated carbon steel.
6. Ball: Nickel plated carbon steel or Type 304 stainless steel.

2.15 IRON, SINGLE FLANGE BUTTERFLY VALVES

A Lug Style; Bidirectional dead-end service without use of downstream flange:

1. Comply with MSS SP-67, Type I.
2. Lug Style, CWP Ratings:
   a. Sizes 2 to 12 inch: 150 psi.
   b. Sizes 14 to 24 inch: 100 psi.
   c. Vacuum Service: Down to 29.9 in-Hg.
3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
4. Stem: One or two-piece stainless steel.
5. Seat: NBR.
6. Disc: Coated ductile iron.
7. Removable Manual Actuator: Lockable handle or worm-gear-connected handwheel with open/close position indication.
8. Service Temperature Range: Minus 30 to 250 degrees F.
9. Operator: Gear operator with handwheel over direct-mount actuator base.

2.16 IRON, GROOVED-END BUTTERFLY VALVES

2.17 HIGH-PERFORMANCE, SINGLE FLANGE BUTTERFLY VALVES

A Lug type; Bidirectional dead end service without downstream flange:

1. Comply with MSS SP-68.
2. Class 150: CWP Rating: 285 psi at 100 degrees F.
3. Body: Provide carbon steel, cast iron, ductile Iron, or stainless steel.
4. Seat: Metal or reinforced PTFE.
5. Offset stem: Stainless steel.
6. Disc: Carbon steel.
7. Operator: Gear operator with handwheel over direct-mount actuator base.

2.18 BRASS, HORIZONTAL SWING CHECK VALVES

A Threaded End-Connections:

1. Class 125: CWP Rating: 200 psi.
2. Body: Forged brass.
3. Disc: Forged brass.
4. Hinge-Pin, Screw, and Cap: Forged brass.

2.19 BRONZE, LIFT CHECK VALVES

A Class 125:

1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
2. CWP Rating: 200 psi.
3. Design: Vertical flow.
4. Body: Bronze.
5. Ends: Threaded.

6. Disc (Type 1): Bronze.
7. Disc (Type 2): NBR or PTFE.

2.20 BRONZE, SWING CHECK VALVES

A Class 125:
1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. WSP Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded or soldered.
6. Disc: Bronze.

B Class 150:
1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. CWP Rating: 300 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded or soldered.
6. Disc: Bronze.

2.21 IRON, FLANGED END SWING CHECK VALVES

A Class 125:
1. 150 psi with metal seats.
2. 200 psi with metal seats and nonmetallic-to-metal seats.

2.22 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

A Class 125:
1. Comply with MSS SP-71, Type I.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
4. Body Design: Clear or full waterway.
5. Body Material: ASTM A126, gray iron with bolted bonnet.
6. Ends: Flanged.
7. Trim: Bronze.
8. Gasket: Asbestos free.
9. Closer Control: Factory installed, exterior lever, and spring or weight.

2.23 CARBON STEEL, SWING CHECK VALVES

A Class 150:
1. Design: T-pattern, horizontal or vertical flow.
2. Body and Disc: ASTM A216/A216M.
3. CWP Rating: 150 psi.
4. End Connections: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.

2.24 STAINLESS STEEL, SWING CHECK VALVES

A Class 150:
1. Body and Disc: ASTM A351/A351M-CF8M.
2. Design: T-pattern, horizontal or vertical flow.
3. CWP Rating: 150 psi.
4. Connection Ends: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.

2.25 IRON, GROOVED-END SWING CHECK VALVES

A Class 300:
1. CWP Rating: 300 psi.

2. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM or Nitrile.
4. Disc: Ductile iron.
5. Coating: Black, non-lead paint.

2.26 IRON, CENTER-GUIDED CHECK VALVES

A Class 125, Compact-Wafer:
1. Comply with MSS SP-125.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
4. Body Material: ASTM A126, gray iron.
5. Metal Seat: Bronze.

B Class 125, Globe:
1. Comply with MSS SP-125.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
4. Body Material: ASTM A126, gray iron.
5. Style: Spring loaded.
6. Ends: Flanged.
7. Metal Seat: Bronze.

C Class 150, Compact-Wafer:
1. Comply with MSS SP-125.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
3. Sizes 14 to 24 inch: CWP Rating; 250 psi.
4. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
5. Metal Seat: Bronze.

D Class 150, Globe:
1. Comply with MSS SP-125.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
3. Sizes 14 to 24 inch: CWP Rating; 250 psi.
4. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
5. Style: Spring loaded.
6. Ends: Flanged.

2.27 IRON, PLATE-TYPE CHECK VALVES

A Class 125 Single-Plate:
1. Comply with API STD 594.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
4. Body Design: Wafer, spring-loaded plate.
5. Body Material: ASTM A126, gray iron.
6. Resilient Seat: EPDM or NBR.

B Class 125 Dual-Plate:
1. Comply with API STD 594.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
4. Body Design: Wafer, spring-loaded plates.
5. Body Material: ASTM A126, gray iron.
6. Metal Seat: Bronze.

C Class 150 Dual-Plate:
1. Comply with API STD 594.

2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
3. Sizes 14 to 24 inch: CWP Rating; 250 psi.
4. Body Design: Wafer, spring-loaded plates.
5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Metal Seat: Bronze.

D Class 250 Wafer, Single-Plate:

1. Comply with API STD 594.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 400 psi.
3. Sizes 14 to 24 inch: CWP Rating; 300 psi.
4. Body Design: Wafer, spring-loaded plate.
5. Body Material: ASTM A126, gray iron.
6. Resilient Seat: EPDM or NBR.

2.28 BRONZE, GATE VALVES

A Rising Stem or OS&Y:

1. Pressure-Temperature Range: MSS SP-80, Type I.
2. Class 125:
   a. WSP Rating: 125 psi, saturated.
   b. CWP Rating: 200 psi.
3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
4. End Connections: Threaded or solder.
5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel Operator: Malleable iron, bronze, or aluminum.

B Nonrising Stem or NRS:

1. Pressure-Temperature Range: MSS SP-80, Type I.
2. Class 125:
   a. WSP Rating: 125 psi, saturated.
   b. CWP Rating: 200 psi.
3. Class 150: CWP Rating; 300 psi.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. Ends Connections: Threaded or solder.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron, bronze, or aluminum.

C Nonrising Stem (NRS) or Rising Stem (RS):

1. Comply with MSS SP-80, Type I.
2. Class 125: CWP Rating; 200 psi.
3. Class 150: CWP Rating; 300 psi.
4. Body Material: Bronze with integral seat and union-ring bonnet.
5. Ends: Threaded.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel: Malleable iron, bronze, or aluminum.

2.29 IRON, GATE VALVES

A NRS or OS&Y:

1. Comply with MSS SP-70, Type I.

2. Class 125:
   a. Sizes 2-1/2 to 12 inch, CWP Rating; 200 psi.
   b. Sizes 14 to 24 inch, CWP Rating; 500 psi.
3. Body Material: Gray iron with bolted bonnet.
4. Ends: Flanged.
5. Trim: Bronze.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.

2.30 CARBON STEEL, GATE VALVES

A Class 150:
1. Body and Disc: ASTM A216/A216M.
2. CWP Rating: 150 psi.
3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Pressure and Temperature Rating: ASME B16.34.

2.31 STAINLESS STEEL, GATE VALVES

A Class 125:
1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 125 psi.
3. Bonnet: NRS; Nonrising Stem.
4. End Connections: Threaded.
5. Adjustable Stem Packing: PTFE.
6. Operator: Handwheel.
7. Pressure and Temperature Rating: ASME B16.34.

B Class 150:
1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 150 psi.
3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Handwheel.
7. Pressure and Temperature Rating: ASME B16.34.

2.32 LUBRICATED PLUG VALVES

A Regular Gland and Cylindrical with Threaded Ends:
1. Comply with MSS SP-78, Type II.
2. Class 150:
   a. Sizes 2-1/2 to 12 inch , CWP Rating; 200 psi.
   b. Sizes 14 to 24 inch, CWP Rating; 150 psi.
3. Body Material: Cast iron with lubrication sealing system.
4. Pattern: Regular or short.
5. Plug: Cast iron or bronze with sealant groove.

2.33 ECCENTRIC PLUG VALVES

A Resilient Seating with Flanged Ends.
1. Comply with MSS SP-108.
2. CWP Rating: 175 psi minimum.
3. Body and Plug: Gray or ductile iron.
4. Bearings: Oil-impregnated bronze or Stainless Steel.
5. Stem-Seal Packing: Asbestos free.

6. Plug, Resilient-Seating Material: Approved for potable water service.

2.34 CHAINWHEELS

A Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball, butterfly, and plug valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

A Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
B Verify valve parts to be fully operational in all positions from closed to fully open.
C Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
D Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
B Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
C Install check valves where necessary to maintain direction of flow as follows:
1. Lift Check: Install with stem plumb and vertical.
2. Swing Check: Install horizontal maintaining hinge pin level.
3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.
D Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION 230523

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Support and attachment components.

1.02 RELATED REQUIREMENTS
- A Divison 03 - Cast-in-Place Concrete: Concrete equipment pads.
- B Section 230548 - Vibration and Seismic Controls for HVAC.

1.03 REFERENCE STANDARDS
- A ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- D ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- I ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- J ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
- L ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- M FM (AG) - FM Approval Guide; Current Edition.
- N MFMA-4 - Metal Framing Standards Publication; 2004.
- O MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- P UL (DIR) - Online Certifications Directory; Current Edition.
- Q UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Divsion 03.

1.05 SUBMITTALS
A See Division 01 Submittal Procedures.
B Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
C Installer's Qualifications: Include evidence of compliance with specified requirements.
D Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE
A Comply with applicable building code.

1.07 DELIVERY, STORAGE, AND HANDLING
A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS
A General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B Materials for Metal Fabricated Supports: Comply with Division 05.
C Prefabricated Trapeze-Framed Metal Strut Systems:
1. Manufacturers:
a. ABB Installation Products: electrification.us.abb.com.

b. B-Line, a brand of Eaton Corporation: www.eaton.com.
c. Elgen Manufacturing Company, Inc: www.elgenmfg.com.
d. Gripple, Inc: www.gripple.com.
e. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
f. Substitutions: See Division 01 - Product Requirments
g. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Strut Channel or Bracket Material:
   a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
5. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

D Strut Channels:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. Gripple, Inc; Universal Bracket: www.gripple.com.
   c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
   d. Substitutions: See Division 01 - Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

E Channel Nuts:
1. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring.

F Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2 inch diameter.
   b. Piping larger than 1 inch: 3/8 inch diameter.
   c. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

G Steel Cable:
1. Manufacturers:
   a. Ductmate Industries, Inc, a DMI Company: www.ductmate.com.
   b. Elgen Manufacturing Company, Inc: www.elgenmfg.com.
   c. Substitutions: See Division 01 - Product Requirements.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

H Cable Hanging System Kits:
1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com.
   b. Ductmate Industries, Inc: ductmate.com.
   c. Gripple, Inc: www.gripple.com.
   d. Substitutions: See Division 01 - Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Provide cable-wire in bulk or precut lengths with respective cable hangers as required to hold minimum weight of 120 lb.

I Thermal Insulated Pipe Supports:
1. Manufacturers:
   a. Buckaroos, Inc: www.buckaroos.com.
   b. KB Enterprises: www.snappitz.com.
   c. Substitutions: See Division 01 - Product Requirements.
2. General Requirements:
   a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
   b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
   c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
   d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
3. PVC Jacket:
   a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
   b. Minimum Service Temperature: Minus 40 degrees F.
   c. Maximum Service Temperature: 180 degrees F.
   d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
   e. Thickness: 60 mil.
   f. Connections: Brush on welding adhesive.
4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
5. Products:
   a. Buckaroos, Inc; CoolDry: www.buckaroos.com.
   b. Substitutions: See Division 01 - Product Requirements.

J Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up To 122 degrees F:
   a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
   b. Support From Below: MSS SP-58 Types 35 through 38.
3. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
   b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.

c. Sliding Support: MSS SP-58 Types 35 through 38.

K Nonpenetrating Pipe Supports:
1. Manufacturers:
   a. Green Link, Inc: www.greenlinkengineering.com.
   b. Substitutions: See Division 01 - Product Requirements.
   c. Source Limitations: Furnish channels/struts and associated fittings, accessories, and hardware produced by a single manufacturer.

L Roller Chairs:
1. Manufacturers:
   a. Substitutions: See Division 01 - Product Requirements.
   b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
3. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
4. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

M Pipe Stanchions:
1. Manufacturers:
   a. Anvil International: www.anvilintl.com.
   b. Substitutions: See Division 01 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

N Beam Clamps:
1. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
3. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
4. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
5. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
6. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
7. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
8. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
9. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

O Riser Clamps:

1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

P U-Bolts:
1. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 Type 24, carbon steel u-bolt for pipe support or anchoring.

Q Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

R Strut Clamps:
1. Manufacturers:
   a. Gripple Inc: www.gripple.com.
   b. Substitutions: See Division 01 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
4. Service Temperature Range: Minus 65 to 275 degrees F.

S Insulation Clamps:
1. Manufacturers:
   a. FNW: www.fnw.com.
   b. Substitutions: See Division 01 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Two bolt-type clamps designed for installation under insulation.
3. Material: Carbon steel with epoxy copper or zinc finish.

T Pipe Hangers:
1. Split Ring Hangers:
   a. Manufacturers:
      1) FNW: www.fnw.com.
      2) Substitutions: See Division 01 - Product Requirements.
      3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   b. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
   c. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
   d. Provide hanger rod and nuts of the same type and material for a given pipe run.
   e. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
2. Band Hangers, Adjustable:

a. Manufacturers:
1) Gripple, Inc: www.gripple.com.
2) Substitutions: See Division 01 - Product Requirements.
3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
b. MSS SP-58 Type 7 or 9, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

3. J-Hangers, Adjustable:
a. Manufacturers:
1) Substitutions: See Division 01 - Product Requirements.
2) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
b. MSS SP-58 Type 5, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

4. Swivel Ring Hangers, Adjustable:
a. Manufacturers:
1) FNW: www.fnw.com.
2) Substitutions: See Division 01 - Product Requirements.
3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
b. MSS SP-58 Type 10, epoxy-painted, zinc-colored.
c. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
d. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
e. Felt-Lining: Provide for uninsulated pipe to reduce noise and prevent static issues.

5. Clevis Hangers, Adjustable:
a. Manufacturers:
1) FNW: www.fnw.com.
2) Substitutions: See Division 01 - Product Requirements.
3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
b. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.
c. Felt-Lined: MSS SP-58 Type 1, zinc-plated, silicone-free carbon steel.
d. Light-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
e. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
f. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch.
g. FM (AG) listed: Pipe sizes 2-1/2 to 8 inch.

U Nonmetallic Pipe Hangers:
1. Manufacturers:
a. DecoShield Systems, Inc: www.decoshield.com.
b. Substitutions: See Division 01 - Product Requirements.

V Intermediate Pipe Guides:
1. Manufacturers:
a. Anvil International: www.anvilintl.com.
b. Substitutions: See Division 01 - Product Requirements.
c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Pipe Diameter 6 inch and Smaller: Provide minimum clearance of 0.16 inch.
3. Pipe Sizes 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
4. Pipe Size 10 inch: 0.75 inch U-bolt.
5. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
6. Pipe Sizes 18 to 30 inch: 1 inch U-bolt.
7. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

W Pipe Alignment Guides: Galvanized steel.
1. Manufacturers:
   a. Anvil International: www.anvilintl.com.
   b. Substitutions: See Division 01 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
3. Pipe Sizes 10 inch and Larger: Roller type.

X Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

Y Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Manufacturers:
   a. Anvil International: www.anvilintl.com.
   b. B-Line, a brand of Eaton Corporation: www.eaton.com.
   c. Erico International Corporation, a brand of Pentair: www.erico.com.
   d. Green Link, Inc: www.greenlinkengineering.com.
   e. PHP Systems/Design: www.phpsd.com.
   f. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
   g. Substitutions: See Division 01 - Product Requirements.
2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

Z Pipe Shields for Insulated Piping:
1. Manufacturers:
   a. Anvil International: www.anvilintl.com.
   b. FNW: www.fnw.com.
   c. Substitutions: See Division 01 - Product Requirements..
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 Type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel
3. General Construction and Requirements:
   a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
   b. Shields Material: UV-resistant polypropylene with glass fill.
   c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.

d. Minimum Service Temperature: Minus 40 degrees F.
e. Maximum Service Temperature: 178 degrees F.
f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

AA Anchors and Fasteners:
1. Manufacturers - Mechanical Anchors:
a. FNW: www.fnw.com.
b. Hilti, Inc: www.us.hilti.com.
c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com.
d. Powers Fasteners, Inc: www.powers.com.
e. Substitutions: See Division 01 - Product Requirements.
2. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
5. Hollow Masonry: Use toggle bolts.
6. Hollow Stud Walls: Use toggle bolts.
7. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
8. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
9. Sheet Metal: Use sheet metal screws.
10. Wood: Use wood screws.
11. Plastic and lead anchors are not permitted.
12. Powder-actuated fasteners are not permitted.
13. Hammer-driven anchors and fasteners are not permitted.
14. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
a. Comply with MFMA-4.
b. Channel Material: Use galvanized steel.
c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
15. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

BB Pipe Installation Accessories:
1. Copper Pipe Supports:
a. Manufacturers:
1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
2) Substitutions: See Division 01 - Product Requirements.
3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Thermal Insulated, Surface-Mounted Pipe Supports:
a. Manufacturers:
1) FNW: www.fnw.com.
2) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
3) Substitutions: See Division 01 - Product Requirements.
4) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

b. Material: Carbon steel with epoxy copper or zinc finish.
c. Weather and UV light resistant foam, plastic, or rubber material with built-in strut. Maximum Load: 50 lb for single pipe or multiple landed on top strut.

3. Overhead Pipe Supports:
   a. Manufacturers:
      1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
      2) Substitutions: See Division 01 - Product Requirements
      3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
4. Plenum Pipe Supports:
   a. Manufacturers:
      1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
      2) Substitutions: See Division 01 - Product Requirements.
      3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
5. Telescoping Pipe Supports:
   a. Manufacturers:
      1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
      2) Substitutions: See Division 01 - Product Requirements.
      3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
6. Inserts and Clamps:
   a. Manufacturers:
      1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
      2) Substitutions: See Division 01 - Product Requirements.
      3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
7. Seismic Bracing Hardware:
   a. Cable Suspension Systems:
      1) Manufacturers:
         (a) B-Line, a brand of Eaton Corporation: www.eaton.com.
         (b) nVent Caddy, a brand of nVent: www.erico.com.
         (c) Gripple, Inc: www.gripple.com.
         (d) Substitutions: See Division 01 - Product Requirements.
         (e) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
      2) Strut channel or bracket-fitted fitting with locking mechanism for pipe or equipment suspension using cable wires extended to surface-mounted end-fixing fittings.
      3) Provide cable wire and end-fixing as required to hold minimum weight of 120 lb.
   b. Cable Sway Bracing Systems:
      1) Manufacturers:
         (a) B-Line, a brand of Eaton Corporation: www.eaton.com.
         (b) nVent Caddy, a brand of nVent: www.erico.com.
         (c) Gripple, Inc: www.gripple.com.
         (d) Substitutions: See Division 01 - Product Requirements.
         (e) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2) Cable wire hanger with fix and release spring mechanism enclosed using zinc housing with 302 stainless steel components for pipe or equipment suspension to surface-mounted end-fixing fittings.
3) Provide cable wire and end-fixing as required to hold minimum weight of 25 lb.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.
B Verify that mounting surfaces are ready to receive support and attachment components.
C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.
B Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
C Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
D Unless specifically indicated or approved by Architect/Engineer, do not provide support from suspended ceiling support system or ceiling grid.
E Unless specifically indicated or approved by Architect/Engineer, do not provide support from roof deck.
F Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
G Field-Welding (where approved by Architect/Engineer): Comply with Division 05.
H Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
I Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Division 05.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
J Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
K Secure fasteners according to manufacturer's recommended torque settings.
L Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A See Division 01 - Quality Requirements for additional requirements.
B Inspect support and attachment components for damage and defects.
C Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
D Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 230529

SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Vibration isolation requirements.
- B Vibration-isolated equipment support bases.
- C Vibration isolators.
- D Vibration-isolated and/or seismically engineered roof curbs.

1.02 RELATED REQUIREMENTS
- A Division 03 - Cast-in-Place Concrete.

1.03 DEFINITIONS

1.04 REFERENCE STANDARDS
- A ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.05 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

1.06 QUALITY ASSURANCE
- A Comply with applicable building code.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS
- A Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C General Requirements:
  1. Select vibration isolators to provide required static deflection.
  2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
  5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
- D Equipment Isolation: As indicated on drawings.
- E Piping Isolation:
  1. Provide vibration isolators for piping supports:
     a. Located in equipment rooms.
     b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
     c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.

2. Minimum Static Deflection:
   a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
   b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
7. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

F Thrust Restraint Applications:
1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.
2. Minimum Static Deflection: Same as static deflection of equipment.
3. Limit lateral movement to 0.25 inch or less unless otherwise indicated.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
   a. Kinetics Noise Control, Inc: www.kineticsnoise.com.
   b. Mason Industries: www.mason-ind.com.
   c. Vibration Eliminator Company, Inc: www.veco-nyc.com.
   d. Vibro-Acoustics: www.vibro-acoustics.com.
   e. Substitutions: See Division 01 - Product Requirements
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B Vibration-Isolated Structural Steel Bases:
1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

C Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Division 03.
6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
7. Pump Applications: Size and configure bases for piping elbow supports as required.

2.03 VIBRATION ISOLATORS

A Manufacturers:
1. Vibration Isolators:
   a. Kinetics Noise Control, Inc: www.kineticsnoise.com.
   b. Mason Industries: www.mason-ind.com.

c. Vibration Eliminator Company, Inc: www.veco-nyc.com.
d. Vibro-Acoustics: www.vibro-acoustics.com.
e. Substitutions: See Division 01 - Prodcuct Requirements.

2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
   a. Color code or otherwise identify springs to indicate load capacity.
   b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
   c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
   d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
   e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
   f. Selected to function without undue stress or overloading.
3. Seismic Snubbing Elements for Seismic Isolators:
   a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
   b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

C Vibration Isolators for Nonseismic Applications:

1. Resilient Material Isolator Mounts, Nonseismic:
   a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
   b. Products:
2. Open (Unhoused) Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
   b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
3. Housed Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
   b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
   c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
   d. Furnished with integral leveling device for positioning and securing supported equipment.
4. Restrained Spring Isolators, Nonseismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.

b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
c. Furnished with integral leveling device for positioning and securing supported equipment.
d. Provides constant free and operating height.

5. Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
6. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
   c. Products:
      1) Substitutions: See Division 01 - Product Requirements.
7. Thrust Restraints:
   a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

2.04 ACOUSTICAL AND VIBRATION ISOLATORS

A Manufacturers:
1. Acoustical and Vibration Isolators:
   a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com.
   b. Substitutions: See Division 01 - Product Requirements.
2. Source Limitations: Furnish isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B General Requirements:
1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.05 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

A Manufacturers:
1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:
   a. Kinetics Noise Control, Inc: www.kineticsnoise.com.
   b. Mason Industries: www.mason-ind.com.
   c. Vibration Eliminator Company, Inc: www.veco-nyc.com.
   d. Vibro-Acoustics: www.vibro-acoustics.com.
   e. Substitutions: See Division 01 - Product Requirements.
2. Source Limitations: Furnish vibration-isolated roof curbs and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B Vibration Isolation Curbs:
1. Nonseismic Curb Rail:
   a. Location: Between existing roof curb and rooftop equipment.
   b. Construction: Aluminum.

c. Integral vibration isolation to comply with requirements of this section.
d. Weather exposed components consist of corrosion resistant materials.

2. Nonseismic Curb:
a. Location: Between structure and rooftop equipment.
b. Construction: Aluminum.
c. Integral vibration isolation to comply with requirements of this section.
d. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as shown on the drawings.
B Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.
B Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
C Secure fasteners according to manufacturer's recommended torque settings.
D Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
E Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
a. Provide specified minimum clearance beneath base.
2. Spring Isolators:
a. Position equipment at operating height; provide temporary blocking as required.
b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
3. Isolator Hangers:
a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Thrust Restraints:
a. Adjust restraint movement under normal operating static pressure.
5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
7. Adjust isolators to be free of isolation short circuits during normal operation.
8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

A See Division 01-Quality Requirements, for additional requirements.
B Inspect vibration isolation and/or seismic control components for damage and defects.
C Vibration Isolation Systems:
1. Verify isolator static deflections.

2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 230548

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Equipment Labels - Nameplates.
- B Tags.
- C Duct Labels - Adhesive-Backed Duct Markers.
- D Stencils.
- E Pipe Labels - Pipe Markers.
- F Warning Signs and Labels

1.02 RELATED REQUIREMENTS
- A Division 09-Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS
- A ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C Valve Numbering Scheme.
- D Valve Tag Schedule: Submit valve chart and schedule, including valve tag number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), variations for identification, and valve manufacturer's name and model number. Mark valves for emergency shutoff and similar special uses. Provide submittal for each piping system to include in maintenance manuals.
- E Equipment Label Schedule: For each item of equipment to be labeled: On 8-1/2-by-11-inch bond paper, tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules). Equipment schedule shall be included in operation and maintenance data.
- F Product Data: Provide manufacturers catalog literature for each product required.
- G Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS - NAMEPLATES
- A Letter Color: White.
- B Letter Height: 1/4 inch.
- C Background Color: Black.
- D Plastic: Comply with ASTM D709.
- E Label Content: Include equipment's Drawing designation or unique equipment number.

2.02 TAGS
- A Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B Metal Tags: Stamped or engraved with 1/4 inch letters for piping system abbreviation and 1/2 inch numbers; tag size minimum 1-1/2 inch diameter with smooth edges.
  1. Tag Material: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire-link or beaded chain; or S-hook.

2.03 DUCT LABELS - ADHESIVE-BACKED DUCT MARKERS

A Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

B Style: Individual Label.

C Color: Yellow/Black.

2.04 STENCILS

A Manufacturers:

B Stencils: With clean cut symbols and letters of following size:

1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
6. Ductwork and Equipment: 2-1/2 inch high letters.

C Stencil Paint: As specified in Division 09, semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE LABELS - PIPE MARKERS

A Color: Comply with ASME A13.1.

B Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

E Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

F Color code as follows:

1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
2. Toxic and Corrosive Fluids: Orange with black letters.
3. Compressed Air: Blue with white letters.

2.06 WARNING SIGNS AND LABELS

A Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B Letter Color: Black.

C Background Color: Yellow.

D Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater

viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G Fasteners: Stainless-steel rivets or self-tapping screws.

H Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I Label Content: Include caution and warning information, plus emergency notification instructions.

PART 3 EXECUTION

3.01 PREPARATION

A Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B Install tags with corrosion resistant chain.

C Install plastic pipe markers in accordance with manufacturer's instructions.

D Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F Pipe Label Installation:

1. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows :
   a. Near each valve and control device.
   b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   c. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   d. At access doors, manholes, and similar access points that permit view of concealed piping.
   e. Near major equipment items and other points of origination and termination.
   f. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   g. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
2. Use tags on piping 3/4 inch diameter and smaller.
   a. Identify service, flow direction, and pressure.
   b. Install in clear view and align with axis of piping.
   c. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

H Valve Tag Installation:

1. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

END OF SECTION 230553

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Testing, adjustment, and balancing of air systems.
- B Measurement of final operating condition of HVAC systems.
- C Commissioning activities.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
- A AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
  1. Submit to Architect/Engineer.
  2. Submit to the Commissioning Authority.
  3. Include at least the following in the plan:
     a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
     b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
     c. Identification and types of measurement instruments to be used and their most recent calibration date.
     d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
     e. Final test report forms to be used.
     f. Detailed step-by-step procedures for TAB work for each system and issue, including:
        1) Terminal flow calibration (for each terminal type).
        2) Diffuser proportioning.
        3) Branch/submain proportioning.
        4) Total flow calculations.
        5) Rechecking.
        6) Diversity issues.
     g. Expected problems and solutions, etc.
     h. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
     i. Method of checking building static and exhaust fan and/or relief damper capacity.
     j. Proposed selection points for sound measurements and sound measurement methods.
     k. Procedures for formal deficiency reports, including scope, frequency and distribution.

D Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
E Progress Reports.
F Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
6. Include the following on the title page of each report:
a. Name of Testing, Adjusting, and Balancing Agency.
b. Address of Testing, Adjusting, and Balancing Agency.
c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.
e. Project location.
f. Project Architect/Engineer.
g. Project Engineer.
h. Project Contractor.
i. Project altitude.
j. Report date.
G Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS
A Perform total system balance in accordance with one of the following:
1. AABC (NSTSB), AABC National Standards for Total System Balance.
2. Maintain at least one copy of the standard to be used at project site at all times.
B Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
C Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
D TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:
a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
E TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

C Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

B Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B Ensure recorded data represents actual measured or observed conditions.

C Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 AIR SYSTEM PROCEDURE

A Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
B Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
C Measure air quantities at air inlets and outlets.
D Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
E Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
F Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
G Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
H Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
I Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
J Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
K Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
L Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
M For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.07 COMMISSIONING

A See Division 01 - General Commissioning Requirments and 230800 for additional Requirements and 230800 Commisioning of HVAC Systems for additional requirments
B Perform prerequisites prior to starting commissioning activities.
C Fill out Prefunctional Checklists for:
    1. Air side systems.
    2. Water side systems.
D Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
E Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 20 percent of the air handlers plus a random sample equivalent to 10 percent of the final TAB report data as directed by Commissioning Authority.
    1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
    2. Use the same test instruments as used in the original TAB work.
    3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
    4. For purposes of re-check, failure is defined as follows:

a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
c. Temperatures: Deviation of more than one degree F.
d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.

5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.

F Additional Testing
1. 1.Thermostat calibration and test report summary shall be provided for all new and any existing thermostates reused in HVAC systems. Report shall be dated with documentation on calibrated equipment and all testing procedures
2. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
3. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions

G In the presence of the Commissioning Authority, verify that:
1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.08 SCOPE

A Test, adjust, and balance the following:
1. Packaged Roof Top Heating/Cooling Units.
2. Unit Air Conditioners.
3. Computer Room Air Conditioning Units.
4. Air Handling Units.
5. Fans.
6. Air Filters.
7. Air Inlets and Outlets.

3.09 MINIMUM DATA TO BE REPORTED

A Electric Motors:
1. Manufacturer.

2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B V-Belt Drives:
1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C Pumps:
1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

D Combustion Equipment:
1. Boiler manufacturer.
2. Model number.
3. Serial number.
4. Firing rate.
5. Overfire draft.
6. Gas meter timing dial size.
7. Gas meter time per revolution.
8. Gas pressure at meter outlet.
9. Gas flow rate.
10. Heat input.
11. Burner manifold gas pressure.
12. Percent carbon monoxide (CO).
13. Percent carbon dioxide (CO2).
14. Percent oxygen (O2).
15. Percent excess air.
16. Flue gas temperature at outlet.
17. Ambient temperature.
18. Net stack temperature.
19. Percent stack loss.
20. Percent combustion efficiency.
21. Heat output.

E Air Cooled Condensers:
1. Identification/number.
2. Location.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Entering DB air temperature, design and actual.
7. Leaving DB air temperature, design and actual.
8. Number of compressors.

F Chillers:
1. Identification/number.
2. Manufacturer.
3. Capacity.
4. Model number.
5. Serial number.
6. Evaporator entering water temperature, design and actual.
7. Evaporator leaving water temperature, design and actual.
8. Evaporator pressure drop, design and actual.
9. Evaporator water flow rate, design and actual.
10. Condenser entering water temperature, design and actual.
11. Condenser pressure drop, design and actual.
12. Condenser water flow rate, design and actual.

G Heat Exchangers:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Steam pressure, design and actual.
8. Primary water entering temperature, design and actual.
9. Primary water leaving temperature, design and actual.
10. Primary water flow, design and actual.
11. Primary water pressure drop, design and actual.
12. Secondary water leaving temperature, design and actual.
13. Secondary water flow, design and actual.
14. Secondary water pressure drop, design and actual.

H Cooling Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Water flow, design and actual.
11. Water pressure drop, design and actual.

12. Entering water temperature, design and actual.
13. Leaving water temperature, design and actual.
14. Saturated suction temperature, design and actual.
15. Air pressure drop, design and actual.

I Heating Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

J Electric Duct Heaters:
1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Design kW.
6. Number of stages.
7. Phase, voltage, amperage.
8. Test voltage (each phase).
9. Test amperage (each phase).
10. Air flow, specified and actual.
11. Temperature rise, specified and actual.

K Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

L Return Air/Outside Air:
1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.

5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

M Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

N Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

O Duct Leak Tests:
1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
    a. Blower.
    b. Orifice, tube size.
    c. Orifice size.
    d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

P Air Monitoring Stations:
1. Identification/location.
2. System.

3. Size.
4. Area.
5. Design velocity.
6. Design air flow.
7. Test velocity.
8. Test air flow.

Q Flow Measuring Stations:
1. Identification/number.
2. Location.
3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Design pressure drop.
9. Actual/final pressure drop.
10. Actual/final flow rate.
11. Station calibrated setting.

R Terminal Unit Data:
1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

S Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

T Sound Level Reports:
1. Location.
2. Octave bands - equipment off.
3. Octave bands - equipment on.

U Vibration Tests:
1. Location of points:
   a. Fan bearing, drive end.
   b. Fan bearing, opposite end.

c. Motor bearing, center (if applicable).
d. Motor bearing, drive end.
e. Motor bearing, opposite end.
f. Casing (bottom or top).
g. Casing (side).
h. Duct after flexible connection (discharge).
i. Duct after flexible connection (suction).

2. Test readings:
   a. Horizontal, velocity and displacement.
   b. Vertical, velocity and displacement.
   c. Axial, velocity and displacement.
3. Normally acceptable readings, velocity and acceleration.
4. Unusual conditions at time of test.
5. Vibration source (if non-complying).

END OF SECTION 230593

SECTION 230713

DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Duct insulation.
- B Duct liner.
- C Weather barrier coatings.
- D Jacketing and accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
- A ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- D ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- E ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- F ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- G ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- H ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).
- I ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers; 2015.
- J ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- K ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- L ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
- M ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
- N ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- O ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- P SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- Q SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- R UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.
- S UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Current Edition, Including All Revisions.

T UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 APPLICATION

A The material descriptions listed in the section may not all be used on this project. Refer to the Insulation Material Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

2.02 REGULATORY REQUIREMENTS

A Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.03 MINERAL-FIBER BOARD INSULATION

A Manufacturers:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com.
4. Owens Corning Corporation: www.ocbuildingspec.com.

B Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket.

C Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company: www.fosterproducts.com
b. Eagle Bridges - Marathon Industries: www.eaglebridges.com
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company: www.fosterproducts.com
d. Mon-Eco Industries, Inc.: www.mon-ecoindustries.com
e. Substitutions: See Division 01 - Product Requirements.

2.04 MINERAL-FIBER BLANKET INSULATION

A Manufacturers:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com.
4. Owens Corning Corporation: www.ocbuildingspec.com.

B Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket.

C Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company: www.fosterproducts.com
b. Eagle Bridges - Marathon Industries: www.eaglebridges.com
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company: www.fosterproducts.com
d. Mon-Eco Industries, Inc.: www.mon-ecoindustries.com
e. Substitutions: See Division 01 - Product Requirements.

2.05 GLASS FIBER, FLEXIBLE

A Manufacturer:

1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville: www.jm.com.
3. JP Lamborn Co: www.jpflex.com.
4. Knauf Insulation: www.knaufinsulation.com.
5. Owens Corning Corporation: www.ocbuildingspec.com.
6. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C553; flexible, noncombustible blanket.
1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 1,200 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure-sensitive tape.

D Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

E Indoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

G Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.06 GLASS FIBER, RIGID

A Manufacturer:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com.
4. Owens Corning Corporation: www.ocbuildingspec.com.
5. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C612; rigid, noncombustible blanket.
1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent.
4. Maximum Density: 8.0 pcf.

C Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure-sensitive tape.

D Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

E Protective Coating:
1. Manufacturers:
   a. Design Polymerics: www.designpoly.com.
   b. Substitutions: See Division 01 - Product Requirements.

F Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.

2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.07 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A Manufacturers:
1. Aeroflex USA, Inc: www.aeroflexusa.com.
2. Armacell LLC: www.armacell.us.
3. K-Flex USA LLC: www.kflexusa.com.
4. Substitutions: See Division 01 - Product Requirements.

B Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 180 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.
1. Manufacturers:
a. Design Polymerics: www.designpoly.com.
b. Vimasco Corporation: www.vimasco.com.
c. Substitutions: See Division 01 - Product Requirements.

2.08 WEATHER BARRIER COATINGS

A Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc: www.fosterproducts.com.
b. Substitutions: See Division 01 - Product Requirements.
2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
3. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
4. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
5. Color: As selected by Architect.

2.09 JACKETING AND ACCESSORIES

A Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive:
a. Manufacturers:
1) Design Polymerics: www.designpoly.com.
2) Substitutions: See Division 01 - Product Requirements.
b. Compatible with insulation.

B Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.

C FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 921, Type I.

D PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.
1. Manufacturers:
a. Johns Manville: www.jm.com.
b. P.I.C. Plastics, Inc.: www.pic-plastics.com
c. Proto Corporation: www.protocorporation.com
d. Speedline Corporation: www.speedlinepvc.com

e. Substitutions: See Division 01 - Product Requirements.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system. Color as selected by Architect.

E Aluminum Jacket:

1. Manufacturers:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company: www.fosterproducts.com
   b. ITW Insulation Systems, a Johns Manville Company: www.jm.com.
   c. RPR Products, Inc.: www.rprhouston.com
   d. Substitutions: See Division 01 - Product Requirements.
2. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
3. Thickness: 0.016 inch sheet.
4. Finish: Smooth.
5. Joining: Longitudinal slip joints and 2 inch laps.
6. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
7. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

F Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.

1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
2. Thickness: 34 mil, 0.034 inch.
3. Finish: Embossed.
4. Color: Silver.
5. Water Vapor Transmission: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
6. Mold Resistance: Pass when tested in accordance with ASTM C1338.
7. Emissivity: 0.30 when tested in accordance with ASTM C1371.
8. Manufacturers:
   a. Polyguard Products: www.polyguardproducts.com.com.
   b. Substitutions: See Division 01 - Product Requirements.

G Reinforced Tape:

1. Manufacturers:
   a. Ideal Tape Co., Inc: www.idealtape.com.
   b. Substitutions: See Division 01 - Product Requirements.
2. FSK tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
3. Comply with UL 723 or ASTM E84.
4. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
5. Finish: Match insulation.

H Plain Foil Tape:

1. Manufacturers:
   a. Ideal Tape Co., Inc: www.idealtape.com.
   b. Substitutions: See Division 01 - Product Requirements.
2. Aluminum foil with pressure-sensitive adhesive on paper release liner.
3. Finish: Plain foil.

I UL181 Tape for Rigid and Flexible Ductwork:

1. Manufacturers:
   a. Ideal Tape Co., Inc: www.idealtape.com.

b. Substitutions: See Division 01 - Product Requirements.
2. Comply with UL 181A for rigid ductwork.
3. Comply with UL 181B for flexible ductwork.
4. Aluminum foil coated with pressure-sensitive adhesive on paper release liner.
5. Foil tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
6. Finish: Printed with UL Listing for identification.

2.10 DUCT LINER

A Manufacturers:
1. Armacell LLC: www.armacell.us.
2. CertainTeed Corporation: www.certainteed.com.
3. Ductmate Industries, Inc, a DMI Company: www.ductmate.com.
4. Johns Manville: www.jm.com.
5. Knauf Insulation: www.knaufinsulation.com.
6. Owens Corning Corporation: www.ocbuildingspec.com.
7. Substitutions: See Division 01 - Product Requirements.

B Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 180 degrees F.
3. Fungal Resistance: No growth when tested according to ASTM G21.
4. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F.
5. Minimum Noise Reduction Coefficients:
   a. 1/2 inch Thickness: 0.30.
   b. 1 inch Thickness: 0.40.
   c. 1-1/2 inches Thickness: 0.50.
   d. 2 inch Thickness: 0.60.
6. Erosion Resistance: Does not show evidence of breaking away, flaking off, or delamination at velocities of 10,000 fpm when tested in accordance with ASTM C1071.
7. Connection: Waterproof vapor barrier adhesive.

C Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with ASTM C916.

D Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer or acrylic polymer.
1. Fungal Resistance: No growth when tested according to ASTM G21.
2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
3. Service Temperature: Up to 250 degrees F.
4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
5. Minimum Noise Reduction Coefficients:
   a. 1/2 inch Thickness: 0.30.
   b. 1 inch Thickness: 0.45.
   c. 1-1/2 inches Thickness: 0.60.
   d. 2 inch Thickness: 0.70.

E Adhesive: Waterproof, fire-retardant type, ASTM C916.
1. Manufacturers:
   a. Design Polymerics: www.designpoly.com.
   b. Elgen Manufacturing Company, Inc: www.elgenmfg.com.
   c. Vimasco Corporation: www.vimasco.com.

d. Substitutions: See Division 01 - Product Requirements.

F Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

1. Manufacturers:
   a. Elgen Manufacturing Company, Inc: www.elgenmfg.com.
   b. Substitutions: See Division 01 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A Test ductwork for design pressure prior to applying insulation materials.

B Verify that surfaces are clean, foreign material removed, and dry.

C All Insulation shall be sufficient thickness to comply with local energy code and ASHRAE/IESNA 90.1

D Refer to Insulation schedules on drawings for HVAC duct insulation requirments.

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install in accordance with NAIMA National Insulation Standards.

C Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

D Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

E Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

F Install insulation with longitudinal seams at top and bottom of horizontal runs.

G Install multiple layers of insulation with longitudinal and end seams staggered.

H Keep insulation materials dry during application and finishing.

I Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J Install insulation with least number of joints practical.

K Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

L Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

N Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

R Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

S Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

T Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

U Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies.

V Insulated Ducts Conveying Air Below Ambient Temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

W Insulated Ducts Conveying Air Above Ambient Temperature:
1. Provide with or without standard vapor barrier jacket.

2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

X Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

Y Exterior Applications: Provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.

1. Slope exterior ductwork to shed water.

Z External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

AA Duct and Plenum Liner Application:

1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

END OF SECTION 230713

SECTION 230716

HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Equipment insulation.
- B Flexible removable and reusable blanket insulation.
- C Weather barrier coatings.
- D Jacketing and accessories.

1.02 REFERENCE STANDARDS
- A ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- D ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- E ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- F ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- G ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- H ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- I ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- J ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- K ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- L ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- M ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- N ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2022.
- O ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- P ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
- Q ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
- R ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- S SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.

T UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A See Division 01 Submittal Procedures.

B Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

C Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 APPLICATION

2.02 REGULATORY REQUIREMENTS

A Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.03 GLASS FIBER, FLEXIBLE

A Manufacturers:

1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville Corporation: www.jm.com.
3. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com.
4. Owens Corning Corporation: www.ocbuildingspec.com.
5. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C553; flexible, noncombustible.

1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1,000 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.

1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
2. Secure with self-sealing longitudinal laps and butt strips.

D Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E Vapor Barrier Lap Adhesive: Compatible with insulation.

F Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.04 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

A Manufacturers:

B Insulation: ASTM C553 Type V; flexible, noncombustible.

1. Comply with ASTM C1695.
2. K Value: 0.37 at 100 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
3. Minimum Service Temperature: 32 degrees F.
4. Maximum Service Temperature: 500 degrees F.
5. Maximum Water Vapor Absorption: Less than 5.0 percent by weight.
6. Weight: 7.65 oz/sq ft.
7. Effective Thickness: 1.25 plus/minus 0.25 inch.

2.05 GLASS FIBER, RIGID

A Manufacturer:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville Corporation: www.jm.com.
3. Knauf Insulation; Earthwool Insulation Board: www.knaufinsulation.com.
4. Owens Corning Corporation: www.ocbuildingspec.com.
5. Substitutions: See Division 01-Product Requirements.

B Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1,200 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.
4. Maximum Density: 8.0 pcf.

C Aluminum-Foil Laminate Jacket:
1. Manufacturers:
2. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.

D Vapor Barrier Jacket:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with self-sealing longitudinal laps and butt strips.
4. Secure with outward clinch expanding staples and vapor barrier mastic.

E Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.

F Vapor Barrier Lap Adhesive: Compatible with insulation.

2.06 CELLULAR GLASS

A Manufacturer:
1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com.
2. Substitutions: See Division 01 - Product Requirements.

B Pipe and Tubing Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F.
2. Service Temperature Range: From 250 degrees F to 800 degrees F.
3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.
5. Density: At least 6.12 pcf, minimum.

C Block Insulation: ASTM C552, Type I, Grade 6.
1. K Value: 0.35 at 100 degrees F.
2. Service Temperature: 800 degrees F, maximum.
3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.
5. Density: 6.12 pcf, minimum.

2.07 HYDROUS CALCIUM SILICATE

A Manufacturer:
1. Johns Manville Corporation: www.jm.com.
2. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C533; rigid molded, asbestos free, gold color.
1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1,200 degrees F.
3. Density: 15 pcf.

C Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.

D Insulating Cement: ASTM C449.

E High Temperature Adhesive: Fire-retardant, sodium silicate based adhesive with fibers treated in compliance with ASTM D93.
1. Manufacturers:
a. Vimasco Corporation: www.vimasco.com.
b. Substitutions: See Division 01 - Product Requirements.

2.08 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A Manufacturer:
1. Aeroflex USA, Inc; Aerocel AC Sheet and Roll: www.aeroflexusa.com.
2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us.
3. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com.
4. Substitutions: See Division 01 - Product Requirements.

B Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.09 WEATHER BARRIER COATINGS

A Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc; Childers - CP Series Weather Barrier Coating: www.fosterproducts.com.
2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
3. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.

2.10 JACKETING AND ACCESSORIES

A PVC Plastic:
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com.
b. Substitutions: See Division 01 - Product Requirements
2. Jacket: Sheet material, off-white color.
a. Minimum Service Temperature: Minus 40 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil, 0.010 inch.
e. Connections: Brush on welding adhesive.

3. Covering Adhesive Mastic: Compatible with insulation.

B Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive: Compatible with insulation.
a. Manufacturers:
1) Vimasco Corporation: www.vimasco.com.
2) Substitutions: See Division 01 - Product Requirements.

C Aluminum Jacket:
1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
2. Thickness: 0.016 inch sheet.
3. Finish: Smooth.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.

D Aluminum-Foil Laminate Jacket:
1. Manufacturers:
a. Ideal Tape Co., Inc: www.idealtape.com.
b. Substitutions: See Division 01 - Product Requirements.
2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
3. Finish: Aluminum smooth.
4. Comply with ASTM C1775.

E Aluminum-Foil Laminate Jacket:
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc; Foster - Vapor-Fas: www.fosterproducts.com.
b. Substitutions: See Division 01 - Product Requirements.
2. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.

F Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

G Reinforced Tape:
1. Manufacturers:
a. Ideal Tape Co., Inc: www.idealtape.com.
b. Substitutions: See Division 01 - Product Requirements.
2. FSK tape suitable for sealing seams in insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
3. Comply with UL 723 or ASTM E84.
4. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
5. Finish: Match insulation.

H Plain Foil Tape:
1. Manufacturers:
a. Ideal Tape Co., Inc: www.idealtape.com.
b. Substitutions: See Division 01 - Product Requirements.
2. Aluminum foil with pressure-sensitive adhesive on paper release liner.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that equipment has been tested before applying insulation materials.

B Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions.
B Factory Insulated Equipment: Do not insulate.
C Exposed Equipment: Locate insulation and cover seams in least visible locations.
D Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
E Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
F Insulated equipment containing fluids below ambient temperature; insulate entire system.
G Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
H For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
I For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
J Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
K Inserts and Shields:
L Finish insulation at supports, protrusions, and interruptions.
M Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
N Exterior Applications:
    1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
    2. Cover with aluminum jacket.
O Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
P Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
Q Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

A Heating Systems:
    1. Pump Bodies:
    2. Heat Exchangers/Converters:
    3. Air Separators:
    4. Expansion Tanks:
    5. Hot Thermal Storage Tanks:
    6. Flue Gas Breeching:
    7. Stacks to Roof:
    8. Boiler and Flue Boxes:
B Cooling Systems:
    1. Pump Bodies:
    2. Air Separators:
    3. Expansion Tanks:
    4. Chiller Cold Surfaces (Not Factory Insulated):
    5. Cold Thermal Storage Tanks:
    6. Equipment Exposed to Freezing with Heat Tracing:

END OF SECTION 230716

SECTION 230719

HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Piping insulation.
- B Flexible removable and reusable blanket insulation.
- C Weather barrier coatings.
- D Jacketing and accessories.
- E Engineered wall outlet seals and refrigerant piping insulation protection.

1.02 RELATED REQUIREMENTS
- A Division 09-Interior Painting: Painting insulation jacket.
- B Section 232300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS
- A ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- C ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- E ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- F ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- G ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- H ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- I ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- J ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- K ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- L ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- M ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.
- N ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.
- O ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2022.
- P ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- Q ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- R ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation; 2019.

S ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
T ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
U ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2022.
V ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
W ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
X ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
Y ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
Z ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).
AA ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics; 2017 (Reapproved 2023).
BB ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
CC ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
DD ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
EE ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
FF ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
GG ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
HH ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
II SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
JJ UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A See Division 01 Submittal Procedures.
B Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
C Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A Maintain ambient conditions required by manufacturers of each product.
B Maintain temperature before, during, and after installation for minimum of 24 hours.

1.08 APPLICATION

A The product descriptions listed in the section may not all be used on this project. Refer to the Piping Material Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be used without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A Manufacturers:
1. JP Lamborn Co; Thermal Sleeve MT: www.jpflex.com.
2. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C553; flexible, noncombustible blanket.
1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 1,200 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C Aluminum-Foil Laminate Jacket:
1. Manufacturers:
   a. H.B. Fuller Construction Products, Inc; Foster - Vapor-Fas: www.fosterproducts.com.
   b. Substitutions: See Division 01 - Product Requirements.
2. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.

D Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure-sensitive tape.

E Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film with pressure-sensitive rubber-based adhesive.

F Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

G Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.03 GLASS FIBER, RIGID

A Manufacturers:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville Corporation: www.jm.com.
3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: www.knaufinsulation.com.
4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com.
5. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
1. K Value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

D Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. Maximum Service Temperature: 650 degrees F.
2. Maximum Moisture Absorption: 0.2 percent by volume.

E Aluminum-Foil Laminate Jacket:
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc; Foster - Vapor-Fas: www.fosterproducts.com.
b. Substitutions: See Division 01 - Product Requirements.
2. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.

F Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

G Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

H Vapor Barrier Lap Adhesive: Compatible with insulation.

I Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

J Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Blanket: 1.0 pcf density.
3. Weave: 5 by 5.

K Indoor Vapor Barrier Finish:
1. Vinyl emulsion type acrylic, compatible with insulation, black color.

L Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

M Insulating Cement: ASTM C449.

2.04 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

A Manufacturers:
1. Auburn Manufacturing Inc; Ever Green Cut 'n Wrap: www.auburnmfg.com.
2. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C553 Type V; flexible, noncombustible.
1. Comply with ASTM C1695.
2. K Value: 0.37 at 100 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
3. Minimum Service Temperature: 32 degrees F.
4. Maximum Service Temperature: 500 degrees F.
5. Maximum Water Vapor Absorption: 5.0 percent by weight.
6. Weight: 7.65 oz/sq ft.
7. Effective Thickness: 1.25 +/- 0.25 inch.

2.05 CELLULAR GLASS

A Manufacturers:
1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com.
2. Substitutions: See Division 01 - Product Requirements.

B Pipe and Tubing Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F.
2. Service Temperature Range: From 250 degrees F to 800 degrees F.

3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.
5. Density: A minimum of 6.12 pcf.

C Block Insulation: ASTM C552, Type I, Grade 6.
1. K Value: 0.35 at 100 degrees F.
2. Service Temperature: 800 degrees F, maximum.
3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.

2.06 EXPANDED POLYSTYRENE

A Insulation: ASTM C578; rigid closed cell.
1. K Value: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 165 degrees F.
3. Maximum Water Vapor Permeance: 5.0 perm.

2.07 EXPANDED PERLITE

A Manufacturers:
1. Schundler Company: www.schundler.com.
2. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C610, molded.
1. Maximum Service Temperature: 1,200 degrees F.
2. Maximum Water Vapor Transmission: 0.1 perm.

2.08 HYDROUS CALCIUM SILICATE

A Manufacturers:
1. Johns Manville Corporation: www.jm.com.
2. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1200 degrees F.
3. Density: 15 pcf.

C Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D Insulating Cement: ASTM C449.

E High Temperature Adhesive: Fire-retardant, sodium silicate based adhesive with fibers treated in compliance with ASTM D93.
1. Manufacturers:
a. Vimasco Corporation: www.vimasco.com.
b. Substitutions: See Division 01 - Product Requirements.

2.09 POLYISOCYANURATE CELLULAR PLASTIC

A Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
1. Dimension: Comply with requirements of ASTM C585.
2. K Value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
3. Minimum Service Temperature: Minus 70 degrees F.
4. Maximum Service Temperature: 300 degrees F.
5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842.
6. Moisture Vapor Transmission: 4.0 perm inch.
7. Connection: Waterproof vapor barrier adhesive.

2.10 POLYETHYLENE

A Manufacturers:
1. Armacell LLC: www.armacell.us.

2. Substitutions: See Division 01 - Product Requirements

B Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
1. K Value: ASTM C177; 0.25 at 75 degrees F.
2. Maximum Service Temperature: 300 degrees F.
3. Density: 2 pcf.
4. Maximum Moisture Absorption: 1.0 percent by volume.
5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
6. Connection: Contact adhesive.

2.11 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A Manufacturers:
1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT): www.aeroflexusa.com.
2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us.
3. K-Flex USA LLC; K-Flex Titan: www.kflexusa.com.
4. Substitutions: See Division 01 - Product Requirements.

B Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 180 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.
1. Manufacturers:
a. Vimasco Corporation: www.vimasco.com.
b. Substitutions: See Division 01 - Product Requirements.

2.12 RIGID, CELLULAR PHENOLIC

A Manufacturers:
1. Dyplast Products, LLC: www.dyplastproducts.com.
2. ITW Insulation Systems: www.itwinsulation.com.
3. Polyguard Products; PolyPhen: www.polyguardproducts.com.com.
4. Substitutions: See Division 01 - Product Requirements.

B Insulation: ASTM C1126, Type III, Grade 1.
1. Nominal Density: 3.75 pcf.
2. Preliminary Initial Minimum K Value: 0.145 at 50 degrees F based on density of 2.5 pcf.
3. Maximum Service Temperature: 248 degrees F.
4. Minimum Service Temperature: Minus 292 degrees F.
5. Minimum compressive strength as determined by ASTM D1621.
6. Minimum tensile strength as determined by ASTM D1623.

2.13 EXTRUDED POLYSTYRENE (XPS) BOARD INSULATION

A Manufacturers:
1. Polyguard Products; Dow Styrofoam PIB: www.polyguardproducts.com.
2. Substitutions: See Division 01 - Product Requirements.

B Comply with ASTM E84.

C Insulation: ASTM C578; rigid closed cell.
1. K Value: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 165 degrees F.
3. Maximum Water Vapor Permeance: 5.0 perm.

D Billet Dimensions: 7 inches by 14 inches by 108 inches.
E Density: Type X, 1.30 pcf (21 kg/cu m), minimum.
F Water Absorption: Type X, 0.3 percent by volume, maximum, by total immersion.

2.14 WEATHER BARRIER COATINGS

A Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc; Childers - CP Series Weather Barrier Coating: www.fosterproducts.com.
b. Substitutions: See Division 01 - Product Requirements.
2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
3. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
4. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
5. Color: As selected by Architect.

2.15 JACKETING AND ACCESSORIES

A PVC Plastic.
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com.
b. Substitutions: See Division 01 - Product Requirements.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil, 0.010 inch.
e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.

B ABS Plastic:
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: Minus 40 degrees F.
b. Maximum Service Temperature: 180 degrees F.
c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
d. Thickness: 30 mil, 0.030 inch.
e. Connections: Brush on welding adhesive.

C Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive: Compatible with insulation.
a. Manufacturers:
1) Vimasco Corporation: www.vimasco.com.
2) Substitutions: See Division 01 - Product Requirements.

D Aluminum Jacket:
1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
2. Thickness: 0.016 inch sheet.
3. Type: Factory-applied, self-adhesive jacketing.
4. Finish: Smooth.

5. Joining: Longitudinal slip joints and 2 inch laps.
6. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.

E Aluminum-Foil Laminate Jacket:
1. Manufacturers:
   a. Ideal Tape Co., Inc: www.idealtape.com.
   b. Substitutions: See Division 01 - Product Requirements.
2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
3. Finish: Aluminum smooth.
4. Comply with ASTM C1775.

F Aluminum-Foil Laminate Jacket:
1. Manufacturers:
   a. Substitutions: See Division 01 - Product Requirements.
2. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.

G Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

H Reinforced Tape:
1. Manufacturers:
   a. Ideal Tape Co., Inc: www.idealtape.com.
   b. Substitutions: See Division 01 - Product Requirements.
2. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
3. Comply with UL 723, ASTM E84.
4. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.

I Plain Foil Tape:
1. Manufacturers:
   a. Ideal Tape Co., Inc: www.idealtape.com.
   b. Substitutions: See Division 01 - Product Requirements.
2. Aluminum foil with pressure-sensitive adhesive on paper release liner.
3. Finish: Plain foil.

J Vapor Barrier Membranes: ASTM C1136, Type IX.
1. Multilayer Laminate Vapor Barrier:
   a. Thickness: 2.4 mil, 0.002 inch.
   b. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
   c. Manufacturers:
      1) Polyguard Products; ZERO-PERM: www.polyguardproducts.com.
      2) Substitutions: See Division 01 - Product Requirements.
2. Rubberized Asphalt Vapor Barrier:
   a. Thickness: 30 mil, 0.030 inch.
   b. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
   c. Manufacturers:
      1) Polyguard Products; Insulrap 30 NG: www.polyguardproducts.com.
      2) Substitutions: See Division 01 - Product Requirements.

2.16 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

A Manufacturers:

1. Airex Manufacturing, Inc: www.airexmfg.com.
2. Substitutions: See Division 01 - Product Requirements.

B Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com.
1. Pipe Penetration Wall Seal: Airex Titan Outlet.
2. Refrigeration Pipe Insulation Protection System: Airex E-Flex Guard.
3. Pipe Penetration Wall Seal and Insulation Protection System: Airex Pro-System Kit.

C Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Outlet Cover Color: Gray.
2. Water Penetration: Comply with ASTM E331.
3. Air Leakage: Comply with ASTM E283.
4. Air Permeance: Comply with ASTM E2178.

D Insulation Protection System: Refrigerant piping insulation PVC protective cover.
1. PVC Insulation Cover Color: Black with full-length velcro fastener.
2. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.

2.17 ACCESSORIES

A General Requirements:
1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
4. Supply materials that are asbestos free.

B Corrosion Inhibitors:
1. Corrosion Control Gel:
   a. Manufacturers:
      1) Polyguard Products; RG2400LT: www.polyguardproducts.com.
      2) Substitutions: See Division 01 - Product Requirements.
   b. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.01 EXAMINATION

A Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B Verify that surfaces are clean and dry, with foreign material removed.

C All Insulation shall be sufficent thickness to comply with local energy code and ASHRAE/IESNA 90.1

D Refer to insulation schedules on drawings for HVAC piping insulation requirements

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Exposed Piping: Locate insulation and cover seams in least visible locations.

C Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Division 07.

J Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

K Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

L Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

M Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

END OF SECTION 230719

SECTION 230923

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES
- A System description.
- B Operator interface.
- C Controllers.
- D Power supplies and line filtering.
- E System software.
- F Controller software.

1.02 RELATED REQUIREMENTS
- A Division 26 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS
- A ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).
- B ASHRAE Std 147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems; 2019, with Addendum (2022).
- C MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2019h.
- D NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide data for each system component and software module.
- C Shop Drawings:
  1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
  2. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
  3. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
  4. Indicate description and sequence of operation of operating, user, and application software.
- D Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- E Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
- F Operation and Maintenance Data:
  1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
  2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
  3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- G Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

H Maintenance Materials:
1. See Division 01 - Product Requirements, for additional provisions.
2. Provide one spare building automation system controller of each type, and spare temperature and humidity sensors, one for each type in the building.
3. Provide an additional 10% spare input and output capacity witnin the DDC system network control panels and front end controller.

1.05 QUALITY ASSURANCE
A Perform work in accordance with NFPA 70.

1.06 WARRANTY
A See Division 01 - Closeout Submittals for additional warranty requirements.
B Provide five year manufacturer's warranty for field programmable micro-processor based units.

1.07 PROTECTION OF SOFTWARE RIGHTS
A Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
1. Limiting use of software to equipment provided under these specifications.
2. Limiting copying.
3. Preserving confidentiality.
4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A Schneider Electric: www.schneider-electric.us.
B Alerton: https://buildings.honeywell.com/us/en/brands/our-brands/alerton
C Substitutions: None

2.02 SYSTEM DESCRIPTION
A Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
B Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
C Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
D Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units.
E Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
F Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.03 OPERATOR INTERFACE
A PC Based Work Station:
1. Connected to server for full access to all system information.
B Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.
C BACnet protocol to comply with ASHRAE Std 135.
D Hardware:
1. Desktop:
a. Computer(s) and display(s) to be provided by DDC controls manufacturer.
b. Quantity: One

c. Minimum RAM: 64 GB.
d. Minimum Processing Speed: 2.1 GHz.
e. Minimum Hard Drive Memory: 512 GB.
f. Drives: 1.
g. Ports: Hdmi, USB C, USB 3.1.
h. Monitor: 24 in. P2422h.
i. Network Connection:
   1) Ethernet interface card.
   2) Minimum Speed: gigabit.
j. System Printer:
   1) Printer(s) to be provided by DDC controls manufacturer.
   2) Quantity: One
   3) Type: Laser.

2. Laptop:
3. Computer(s) and display(s) to be provided by DDC controls manufacturer.
4. Quantity: One
5. Minimum RAM: 64 GB.
6. Minimum Processing Speed: 2.1 GHz.
7. Minimum Hard Drive Memory: 512 GB.
8. Drives: 1.
9. Ports: Hdmi, USB C, USB 3.1.
10. Network Connection:
    a. Ethernet interface card.
    b. Minimum Speed: gigabit.

2.04 CONTROLLERS

A Building Controllers:

1. General:
   a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
   b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
   c. Share data between networked controllers.
   d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
   e. Utilize real-time clock for scheduling.
   f. Continuously check processor status and memory circuits for abnormal operation.
   g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
   h. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
   b. Perform routing when connected to a network of custom application and application specific controllers.
   c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. External Input-Output (I-O) Data Bus:
   a. Input only modules.

b. Output only modules.
c. Variable frequency drives (VFD's).
d. Universal I-O module (configurable).
e. Access control module for single door.
f. Specific wired and wireless data integration modules.
g. DALI (Digital addressable lighting interface) modules.
h. Motor control of devices like blinds, roller shutters, and sun protection systems.
i. Multiple Input Output (I-O) Module:
   1) IAQ: Temperature, humidity, and CO2.
   2) Audio: Microphone, tone generator, and speaker.
   3) Occupancy: Light and thermal sensing with multi-colored LED feedback.

4. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1) Mount within waterproof enclosures.
      2) Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1) Mount within dustproof enclosures.
      2) Rated for operation at 32 to 120 degrees F.
5. Local Keypad and Display for each Controller:
   a. Use for interrogating and editing data.
   b. System security password prevents unauthorized use.
6. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
7. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
8. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B Custom Application Controller:
1. General:
   a. Provide sufficient memory to support controller's operating system, database, and programming requirements.
   b. Share data between networked, microprocessor based controllers.
   c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
   d. Utilize real-time clock for scheduling.
   e. Continuously check processor status and memory circuits for abnormal operation.
   f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
   g. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.

b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1) Mount within waterproof enclosures.
      2) Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1) Mount within dustproof enclosures.
      2) Rated for operation at 32 to 120 degrees F.
4. Local Keypad and Display for each Controller:
   a. Use for interrogating and editing data.
   b. System security password prevents unauthorized use.
5. Provisions for Serviceability:
   a. Diagnostic LED's for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
6. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
7. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

C Application Specific Controllers:

1. General:
   a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
   b. Customized for operation within the confines of equipment served.
   c. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
   b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1) Mount within waterproof enclosures.
      2) Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1) Mount within dustproof enclosures.
      2) Rated for operation at 32 to 120 degrees F.
4. Local Keypad and Display for each Controller:
   a. Use for interrogating and editing data.
   b. System security password prevents unauthorized use.
5. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

6. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
7. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

D Input/Output Interface:

1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
   a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
   b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
   a. Allow monitoring of On/Off signals from remote devices.
   b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
   c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
   a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
   b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
   a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
   b. Outputs provided with three position (On/Off/Auto) override switches.
   c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
   a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
   b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
   c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
   a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
   b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
      1) None.
   c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:

a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.05 POWER SUPPLIES AND LINE FILTERING

A Power Supplies:
1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

B Power Line Filtering:
1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
a. Dielectric strength of 1000 volts minimum.
b. Response time of 10 nanoseconds or less.
c. Transverse mode noise attenuation of 65 dB or greater.
d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.06 LOCAL AREA NETWORK (LAN)

A Provide communication between control units over local area network (LAN).
B LAN Capacity: Not less than 60 stations or nodes.
C Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
D LAN Data Speed: Minimum 19.2 Kb.
E Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
F Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
G Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.07 SYSTEM SOFTWARE

A Operating System:
1. Concurrent, multi-tasking capability.
a. Common Software Applications Supported: Microsoft Excel.
2. System Graphics:
a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
b. Animation displayed by shifting image files based on object status.

c. Provide method for operator with password to perform the following:
1) Move between, change size, and change location of graphic displays.
2) Modify on-line.
3) Add, delete, or change dynamic objects consisting of:
(a) Analog and binary values.
(b) Dynamic text.
(c) Static text.
(d) Animation files.

3. Custom Graphics Generation Package:
a. Create, modify, and save graphic files and visio format graphics in PCX formats.
b. HTML graphics to support web browser compatible formats.
c. Capture or convert graphics from AutoCAD.

4. Standard HVAC Graphics Library:
a. HVAC Equipment:
1) Chillers.
2) Boilers.
3) Air Handlers.
4) Terminal HVAC Units.
5) Fan Coil Units.
6) Unit Ventilators.
b. Ancillary Equipment:
1) Fans.
2) Pumps.
3) Coils.
4) Valves.
5) Piping.
6) Dampers.
7) Ductwork.
c. File Format Compatible with Graphics Generation Package Program.

B Workstation System Applications:
1. Automatic System Database Save and Restore Functions:
a. Current database copy of each Building Controller is automatically stored on hard disk.
b. Automatic update occurs upon change in any system panel.
c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.

2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
a. Save database from any system panel.
b. Clear a panel database.
c. Initiate a download of a specified database to any system panel.

3. Software provided allows system configuration and future changes or additions by operators under proper password protection.

4. On-line Help:
a. Context-sensitive system assists operator in operation and editing.
b. Available for all applications.
c. Relevant screen data provided for particular screen display.
d. Additional help available via hypertext.

5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.
6. System Diagnostics:
   a. Operations Automatically Monitored:
      1) Workstations.
      2) Printers.
      3) Modems.
      4) Network connections.
      5) Building management panels.
      6) Controllers.
   b. Device failure is annunciated to the operator.
7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
   b. Configurable Objects:
      1) Alarm limits.
      2) Alarm limit differentials.
      3) States.
      4) Reactions for each object.
8. Alarm Messages:
   a. Descriptor: English language.
   b. Recognizable Features:
      1) Source.
      2) Location.
      3) Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
   a. Logging.
   b. Printing.
   c. Starting programs.
   d. Displaying messages.
   e. Dialing out to remote locations.
   f. Paging.
   g. Providing audible annunciation.
   h. Displaying specific system graphics.
10. Custom Trend Logs:
    a. Definable for any data object in the system including interval, start time, and stop time.
    b. Trend Data:
       1) Sampled and stored on the building controller panel.
       2) Archivable on hard disk.
       3) Retrievable for use in reports, spreadsheets and standard database programs.
       4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.

5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.

11. Alarm and Event Log:
    a. View all system alarms and change of states from any system location.
    b. Events listed chronologically.
    c. Operator with proper security acknowledges and clears alarms.
    d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
    a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    b. Status Available by the Following Methods:
        1) Menu.
        2) Graphics.
        3) Custom Programs.
13. Reports and Logs:
    a. Reporting Package:
        1) Allows operator to select, modify, or create reports.
        2) Definable as to data content, format, interval, and date.
        3) Archivable to hard disk.
    b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
    c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
    d. Set to be printed on operator command or specific time(s).
14. Reports:
    a. Standard:
        1) Objects with current values.
        2) Current alarms not locked out.
        3) Disabled and overridden objects, points and SNVTs.
        4) Objects in manual or automatic alarm lockout.
        5) Objects in alarm lockout currently in alarm.
        6) Logs:
            (a) Alarm History.
            (b) System messages.
            (c) System events.
            (d) Trends.
    b. Custom:
        1) Daily.
        2) Weekly.
        3) Monthly.
        4) Annual.
        5) Time and date stamped.
        6) Title.
        7) Facility name.
    c. Tenant Override:
        1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
        2) Annual report showing override usage on a monthly basis.
    d. Electrical, Fuel, and Weather:
        1) Electrical Meter(s):

(a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
(b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.

2) Fuel Meter(s):
(a) Monthly showing daily natural gas consumption for each meter.
(b) Annual summary showing monthly consumption for each meter.

3) Weather:
(a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.

e. Daily Operating Condition of Chiller(s) Based on ASHRAE Std 147:
1) Chilled water inlet and outlet temperature.
2) Chilled water flow.
3) Chilled water inlet and outlet pressure.
4) Evaporator refrigerant pressure and temperature.
5) Condenser refrigerant pressure and temperature.
6) Condenser refrigerant pressure and liquid temperature.
7) Refrigerant levels.
8) Oil pressure and temperature.
9) Oil level.
10) Compressor refrigerant discharge temperature.
11) Refrigerant suction temperature.
12) Addition of refrigerant.
13) Addition of oil.
14) Motor amperes per phase.
15) Motor volts per phase.
16) Ambient temperature (dry-bulb and wet-bulb).
17) Date and time logged.

C Workstation Applications Editors:
1. Provide editing software for each system application at PC workstation.
2. Downloaded application is executed at controller panel.
3. Full screen editor for each application allows operator to view and change:
a. Configuration.
b. Name.
c. Control parameters.
d. Set-points.
4. Scheduling:
a. Monthly calendar indicates schedules, holidays, and exceptions.
b. Allows several related objects to be scheduled and copied to other objects or dates.
c. Start and stop times adjustable from master schedule.
5. Custom Application Programming:
a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
b. Programming Features:
1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.

3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values cab be used in IF/THEN comparisons, calculations, programming statement logic, etc.
9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.08 CONTROLLER SOFTWARE

A All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.

B System Security:
1. User access secured via user passwords and user names.
2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
3. User Log On/Log Off attempts are recorded.
4. Automatic Log Off occurs following the last keystroke after a user defined delay time.

C Object or Object Group Scheduling:
1. Weekly Schedules Based on Separate, Daily Schedules:
   a. Include start, stop, optimal stop, and night economizer.
   b. 10 events maximum per schedule.
   c. Start/stop times adjustable for each group object.
2. Exception Schedules:
   a. Based on any day of the year.
   b. Defined up to one year in advance.
   c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.
3. Holiday or Special Schedules:
   a. Capability to define up to 99 schedules.
   b. Repeated annually.
   c. Length of each period is operator defined.

D Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.

E Alarms:
1. Binary object is set to alarm based on the operator specified state.
2. Analog object to have high/low alarm limits.
3. All alarming is capable of being automatically and manually disabled.
4. Alarm Reporting:

a. Operator determines action to be taken for alarm event.
b. Alarms to be routed to appropriate workstation.
c. Reporting Options:
1) Start programs.
2) Print.
3) Logged.
4) Custom messaging.
5) Graphical displays.
6) Dial out to workstation receivers via system protocol.

F Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.

G Sequencing: Application software based upon specified sequences of operation in Section 230993.

H PID Control Characteristics:
1. Direct or reverse action.
2. Anti-windup.
3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
4. User selectable controlled variable, set-point, and PED gains.

I Staggered Start Application:
1. Prevents all controlled equipment from simultaneously restarting after power outage.
2. Order of equipment startup is user selectable.

J Energy Calculations:
1. Accumulated instantaneous power or flow rates are converted to energy use data.
2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.

K Anti-Short Cycling:
1. All binary output objects protected from short-cycling.
2. Allows minimum on-time and off-time to be selected.

L On-Off Control with Differential:
1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.

M Run-Time Totalization:
1. Totalize run-times for all binary input objects.
2. Provides operator with capability to assign high run-time alarm.

PART 3 EXECUTION

3.01 INSTALLERS

A Installer List:

B Schneider Electric: www.schneider-electric.us.

C Alerton-Northwest Controls: http://nwcontrols.com
1. Substitutions: None

3.02 EXAMINATION

A Verify existing conditions before starting work.

B Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.03 INSTALLATION

A Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 230993.

C Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.

D Provide conduit and electrical wiring in accordance with Division 26. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

E Controls contractor shall be respoonsible for all pressure/temperature taps in ductwork and piping as required to meet requirements for a complete fucntioning controls system.

3.04 MANUFACTURER'S FIELD SERVICES

A Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

B Provide basic operator training for Owner Staff persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 16 hours dedicated instructor time. Provide training on site.

C Contractor shall provide remote "read only" access of the controls to the engineer for a minimum period of one year after substantial completion. Access shall include ability to see and set up trends of all assigned points. Provide minimum allowance of 40 hours on site or remote to assist the engineer with functional testing of proper operation of equipment.

3.05 DEMONSTRATION AND INSTRUCTIONS

A Demonstrate complete operating system to Owner.

3.06 MAINTENANCE

A See Division 01 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.

C Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

D Provide complete service of systems, including call backs. Make minimum of four complete normal inspections of approximately four hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

END OF SECTION 230923

SECTION 231123

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.02 RELATED REQUIREMENTS
- A Division 08 - Access Doors and Panels
- B Division 09 - Interior Painting
- C Section 230516 - Expansion Fittings and Loops for HVAC Piping.
- D Section 230548 - Vibration and Seismic Controls for HVAC.
- E Division 33 - Gas Hydrocarbon Piping

1.03 REFERENCE STANDARDS
- A ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.
- B ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.
- C ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.
- D ANSI Z223.1 - National Fuel Gas Code; 2021.
- E ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- F ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- G ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- H ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- I ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- J ASME B31.1 - Power Piping; 2022.
- K ASME B31.9 - Building Services Piping; 2020.
- L ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- M ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- N ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- O ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2022.
- P ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- Q ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- R ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- S ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- T ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
- U ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
- V ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.

W AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
X AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
Y AWWA C606 - Grooved and Shouldered Joints; 2015.
Z ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
AA ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
BB ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
CC ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
DD MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
EE MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.04 SUBMITTALS

A See Division 01 Submittal Procedures.
B Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
C Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.
D Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
E Sustainable Design Documentation: For soldered copper joints, submit installer's certification that the specified installation method and materials were used.

1.05 QUALITY ASSURANCE

A Perform work in accordance with applicable codes.
B Valves: Manufacturer's name and pressure rating marked on valve body.
C Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
D Welder Qualifications: Certified in accordance with ASME BPVC-IX.
E Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.06 DELIVERY, STORAGE, AND HANDLING

A Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B Provide temporary protective coating on cast iron and steel valves.
C Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
D Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

A Steel Pipe: ASTM A53/A53M, Schedule 40 black.
    1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
    2. Joints: ASME B31.1, welded.
B Copper Tubing: Listed, ASTM B88 (ASTM B88M), Type K (A), annealed.
    1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
    2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.

3. Mechanical Press Sealed Fittings: Double-pressed type and approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.

C Flexible Gas Piping:
1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
2. Fittings: Provided by piping system manufacturer.

D Polyethylene Pipe: ASTM D2513, SDR 11.
1. Fittings: ASTM D2683 or ASTM D2513 socket type.
2. Joints: Fusion welded.

2.02 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A Steel Pipe: ASTM A53/A53M, Schedule 40 black.
1. Fittings: ASTM A234/A234M, wrought steel welding type.
2. Joints: ANSI Z223.1, welded.
3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

B Flexible Gas Piping:
1. Corrugated Stainless Steel Tubing: Comply with ANSI LC1 / CSA 6.26.
2. Fittings: Provided by piping system manufacturer.

C Polyethylene Pipe: ASTM D2513, SDR 11.
1. Fittings: ASTM D2683 or ASTM D2513 socket type.
2. Joints: Fusion welded.

2.03 NATURAL GAS PIPING, ABOVE GRADE

A Steel Pipe: ASTM A53/A53M, Schedule 40 black.
1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
2. Joints: Threaded or welded to ASME B31.1.

B Copper Tube: ASTM B88 (ASTM B88M), Type K (A) or L (B) annealed.
1. Fittings: ASME B16.26, cast bronze.
2. Joints: Flared.

C Flexible Gas Piping:
1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
2. Comply with ASTM E84.
3. Fittings: Provided by piping system manufacturer.
4. Provide piping with integral lightning protection.

2.04 FLANGES, UNIONS, AND COUPLINGS

A Unions for Pipe Sizes 3 Inches and Under:
1. Ferrous Pipe: Class 150 malleable iron threaded unions.
2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B Flanges for Pipe Size Over 1 Inch:
1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
2. Housing Material: Provide ASTM A47/A47M malleable iron, ductile iron, or _____, galvanized.
3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.

5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
6. Manufacturers:
   a. Apollo Valves: www.apollovalves.com.
   b. Grinnell Products: www.grinnell.com.
   c. Substitutions: See Division 01 - Product Requirements

D Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.05 PIPE HANGERS AND SUPPORTS

A Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   a. Cold and Hot Pipe Sizes 6 Inches and Over: Double hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.
5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
   a. Bases: High density polypropylene.
   b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
   e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.
   f. Manufacturers:
      1) PHP Systems/Design: www.phpsd.com.
      2) Substitutions: See Division 01 - Product Requirements

B Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
6. Other Types: As required.

2.06 BALL VALVES

A Manufacturers:
1. Apollo Valves: www.apollovalves.com.
2. Grinnell Products: www.grinnell.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Nibco, Inc: www.nibco.com.
5. Substitutions: See Division 01 - Product Requirements

B Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, grooved, or _____ ends with union.

2.07 PLUG VALVES

A Manufacturers:
1. Apollo Valves: www.apollovalves.com.
2. Grinnell Products: www.grinnell.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Nibco, Inc: www.nibco.com.
5. Substitutions: See Division 01 - Product Requirements

B Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.08 STRAINERS

A Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com.
2. Green Country Filter Manufacturing: www.greencountryfilter.com.
3. WEAMCO: www.weamco.com.
4. Substitutions: See Division 01 - Product Requirements

B Size 2 inch and Under:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C Size 1-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

D Size 5 inch and Larger:
1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.09 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A Manufacturers:
1. Actaris Metering Systems (A brand of ITT Controls): www.actaris-metering-systems.com.
2. Dungs Combustion Controls: www.dungs.com.
3. Maxitrol Company: www.maxitrol.com.
4. Substitutions: See Division 01 - Product Requirements

B Compliance Requirements:
1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.

C Materials in Contact With Gas:
1. Housing: Aluminum, steel (free of non-ferrous metals).
2. Seals and Diaphragms: NBR-based rubber.

D Maximum Inlet Operating Pressure: 10 psi.
1. Appliance Regulator: 10 psi.
2. Line Pressure Regulator: 10 psi.

E Maximum Body Pressure: 10 psi.

F Output Pressure Range: 1 inch wc to 80 inch wc.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B Remove scale and dirt, on inside and outside, before assembly.
C Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A Install in accordance with manufacturer's instructions.
B Provide non-conducting dielectric connections wherever jointing dissimilar metals.
C Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
D Install piping to maintain headroom, conserve space, and not interfere with use of space.
E Group piping whenever practical at common elevations.
F Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230516.
G Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
H Provide access where valves and fittings are not exposed.
1. Coordinate size and location of access doors with Division
I Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
J Provide support for utility meters in accordance with requirements of utility companies.
K Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
1. Painting of interior piping systems and components is specified in Division 09.
2. Painting of exterior piping systems and components is specified in Division 09.
L Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
M Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.
N Sleeve pipes passing through partitions, walls and floors.
O Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
P Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

a. Painting of interior piping systems and components is specified in Division 09.
b. Painting of exterior piping systems and components is specified in Division 09

10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 230548.

3.04 APPLICATION

A Install unions downstream of valves and at equipment or apparatus connections.
B Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
C Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
D Install ball valves for throttling, bypass, or manual flow control services.
E Provide plug valves in natural gas systems for shut-off service.

3.05 SERVICE CONNECTIONS

A Provide new gas service complete with gas meter and regulators in accordance with Division 33. Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.06 SCHEDULES

A Pipe Hanger Spacing:
1. Metal Piping:
a. Pipe Size: 1/2 inches to 1-1/4 inches:
1) Maximum Hanger Spacing: 6.5 ft.
2) Hanger Rod Diameter: 3/8 inches.
b. Pipe Size: 1-1/2 inches to 2 inches:
1) Maximum Hanger Spacing: 10 ft.
2) Hanger Rod Diameter: 3/8 inch.
c. Pipe Size: 2-1/2 inches to 3 inches:
1) Maximum Hanger Spacing: 10 ft.
2) Hanger Rod Diameter: 1/2 inch.
d. Pipe Size: 4 inches to 6 inches:
1) Maximum Hanger Spacing: 10 ft.
2) Hanger Rod Diameter: 5/8 inch.
e. Pipe Size: 8 inches to 12 inches:
1) Maximum Hanger Spacing: 14 ft.
2) Hanger Rod Diameter: 7/8 inch.
f. Pipe Size: 14 inches and Over:
1) Maximum Hanger Spacing: 20 ft.
2) Hanger Rod Diameter: 1 inch.

END OF SECTION 231123

SECTION 232300

REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Piping.
- B Refrigerant.
- C Moisture and liquid indicators.
- D Valves.
- E Strainers.
- F Check valves.
- G Pressure regulators.
- H Pressure relief valves.
- I Filter-driers.
- J Solenoid valves.
- K Expansion valves.
- L Flexible connections.
- M Exterior penetration accessories.

1.02 RELATED REQUIREMENTS
- A Division 08 - Access Doors and Panels.
- B Division 09 - Interior Painting.
- C Section 230716 - HVAC Equipment Insulation.
- D Division 26 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS
- A AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.
- B ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Errata (2023).
- C ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- D ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- E ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- F ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- G ASME B31.9 - Building Services Piping; 2020.
- H ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- I ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- J ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2022.
- K ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- L ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- M ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2020.
- N AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- O AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- P ICC (IMC)-2018 - International Mechanical Code; 2018.

Q MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
R UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.
S UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A See Division 01 Submittal Procedures.
B Design Data: Submit design data indicating pipe sizing. Indicate load-carrying capacity of trapeze, multiple pipe, and riser support hangers.
C Test Reports: Indicate results of leak test, acid test.
D Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
E Submit welders certification of compliance with ASME BPVC-IX.
F Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.
G Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Divison 01 - Product Requirements, for additional provisions.
2. Extra Filter-Dryer Cartridges: One of each type and size.
3. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.
4. Extra Refrigerant: One container of refrigerant, 50 lbs.

1.05 QUALITY ASSURANCE

A Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A Deliver and store piping and specialties in shipping containers with labeling in place.
B Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
C Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A Where more than one piping system material is specified ensure system components are compatible and joined to ensure integrity of system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
B Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
C Liquid Indicators:
1. Use line size liquid indicators in main liquid line leaving condenser.
2. If receiver is provided, install in liquid line leaving receiver.
3. Use line size on leaving side of liquid solenoid valves.
D Valves:
1. Use service valves on suction and discharge of compressors.
2. Use gauge taps at compressor inlet and outlet.
3. Use gauge taps at hot gas bypass regulators, inlet and outlet.
4. Use check valves on compressor discharge.
5. Use check valves on condenser liquid lines on multiple condenser systems.
E Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

F Strainers:
1. Use line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
3. On steel piping systems, use strainer in suction line.
4. Use shut-off valve on each side of strainer.

G Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.

H Filter-Driers:
1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
2. Use a filter-drier on suction line just ahead of compressor.
3. Use sealed filter-driers in lines smaller than 1/2 inch outside diameter.
4. Use sealed filter-driers in low temperature systems.
5. Use sealed filter-driers in systems utilizing hermetic compressors.
6. Use replaceable core filter-driers in lines of 1/2 inch outside diameter or greater.
7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
8. Use filter-driers for each solenoid valve.

I Solenoid Valves:
1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Use in liquid line of single or multiple evaporator systems.
3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

J Receivers:
1. Use on systems with long piping runs.

K Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

2.02 REGULATORY REQUIREMENTS

A Comply with ASME B31.9 for installation of piping system.

B Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

C Welders Certification: In accordance with ASME BPVC-IX.

2.03 PIPING

A Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed type L or type K as required for equipment pressure requirements..
1. Fittings: ASME B16.22 wrought copper.
2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
3. Mechanical Press Sealed Fittings: Double pressed type complying with UL 207 and ICC (IMC)-2018.
   a. Manufacturers:

B Copper Tube to 7/8-inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed or hard drawn type L or type K as required for equipment pressure requirements.
1. Fittings: ASME B16.26 cast copper.
2. Joints: Flared.
3. Mechanical Press Sealed Fittings: Double pressed type complying with UL 207 and ICC (IMC)-2018.
   a. Manufacturers:

C Steel Pipe: ASTM A53/A53M, Schedule 40, black.
1. Fittings: ASTM A234/A234M, wrought steel welding type.

2. Joints: Welded in accordance with AWS D1.1/D1.1M.

D Steel Pipe Sizes 12 Inch and Over: ASTM A53/A53M, 0.375 inch wall, black.
1. Fittings: ASTM A234/A234M, wrought steel welding type.
2. Joints: Welded in accordance with AWS D1.1/D1.1M.

E Pipe Supports and Anchors:
1. Provide hangers and supports that comply with MSS SP-58.
a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
12. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

2.04 REFRIGERANT

A Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

2.05 MOISTURE AND LIQUID INDICATORS

A Manufacturers:
1. Henry Technologies: www.henrytech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Division 01 - Product Requirements.

B Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.06 VALVES

A Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Henry Technologies: www.henrytech.com/#sle.

3. Flomatic Valves: www.flomatic.com/#sle.
4. Substitutions:

B Diaphragm Packless Valves:
1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, soldered or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C Packed Angle Valves:
1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, soldered or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

D Ball Valves:
1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

E Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi.

2.07 STRAINERS

A Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Division 01 - Product Requirements.

B Straight Line or Angle Line Type:
1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.08 CHECK VALVES

A Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Division 01 - Product Requirements.

B Globe Type:
1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

C Straight Through Type:
1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.09 PRESSURE REGULATORS

A Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Division 01 - Product Requirements.

B Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

2.10 PRESSURE RELIEF VALVES

A Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Henry Technologies: www.henrytech.com/#sle.
3. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com/#sle.
4. Substitutions: See Division 01 - Product Requirements.

B Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

2.11 FILTER-DRIERS

A Manufacturers:
1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Division 01 - Product Requirements.

B Performance:
1. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
2. Design Working Pressure: 350 psi, minimum.

C Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

D Construction: UL listed.
1. Replaceable Core Type: Steel shell with removable cap.
2. Sealed Type: Copper shell.
3. Connections: As specified for applicable pipe type.

2.12 SOLENOID VALVES

A Manufacturers:
1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Division 01 - Product Requirements.

B Valve: AHRI 760 I-P, pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi.

C Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.13 EXPANSION VALVES

A Manufacturers:
1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.

B Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with nonreplaceable capillary tube and remote sensing bulb and remote bulb well.

C Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum

10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.14 ELECTRONIC EXPANSION VALVES

A Manufacturers:
1. Flomatic Valves: www.flomatic.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Division 01 - Product Requirements.

B Valve:
1. Brass body with flared or soldered connection, needle valve with floating needle and machined seat, stepper motor drive.

C Evaporation Control System:
1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.

D Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.15 FLEXIBLE CONNECTORS

A Manufacturers:
1. Circuit Hydraulics, Ltd: www.circuit-hydraulics.co.uk/#sle.
2. Flexicraft Industries: www.flexicraft.com/#sle.
3. Penflex: www.penflex.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

2.16 EXTERIOR PENETRATION ACCESSORIES

A Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
1. Products:
a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
b. Substitutions: See Division 01 - Product Requirements.

B Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
1. Products:
a. Alta Products, LLC; Sigrist Pipe Chase Housing, Curbs, and Exit Seals: www.altaproductsllc.com/#sle.
b. Menzies Metal Products: www.menzies-metal.com/#sle.
c. Substitutions: See Division 01 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

A Ream pipe and tube ends. Remove burrs. Bevel plain-end ferrous pipe.

B Remove scale and dirt on inside and outside before assembly.

C Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A Install refrigeration specialties in accordance with manufacturer's instructions.

B Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C Install piping to conserve building space and avoid interference with use of space.

D Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

G Pipe Hangers and Supports:

1. Install in accordance with ASME B31.5.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.

H Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

I Provide clearance for installation of insulation and access to valves and fittings.

J Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 083100.

K Flood piping system with nitrogen when brazing.

L Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

M Prepare unfinished pipe, fittings, supports, and accessories for finish painting. See Section 099123.

N Insulate piping and equipment.

O Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

P Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

Q Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

R Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

S Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

T Fully charge completed system with refrigerant after testing.

U Provide electrical connection to solenoid valves. See Division 26.

3.03 FIELD QUALITY CONTROL

A See Division 01 - Quality Requriements, for additional requirements.

B Test refrigeration system in accordance with ASME B31.5.

C Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using halide torch. Test and repair piping until no leakage.

3.04 SCHEDULES

A Hanger Spacing for Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.
8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.
9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.

B Hanger Spacing for Steel Piping.

1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.

END OF SECTION 232300

SECTION 233100

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Metal ducts.
- B Flexible ducts.
- C Air plenums and casings.
- D Ducts for kitchen exhaust applications.

1.02 RELATED REQUIREMENTS
- A Section 230713 - Duct Insulation: External insulation and duct liner.
- B Section 233300 - Air Duct Accessories.
- C Section 233700 - Air Outlets and Inlets: Fabric air distribution devices.

1.03 REFERENCE STANDARDS
- A ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- D ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
- E ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- F ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- G ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023.
- H ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- I ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- J ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems; 2020.
- K ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- L ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- M ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- N ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- O NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- P NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

Q NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
R SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
S SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2021.
T SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
U UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
V UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
W UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
X UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A See Division 01 Submittal Procedures.
B Product Data: Provide data for duct materials.
C Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

1.05 QUALITY ASSURANCE
A Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
B Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS
A Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
B Maintain temperatures within acceptable range during and after installation of duct sealants.

1.07 WARRANTY
A See Division 01 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 APPLICATIONS
A The material descriptions listed in the section may not all be used on this project. Refer to the Material Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

2.02 GENERAL REQUIREMENTS
A Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
B Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.
C Duct Shape and Material in accordance with Allowed Static Pressure Range:
1. Round: Plus or minus 2 in-wc of galvanized steel.
2. Rectangular: Plus or minus 1/2 in-wc of galvanized steel.
3. Flat Oval: Plus 2 in-wc of galvanized steel.
4. Fibrous Glass Duct-board: Plus or minus 1/2 in-wc.
5. Flexible Duct (Fabric and wire): Plus or minus 1/2 in-wc; see Section 233700.
D Duct Sealing and Leakage in accordance with Static Pressure Class:

1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
   a. Supply Air: 1/2 in-wc pressure class, galvanized steel.
   b. Outside Air Intake: 1/2 in-wc pressure class, galvanized steel.
   c. Return and Relief Air: 1/2 in-wc pressure class, galvanized steel.
   d. General Exhaust Air: 1/2 in-wc pressure class, galvanized steel.
   e. Heating or Combustion Air: 1/2 in-wc pressure class, galvanized steel.
   f. Transfer-air and Sound Booths: 1/2 in-wc pressure class, fibrous glass.
   g. Buried Duct for Supply and Return Air:
      1) 1/2 in-wc pressure class, galvanized steel.
      2) 2 in-wc pressure class, fabricate using two sheet-metal gauges heavier material than indicated.
   h. Buried Slab-Ventilation Duct: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS, with G90/Z275 coating designed for installation in cast-in-place concrete floor assemblies.
      1) Fittings: Elbows, End caps, Connecting couplings, Spin-in-collar, Sofit-discharge head, Support Brackets, and Wall discharge head.
2. Low Pressure Service: Up to 2 in-wc:
   a. Seal: Class C, apply to seal off transverse joints.
   b. Leakage:
      1) Rectangular: Class 24 or 24 cfm/100 sq ft.
      2) Round: Class 12 or 12 cfm/100 sq ft.
3. Low Pressure Service: From 2 in-wc to 3 in-wc:
   a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
   b. Leakage:
      1) Rectangular: Class 12 or 12 cfm/100 sq ft.
      2) Round: Class 6 or 6 cfm/100 sq ft.
4. Medium and High Pressure Service: Above 3 in-wc:
   a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
   b. Leakage:
      1) Rectangular: Class 6 or 6 cfm/100 sq ft.

E Duct Fabrication Requirements:
1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.03 METAL DUCTS

A Material Requirements:
1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
2. Ungalvanized Steel: ASTM A1008/A1008M Designation CS (commercial steel), cold-rolled.
3. Aluminum: ASTM B209/B209M, aluminum sheet, alloy 3003-H14.
4. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
5. Stainless Steel: ASTM A666, Type 304.

B Fire Rated Ducts:
1. Two-hour, Fire Rated Duct:
   a. UL labeled, construct of 18-gauge, 0.0516-inch galvanized steel.
   b. R-Value: 4.5 when tested in accordance with ASTM C177.
2. Three-hour, Fire Rated Duct:
   a. UL labeled, construct of 22-gauge, 0.033-inch galvanized steel.

C Rectangular Metal Duct:
1. Rectangular Double Wall Insulated: Rectangular spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
   a. Insulation:
      1) Material: Air.
   b. Manufacturers:
      1) Lindab Inc.:www.linfab.com
      2) McGill AirFlow LLC.: www.mcgillairflow.com
      3) SEMCO Incorporated.: www.engineeredproducts.com/semco
      4) Sheet Metal Connectors, Inc.:www.smcduct.com
      5) Spiral Manufacturing Co., Inc: www.spiralmfg.com
      6) Substitutions: See Division 01 - Product Requirements.

D Flat-Oval Metal Ducts:
1. Flat-Oval Single Wall Duct: Machine made from a round spiral lock seam duct.
   a. Fittings: Manufacture at least two gauges heavier metal than the duct.
   b. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
   c. Manufacturers:
      1) Lindab Inc.:www.linfab.com
      2) McGill AirFlow LLC.: www.mcgillairflow.com
      3) SEMCO Incorporated.: www.engineeredproducts.com/semco
      4) Sheet Metal Connectors, Inc.:www.smcduct.com
      5) Spiral Manufacturing Co., Inc: www.spiralmfg.com
      6) Substitutions: See Division 01 - Product Requirements.
2. Flat-Oval Double Wall Insulated Duct: Machine made from round spiral lock seam duct.
   a. Fittings: Manufacture with solid inner wall.
   b. Inner Wall: Perforated galvanized steel.
   c. Manufacturers:
      1) Lindab Inc.:www.linfab.com
      2) McGill AirFlow LLC.: www.mcgillairflow.com
      3) SEMCO Incorporated.: www.engineeredproducts.com/semco
      4) Sheet Metal Connectors, Inc.:www.smcduct.com
      5) Spiral Manufacturing Co., Inc: www.spiralmfg.com
      6) Substitutions: See Division 01 - Product Requirements.

E Round Metal Ducts:
1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
2. Round Double Wall Insulated Duct: Round spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
   a. Insulation:
      1) Material: Air.
   b. Manufacturers:
      1) Lindab Inc.:www.linfab.com
      2) McGill AirFlow LLC.: www.mcgillairflow.com
      3) SEMCO Incorporated.: www.engineeredproducts.com/semco
      4) Sheet Metal Connectors, Inc.:www.smcduct.com
      5) Spiral Manufacturing Co., Inc: www.spiralmfg.com
      6) Substitutions: See Division 01 - Product Requirements.
3. Round Connection System: Interlocking duct connection system per SMACNA (DCS).
   a. Manufacturers:
      1) Ductmate Industries, Inc, a DMI Company: www.ductmate.com.
      2) Nordfab Ducting: www.nordfab.com.
      3) Lindab Inc.:www.linfab.com
      4) McGill AirFlow LLC.: www.mcgillairflow.com
      5) SEMCO Incorporated.: www.engineeredproducts.com/semco
      6) Sheet Metal Connectors, Inc.:www.smcduct.com
      7) Spiral Manufacturing Co., Inc: www.spiralmfg.com
      8) Substitutions: See Division 01 - Product Requirements.

F Round Spiral Duct:
1. Round spiral lock seam duct with galvanized steel outer wall.
2. Manufacturers:
   a. Lindab Inc.:www.linfab.com
   b. McGill AirFlow LLC.: www.mcgillairflow.com
   c. SEMCO Incorporated.: www.engineeredproducts.com/semco
   d. Sheet Metal Connectors, Inc.:www.smcduct.com
   e. Spiral Manufacturing Co., Inc: www.spiralmfg.com
   f. Substitutions: See Division 01 - Product Requirements.

G Connectors, Fittings, Sealants, and Miscellaneous:
1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
   a. Manufacturers:
      1) Carlisle HVAC Products; Nexus Flange Connectors with Sealant Pocket: www.carlislehvac.com.
      2) Ductmate Industries, Inc, a DMI Company: www.ductmate.com.
      3) Lindab Inc.:www.linfab.com
      4) McGill AirFlow LLC.: www.mcgillairflow.com
      5) SEMCO Incorporated.: www.engineeredproducts.com/semco
      6) Sheet Metal Connectors, Inc.:www.smcduct.com
      7) Spiral Manufacturing Co., Inc: www.spiralmfg.com
3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
b. VOC Content: Not more than 250 g/L, excluding water.
c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
d. For Use with Flexible Ducts: UL labeled.

4. Gasket Tape:
   a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
6. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:
   a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   f. Other Types: As required.

H Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: R6 insulation with polyethylene vapor barrier film.
2. Pressure Rating: 10 in-wc positive and 5 in-wc negative.
3. Maximum Velocity: 5500 fpm.
4. Temperature Range: Minus 20 degrees F to 250 degrees F.
5. Manufacturers:
   a. Flexmaster USA, a brand of Masterduct, Inc; Type 1: www.flexmasterusa.com.
   b. Thermaflex: www.thermaflex.net
   c. Lindfab: www.lindfab.com
   d. Substitutions: See Division 01 - Product Requirements.

I Acoustic Flexible Ducts: UL 181, Class 1, spun-bond nylon, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: Fiberglass insulation with metalic vapor barrier.
2. Inner Core: Spun-bonded, nonwoven inner core.
3. Pressure Rating: 6 in-wc positive and 5 in-wc negative.
4. Maximum Velocity: 4000 fpm.
5. Temperature Range: Minus 20 degrees F to 250 degrees F.
6. Manufacturers:
   a. Flexmaster USA, a brand of Masterduct, Inc; Type 6: www.flexmasterusa.com.
   b. Thermaflex: www.thermaflex.net
   c. Lindfab: www.lindfab.com
   d. Substitutions: See Division 01 - Product Requirements.

J Medium Pressure Flexible Ducts: UL 181, Class 1, aluminized laminate, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: Fiberglass insulation with metalic vapor barrier.
2. Inner Core: Tri-laminate of polyester, fiberglass, and aluminum foil.
3. Pressure Rating: 15 in-wc positive and 5 in-wc negative.
4. Maximum Velocity: 5500 fpm.

5. Temperature Range: Minus 20 degrees F to 250 degrees F.
6. Manufacturers:
   a. Flexmaster USA, a brand of Masterduct, Inc; Type 5: www.flexmasterusa.com.
   b. Thermaflex: www.thermaflex.net
   c. Lindfab: www.lindfab.com
   d. Substitutions: See Division 01 - Product Requirements.

K High Pressure Flexible Ducts: UL 181, Class 1, aluminized tri-laminate, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: Fiberglass insulation with metalic vapor barrier.
2. Inner Core: Tri-laminate of polyester, fiberglass, and aluminum foil.
3. Pressure Rating: 20 in-wc positive and 5 in-wc negative.
4. Maximum Velocity: 5500 fpm.
5. Temperature Range: Minus 20 degrees F to 250 degrees F.
6. Manufacturers:
   a. Flexmaster USA, a brand of Masterduct, Inc; Type 3: www.flexmasterusa.com.
   b. Thermaflex: www.thermaflex.net
   c. Lindfab: www.lindfab.com
   d. Substitutions: See Division 01 - Product Requirements.

L High Pressure Flexible Ducts: UL 181, Class 1, PVC-coated, fiberglass cloth fabric, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: Fiberglass insulation with metalic vapor barrier.
2. Inner Core: PVC-coated, fiberglass cloth fabric.
3. Pressure Rating: 25 in-wc positive and 5 in-wc negative.
4. Maximum Velocity: 5500 fpm.
5. Temperature Range: Minus 20 degrees F to 250 degrees F.
6. Manufacturers:
   a. Flexmaster USA, a brand of Masterduct, Inc; Type 4: www.flexmasterusa.com.
   b. Thermaflex: www.thermaflex.net
   c. Lindfab: www.lindfab.com
   d. Substitutions:

2.04 FLEXIBLE DUCTS

A Flexible Air Ducts:
1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
2. Pressure Rating: From 10 in-wc to 1 in-wc negative.
3. Temperature Range: Minus 20 to 210 degrees F.

B Flexible Air Ducts:
1. UL 181, Class 1, polyethylene film supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
3. Pressure Rating: From 10 in-wc to 5 in-wc negative.
4. Maximum Velocity: 5,500 fpm.
5. Temperature Range: Minus 20 to 250 degrees F.

C Flexible Air Ducts:
1. UL 181, Class 0, interlocking spiral of aluminum foil.
2. Pressure Rating: 8 in-wc positive or negative.
3. Temperature Range: Minus 20 to 250 degrees F.

D Vapor Barrier Insulated Flexible Air Ducts:
1. UL 181, Class 1, two-ply polyester or vinyl film supported by helically wound spring steel wire.

2. Insulation: Fiberglass insulation with polyethylene vapor barrier core.
3. Pressure Rating: From 10 in-wc positive to 1 in-wc negative.
4. Temperature Range: Minus 10 to 160 degrees F.

E Uninsulated Flexible Air Ducts:
1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
2. Pressure Rating: From 10 in-wc to 1 in-wc negative.
3. Temperature Range: Minus 20 to 210 degrees F.

F Acoustic Flexible Air Ducts:
1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
2. Inner Core: Spun-bonded, nonwoven inner core.
3. Pressure Rating: From 6 in-wc to 5 in-wc negative.
4. Temperature Range: Minus 20 to 250 degrees F.

G Antimicrobial Flexible Air Ducts:
1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with reinforced vapor barrier.
3. Inner Core: Microbial growth resistant inner core treated with Agion silver.
4. Pressure Rating: From 10 in-wc to 1 in-wc negative.
5. Temperature Range: Minus 20 to 210 degrees F.

H Flexible Air Ducts with Rip-Resistant Scrim and Collared Ends:
1. UL 181, Class 1, aluminum laminate and polyester vapor barrier with rip-resistant scrim reinforcement and collared ends supported by helically wound spring steel wire.
2. Pressure Rating: From 10 in-wc to 0.5 in-wc negative.
3. Temperature Range: Minus 20 to 175 degrees F.

I High Pressure Flexible Air Ducts:
1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with reinforced vapor barrier.
3. Pressure Rating: From 16 in-wc positive to 2 in-wc negative.
4. Temperature Range: Minus 20 to 210 degrees F.

J Medium Pressure Flexible Air Ducts:
1. Pressure Rating: From 10 in-wc to 10 in-wc negative.
2. Maximum Velocity: 5,500 fpm.
3. Temperature Range: Minus 20 to 250 degrees F.

K High Pressure Flexible Air Ducts:
1. Pressure Rating: From 20 in-wc to 5 in-wc negative.
2. Maximum Velocity: 5,500 fpm.
3. Temperature Range: Minus 20 to 250 degrees F.

L High Pressure Flexible Air Ducts:
1. Inner Core: PVC-coated, fiberglass cloth fabric.
2. Pressure Rating: From 20 in-wc to 5 in-wc negative.
3. Maximum Velocity: 5,500 fpm.
4. Temperature Range: Minus 20 to 250 degrees F.

2.05 AIR PLENUMS AND CASINGS

A Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.

B Minimum Fabrication Requirements:
1. Fabricate acoustic plenum or casing with reinforcing turned inward.

2. Provide 16-gauge, 0.059-inch sheet steel back facing and 22-gauge, 0.029-inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers.
3. Construct panels 3 inches thick, packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16-gauge, 0.059-inch sheet steel.
4. Mount floor-mounted plenum or casings on 4-inch high concrete curbs. At floor, rivet panels on 8-inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.

C Access Doors:
1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
3. Provide clear wire glass observation ports, minimum 6 by 6 inch size.

D Thermal Panels:
1. Material: Steel-faced composite panel with noncombustible structural high density mineral fiber core for plenum fabrication.
   a. Facing: Galvanized steel (G90), 24 gauge, 0.0275 inch.
   b. Finish: Unpainted.
   c. Core: Mineral wool board.
   d. Structural: Nonload bearing.

E Fire-Rated Metal Panels:
1. Fire Rating: 60 minutes when tested in accordance with ASTM E119.
2. Material: Steel-faced composite panel with noncombustible structural high density mineral fiber core, UL or ETL labeled, nonload bearing fire separations.
   a. Facing: Galvanized steel (G90), 24 gauge (0.0275 inch).
   b. Finish: Unpainted.
   c. Core: Mineral wool board.
   d. Structural: Nonload bearing.

2.06 DUCTS FOR KITCHEN EXHAUST APPLICATIONS

A Provide ductwork, fittings, and appurtenances per NFPA 96, SMACNA (KVS), UL 1978, and UL 2221 requirements and guidelines.

B Class 1 duct for air with gas and grease particle exhaust at an air velocity of 1,500 to 2,500 fpm.

C Where ducts are not self-draining back to equipment, provide low-point drain pocket with the copper drain pipe to a sanitary sewer.

D Design, fabricate, and install liquidtight preventing exhaust leakage into building.

E Dishwasher Exhaust Duct:
1. Duct Size: 1/2 in-wc pressure class stainless steel.
2. Seal joints during installation with factory-supplied overlapping V-bands and sealant.

F Kitchen Hood and Grease Exhaust Duct:
1. Fabricate in accordance with ductwork manufacturer's instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.
2. Round, Single-Wall, Premanufactured Grease Exhaust Duct:
   a. UL Listed and labeled to UL 1978.
   b. Construct of 20-gauge, 0.035-inch Type 304 stainless steel.
   c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
   d. Minimum horizontal slope of 1/16 inch per foot per manufacturers listing to UL 1978.
   e. Manufacturers:

1) Captive-Aire: https://www.captiveaire.com.
2) Substitutions: See Division 01 - Product Requirements.

3. Rectangular, Single-Wall, Premanufactured Grease Exhaust Duct:
   a. UL Listed and labeled to UL 1978.
   b. Construct of 16-gauge, 0.059-inch sheet steel using continuous external welded joints in rectangular sections.
   c. Construct of 18-gauge, 0.050-inch stainless steel using continuous external welded joints in rectangular sections.
   d. Manufacturers:
      1) Captive-Aire: https://www.captiveaire.com.
      2) Substitutions: See Division 01 - Product Requirements.
4. Round, Double-Wall, Premanufactured Grease Exhaust Ducts:
   a. UL Listed and labeled to UL 1978.
   b. Nominal 1 inch thick, body soluble fiber insulation that fills annular space between inner liner of 20-gauge, 0.035 inch Type 304 stainless steel and outer jacket of 24-gauge, 0.023-inch aluminized steel.
   c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
   d. Minimum horizontal slope of 1/16 inch per foot per manufacturer's listing to UL 1978.
   e. Manufacturers:
   f. Captive-Aire: https://www.captiveaire.com.
      1) Substitutions: See Division 01 - Product Requirements.
5. Zero Clearance, 2-Hour Fire-Rated, Round, Double-Wall, Premanufactured Grease Duct:
   a. UL Listed and labeled to UL 1978 and UL 2221.
   b. Nominal 3 inches thick, high density body soluble fiber insulation between 20-gauge, 0.035-inch Type 304 stainless steel liner, and 24-gauge, 0.0239-inch aluminized steel sheet outer jacket.
   c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
   d. Through-penetration firestop listed to UL 1479 or ASTM E814.
   e. Minimum horizontal slope of 1/16 inch per foot per manufacturers listing to UL 1978.
   f. Captive-Aire: https://www.captiveaire.com.
      1) Substitutions: See Division 01 - Product Requirements.
6. Zero Clearance, 2-Hour Fire-Rated, Rectangular, Double-Wall, Premanufactured Grease Duct:
   a. Listed when tested in accordance with UL 1978 and ASTM E2336.
   b. Construct of 16-gauge, 0.059-inch sheet steel using continuous external welded joints in rectangular sections.
   c. Liquidtight with continuous external weld for seams and joints.
   d. Where ducts are not self-draining back to equipment, provide low-point drain pocket with copper drain pipe to sanitary sewer.
   e. Through-penetration firestop listed to UL 1479 or ASTM E814.
   f. Manufacturers:
      1) Captive-Aire: https://www.captiveaire.com.
      2) Substitutions: See Division 01 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A Install, support, and seal ducts in accordance with SMACNA (DCS).

B Install products following the manufacturer's instructions.

C Comply with safety standards NFPA 90A and NFPA 90B.

D During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
E Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
F Buried Metal Ductwork Without Factory Jacket: Paint with one coat and seams and joints with additional coat of asphalt base protective coating.
G Fibrous Glass Ducts: Install per SMACNA (FGD). Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.
H Kitchen Range Hoods: Install when provided by Division 11 then fit-out with respective ductwork and accessories to interconnect exhaust system.
I Kitchen Hood Exhaust: Provide residue traps at the base of vertical risers with provisions for the cleanout.
J Kitchen Hood Exhaust: Provide minimum 20 in. x 20 in. access panel in vertical risers passing through more than one or more fllors, or minimum every 12 ft pre NFPA 96.
K PVC Coated Metal Ductwork: Tape with PVC tape.
L Underground Ducts: Slope to plenums or low pump-out points at 1:500. Provide access doors for inspection.
M Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
N Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
O Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
P Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.
Q Use double nuts and lock washers on threaded rod supports.
R Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
S Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
T Set plenum doors at 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
U At exterior wall louvers, seal duct to louver frame and install blank-out panels.
V Louver Fit-out:
    1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.
    2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.
W Plenums and Casings:
    1. Mount floor-mounted casings on 4 inch high concrete curbs.
    2. At floor, rivet panels on 8 inch centers to angles.
    3. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.
X Fire Partitions: Provide firestopping sealing as indicated within Division 07.
Y Duct Insulation: Provide duct insulation in compliance with Section 230713.

3.02 CLEANING

A Clean duct systems with high-power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters or bypass during cleaning. Provide adequate access to the ductwork for cleaning purposes.

END OF SECTION 233100

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Air turning devices/extractors.
- B Backdraft dampers - metal.
- C Combination fire and smoke dampers.
- D Combination fire and smoke dampers - corridor dampers.
- E Duct access doors.
- F Duct test holes.
- G Fire dampers.
- H Flexible duct connectors.
- I Smoke dampers.
- J Smoke and fire-smoke damper test module.
- K Volume control dampers.
- L Low leakage (Class 1A) control dampers.
- M Miscellaneous Products:
  1. Internal strut end plugs.

1.02 RELATED REQUIREMENTS
- A Section 233100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS
- A NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- B NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- C NFPA 92 - Standard for Smoke Control Systems; 2021, with Amendment.
- D NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- E NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- F SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- G UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- H UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- I UL 555C - Standard for Safety Ceiling Dampers; Current Edition, Including All Revisions.
- J UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C Manufacturer's Installation Instructions: Provide instructions for fire dampers.
- D Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 016000 - Product Requirements for additional provisions.
  2. Extra Fusible Links: One of each type and size.

1.05 QUALITY ASSURANCE
- A Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 APPLICATION

A The Products listed in the section may not all be used on this project. Refer to the Equipment Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

1. AIR TURNING DEVICES/EXTRACTORS
   a. Manufacturers:
      1) Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane): www.carlislehvac.com/#sle.
      2) Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
      3) Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.
      4) Ruskin Company: www.ruskin.com/#sle.
      5) Titus HVAC, a brand of Johnson Controls: www.titus-hvac.com/#sle.
      6) Substitutions: See Section 016000 - Product Requirements.
2. BACKDRAFT DAMPERS - METAL
   a. Manufacturers:
      1) Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
      2) Nailor Industries, Inc: www.nailor.com/#sle.
      3) Ruskin Company: www.ruskin.com/#sle.
      4) United Enertech: www.unitedenertech.com/#sle.
      5) Substitutions: See Section 016000 - Product Requirements.
3. COMBINATION FIRE AND SMOKE DAMPERS
   a. Manufacturers:
      1) Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
      2) Nailor Industries, Inc: www.nailor.com/#sle.
      3) NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
      4) Pottorff: www.pottorff.com/#sle.
      5) Ruskin Company: www.ruskin.com/#sle.
      6) Greenheck: www.greenheck.com
      7) Johnson Controls: www.jonhsoncontrols.com
      8) Substitutions: See Section 016000 - Product Requirements.
   b. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
   c. Provide factory sleeve and collar for each damper.
   d. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.

e. Operators: UL listed and labeled; spring-return, electric-type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
f. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
g. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.
h. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.
   1) Manufacturers:
      (a) Ruskin Company: www.ruskin.com/#sle.
      (b) Substitutions: See Section 016000 - Product Requirements.

4. COMBINATION FIRE AND SMOKE DAMPERS - CORRIDOR DAMPERS
   a. Manufacturers:
      1) Ruskin Company: www.ruskin.com/#sle.
      2) United Enertech: www.unitedenertech.com/#sle.
      3) Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
      4) Nailor Industries, Inc: www.nailor.com/#sle.
      5) NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
      6) Pottorff: www.pottorff.com/#sle.
      7) Ruskin Company: www.ruskin.com/#sle.
      8) Greenheck: www.greenheck.com
      9) Johnson Controls: www.jonhsoncontrols.com
      10) United Enertech: www.unitedenertech.com/#sle.
   b. Performance-Select single dampers and assemblies of multiple dampers for a maximum pressure drop of 0.2" w.c at 2,500 fpm. Pressure drop is for the complete assembly, including wall sleeves, reinforments, and all accessories. If pressure drop exceeds the 0.2", the damper or assembly must be increased to meet maximum allowable pressure specified.
5. DUCT ACCESS DOORS
   a. Manufacturers:
      1) Acudor Products Inc, a Division of Nelson Industrial Inc: www.acudor.com/#sle.
      2) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
      3) Lloyd Industries, Inc: www.firedamper.com/#sle.
      4) Nailor Industries, Inc: www.nailor.com/#sle.
      5) Ruskin Company: www.ruskin.com/#sle.
      6) SEMCO LLC: www.semcohvac.com/#sle.
      7) Substitutions: See Section 016000 - Product Requirements.
   b. Fabricate in accordance with SMACNA (DCS) and as indicated.
6. DUCT TEST HOLES
   a. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
   b. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
      1) Manufacturers:
         (a) Carlisle HVAC Products; Dynair Test Port with Red Cap with O-Ring Seal: www.carlislehvac.com/#sle.

(b) Substitutions: See Section 016000 - Product Requirements.

7. FIRE DAMPERS
   a. Manufacturers:
      1) Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
      2) Nailor Industries, Inc: www.nailor.com/#sle.
      3) NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
      4) Pottorff: www.pottorff.com/#sle.
      5) Ruskin Company: www.ruskin.com/#sle.
      6) Greenheck: www.greenheck.com
      7) Johnson Controls: www.jonhsoncontrols.com
      8) United Enertech: www.unitedenertech.com/#sle.
      9) Substitutions: See Section 016000 - Product Requirements.
   b. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
   c. Ceiling (Radiation) Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame and 16-gauge, 0.0598-inch flap, two layers of 0.125-inch thick ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
      1) Rated for three hour service in compliance with UL 555C.
      2) Manufacturers:
         (a) Ruskin Company: www.ruskin.com/#sle.
         (b) Johnson Controls: www.jonhsoncontrols.com
         (c) Titus: www.titus-hvac.com
         (d) Substitutions: See Section 016000 - Product Requirements.
   d. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.
   e. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch pressure-class ducts up to 12 inches in height.
   f. Multiple Blade Dampers: 16-gauge, 0.0598-inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
   g. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.
   h. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.
   i. Performance-Select single dampers and assemblies of multiple dampers for a maximum pressure drop of 0.2" w.c at 2,500 fpm. Pressure drop is for the complete assembly, including wall sleeves, reinforments, and all accessories. If pressure drop exceeds the 0.2", the damper or assembly must be increased to meet maximum allowable pressure specified.
8. FLEXIBLE DUCT CONNECTORS
   a. Manufacturers:
      1) Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com/#sle.
      2) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
      3) Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
   b. Fabricate in accordance with SMACNA (DCS) and as indicated.
   c. Flexible Duct Connections: Fabric crimped into metal edging strip.

1) Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

d. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

e. Maximum Installed Length: 14 inch.

9. SMOKE DAMPERS

a. Manufacturers:

1) AireTechnologies, Inc, a DMI Company: www.airetechnologies.com/#sle.

2) Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.

3) Nailor Industries, Inc: www.nailor.com/#sle.

4) Ruskin Company: www.ruskin.com/#sle.

5) United Enertech: www.unitedenertech.com/#sle.

6) Substitutions: See Section 016000 - Product Requirements.

b. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

c. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.

d. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

e. Performance-Select single dampers and assemblies of multiple dampers for a maximum pressure drop of 0.2" w.c at 2,500 fpm. Pressure drop is for the complete assembly, including wall sleeves, reinforments, and all accessories. If pressure drop exceeds the 0.2", the damper or assembly must be increased to meet maximum allowable pressure specified.

10. SMOKE AND FIRE-SMOKE DAMPER TEST MODULE

a. Addressable fire alarm system proprietary controller module preconfigured for remote testing of dedicated smoke damper or combination fire-smoke damper.

b. Provide module, accessories, and connectivity to meet NFPA 80 and NFPA 105 requirements.

c. Products:

1) Ruskin Company; ADC105: www.ruskin.com/#sle.

2) Substitutions: See Section 016000 - Product Requirements.

11. VOLUME CONTROL DAMPERS

a. Manufacturers:

1) AireTechnologies, Inc, a DMI Compan www.airetechnologies.com/#sle.

2) Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.

3) Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.

4) MKT Metal Manufacturing: www.mktduct.com/#sle.

5) Nailor Industries, Inc: www.nailor.com/#sle.

6) NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.

7) Ruskin Company: www.ruskin.com/#sle.

8) United Enertech: www.unitedenertech.com/#sle.

9) Substitutions: See Section 016000 - Product Requirements.

b. Fabricate in accordance with SMACNA (DCS) and as indicated.

c. Splitter Dampers:

1) Material: Same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.

2) Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3) Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

d. Single Blade Dampers:
   1) Fabricate for duct sizes up to 6 by 30 inch.
   2) Blade: 24 gauge, 0.0239 inch, minimum.

e. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches. Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
   1) Blade: 18 gauge, 0.0478 inch, minimum.

f. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
   1) Manufacturers:
      (a) Carlisle HVAC Products; Dynair End Bearing Leak Resistant Sets: www.carlislehvac.com/#sle.
      (b) Elgen Manufacturing Company, Inc; Snap-In Bushing: www.elgenmfg.com/#sle.
      (c) Substitutions: See Section 016000 - Product Requirements.

g. Quadrants:
   1) Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2) On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3) Where rod lengths exceed 30 inches provide regulator at both ends.
   4) Manufacturers:
      (a) Carlisle HVAC Products; Dynair Double Shear Rattle Free Quadrants 1/2 inch: www.carlislehvac.com/#sle.
      (b) Substitutions: See Section 016000 - Product Requirements.

12. LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS
   a. Manufacturers:
      1) Ruskin Company; CD50: www.ruskin.com/#sle.
      2) United Enertech: www.unitedenertech.com/#sle.
      3) Substitutions: See Section 016000 - Product Requirements.
   b. Maximum Leakage Allowed: 3 cfm/sq ft at 1 in-wc.
   c. Frame:
      1) Material: 20-gauge galvanized steel.
      2) Free-area: Single cross section.
      3) Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.
   d. Blade:
      1) Type: Single-blade rectangle shape.
      2) Operation: Opposed type.
      3) Maximum Individual Blade Height: 8 inches.
      4) Material: 12-gauge galvanized steel.
      5) Authority: Opposed type, 5 to 50 percent (typically 10 percent).
   e. Insulation: Water-resistant sound absorbing material.
   f. Temperature Service Range: Minus 25 to 185 degrees F.
   g. Other Requirements:

1) Sleeve or Flange: Factory-mounted standard.

13. MISCELLANEOUS PRODUCTS
    a. Damper Operators: Provide electric operators.
    b. Damper position switch.
    c. Internal Strut End Plugs: Combination end-mounting and sealing plugs for metal conduit used as internal reinforcement struts for metal ducts; plug crimped inside conduit with outside gasketed washer seal.
        1) Manufacturers:
            (a) Carlisle HVAC Products; Dynair Internal Duct Reinforcement - Conduplugs: www.carlislehvac.com/#sle.
            (b) Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

A Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.

B Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.

D Provide duct test holes where indicated and required for testing and balancing purposes.

E Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

G Demonstrate re-setting of fire dampers to Owner's representative.

H At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

I At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

J For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

K Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

L Use splitter dampers only where indicated.

M Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 233300

SECTION 233423

HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Roof exhausters.
- B Roof intake fans.
- C Ceiling exhaust fans.
- D Inline centrifugal fans and blowers.
- E Kitchen hood upblast roof exhausters.

1.02 REFERENCE STANDARDS
- A AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B AMCA 99 - Standards Handbook; 2016.
- C AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
- E AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- F AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

1.03 ADMINISTRATIVE REQUIREMENTS

1.04 SUBMITTALS
- A See Divison 01 Submittal Procedures.
- B Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C Manufacturer's Instructions: Indicate installation instructions.

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL
- A Static and Dynamically Balanced: Comply with AMCA 204.
- B Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D Fabrication: Comply with AMCA 99.
- E Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.02 ROOF EXHAUSTERS
- A Manufacturers:
  1. Carnes, a division of Carnes Company Inc: www.carnes.com.
  2. Greenheck Fan Corporation: www.greenheck.com.
  3. Patterson Fan Company, Inc: www.pattersonfan.com.
  4. Twin City Fan & Blower; BCRD: www.tcf.com.
- B Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- C Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

D Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.03 CEILING EXHAUST FANS

A Manufacturers:
1. Broan-NuTone, LLC; 744 Recessed Ventilation Fan with Light: www.broan-nutone.com.
2. Carnes, a division of Carnes Company Inc: www.carnes.com.
3. Greenheck Fan Corporation: www.greenheck.com.
4. Twin City Fan & Blower; T: www.tcf.com.

B Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resiliently mounted motor, gravity backdraft damper in discharge.

C Grille: Molded white plastic.

D Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.04 ROOF INTAKE FANS

A Fan Unit: Adjustable belt or direct-driven forward curved fan, resiliently-mounted induction motor, heavy duty ball bearings, powder-coated steel weatherproof cabinet with side intake hood, and removable service panels.

B Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

2.05 INLINE CENTRIFUGAL FANS AND BLOWERS

A Manufacturers:
1. Greenheck Fan Corporation: www.greenheck.com.
2. Loren Cook Company: www.lorencook.com.
3. Twin City Fan & Blower; BSI: www.tcf.com.

B Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing lined with acoustic insulation, resiliently-mounted motor, gravity backdraft damper in discharge.

C Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm gets reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

2.06 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

A Manufacturers:
1. Carnes, a division of Carnes Company Inc; VRBK: www.carnes.com.
2. Greenheck Fan Corporation: www.greenheck.com.
3. Twin City Fan & Blower; BCRUR: www.tcf.com.

B Belt Drive Fan:
1. Fan Wheel:
   a. Type: Non-overloading, backward inclined centrifugal.
   b. Material: Aluminum, statically and dynamically balanced.
2. Housing:
   a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
   b. Rigid internal support structure.
   c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
   d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
   e. Provide breather tube for fresh air motor cooling and wiring.

C Shafts and Bearings:
1. Fan Shaft:
a. Ground and polished steel with anti-corrosive coating.
b. First critical speed at least 25 percent over maximum cataloged operating speed.
2. Bearings:
a. Permanently sealed or pillow block type.
b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
c. 100 percent factory tested.

D Drive Assembly:
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
2. Belts: Static free and oil resistant.
3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. Motor pulley adjustable for final system balancing.
5. Readily accessible for maintenance.

E Drain Trough: Allows for single-point drainage of water, grease, and other residues.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

END OF SECTION 233423

SECTION 233600

AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Single-duct terminal units.
  1. Constant-volume units.

1.02 RELATED REQUIREMENTS
- A Section 230548 - Vibration and Seismic Controls for HVAC.
- B Section 233100 - HVAC Ducts and Casings.
- C Section 233300 - Air Duct Accessories.
- D Section 233700 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS
- A AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017.
- B ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.
- C ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2019).
- D ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.
- E ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- F NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- G NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- D Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
- E Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- F Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

1.06 WARRANTY
- A See Section 017800 - Closeout Submittals for additional warranty requirements.
- B Provide five year manufacturer warranty for air terminal units.

PART 2 PRODUCTS

2.01 APPLICATION
- A The products listed in the section may not all be used on this project. Refer to the Equipment Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without pre-

approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

2.02 SINGLE-DUCT, CONSTANT-VOLUME UNITS

A Manufacturers:
1. Johnson Controls, Inc: www.johnsoncontrols.com.
2. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.
3. Price Industries, Inc: www.priceindustries.com.
4. Trane, a brand of Ingersoll Rand: www.trane.com.
5. Titus HVAC:https://www.titus-hvac.com
6. Substitutions: See Section 016000 - Product Requirements.

B General:
1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

C Unit Casing:
1. Minimum 22 gauge, 0.0299 inch galvanized steel.
   a. Assembled with longitudinal lock seam construction.
   b. Casing leakage to meet ASHRAE Std 130.
2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
3. Unit Discharge: Rectangular, with slip-and-drive connections.
4. Acceptable Liners:
   a. Refer to drawings.
   b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

D Electric Heating Coil:
1. Listed and provided by the terminal unit manufacturer.
2. Coil Casing: 20 gauge, 0.0359 inch galvanized steel.
3. Heating Elements: Nickel chrome, supported by ceramic insulators.
4. SRC Controllers shall be provided over staged electical reheat.
5. Integral Control Panel: NEMA EN 10250, Type 2 enclosure with hinged access door for access to all controls and safety devices.
6. Furnish a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow.
7. Provide the following additional components, mounted and/or wired within the control enclosure:
   a. Fused or non-fused door interlocking disconnect switch.
   b. Mercury contactors.
   c. Fuse block.
8. Factory wired, including all limit switches and steps of control as indicated on the equipment schedule, with the SSR (solid-state relay) proportional heat control.

E Electrical Requirements:
1. Single-point power connection.
2. Equipment wiring to comply with requirements of NFPA 70.

F Control Transformers: Factory supplied and mounted for electric and electronic control applications.

G Controls:

1. Terminal Unit Controls:
    a. Refer to Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that conditions are suitable for installation.

B Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

C See drawings for the size(s) and duct location(s) of the air terminal units.

D Provide ceiling access doors or locate units above easily removable ceiling components.

E Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.

F Embed anchors in concrete in accordance with ASTM E488/E488M.

G Do not support from ductwork.

H Connect to ductwork in accordance with Section 233100.

I Verify that electric power is available and of the correct characteristics.

3.03 ADJUSTING

A Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

3.04 FIELD QUALITY CONTROL

A See Section 014000 - Quality Requirements for additional requirements.

B Provide manufacturer's field representative to test, inspect, instruct, and observe field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

1. Leak Test:
    a. After installation, fill water coils and test for leaks.
    b. Repair leaks and retest until no leaks exist.
2. Operational Test:
    a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    b. Test and adjust controls and safeties.
    c. Replace damaged and malfunctioning controls and other equipment.
    d. Remove and replace malfunctioning units and retest as specified above.

3.05 CLEANING

A Vacuum clean coils and inside of units.

B Install new filters.

3.06 CLOSEOUT ACTIVITIES

A See Section 017900 - Demonstration and Training for additional requirements.

END OF SECTION 233600

SECTION 233700

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Diffusers:
  1. Perforated ceiling diffusers.
- B Rectangular ceiling diffusers.
- C Round ceiling diffusers.
- D Slot ceiling diffusers.
- E Registers/grilles:
  1. Ceiling-mounted, egg crate exhaust and return register/grilles.
  2. Ceiling-mounted, exhaust and return register/grilles.
  3. Ceiling-mounted, linear exhaust and return register/grilles.
  4. Ceiling-mounted, supply register/grilles.
  5. Wall-mounted, supply register/grilles.
  6. Wall-mounted, exhaust and return register/grilles.
- F Door grilles.
- G Louvers:
- H Roof hoods.
- I Goosenecks.
- J Gravity ventilators.

1.02 RELATED REQUIREMENTS
- A Section 099123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.03 REFERENCE STANDARDS
- A AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).
- B AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.
- C ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- E SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.05 QUALITY ASSURANCE
- A Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 APPLICATION
- A The product descriptions listed in the section may not all be used on this project. Refer to the Equipment Schedules on the drawings for the specific application for each product or material. Products not shown on the schedule for the specific application may not be substituted without

pre-approval from the Engineer. Where there is a conflict between the drawing schedule and specifications, the drawing schedule shall take precedent.

2.02 ROUND CEILING DIFFUSERS

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.
4. Substitutions: See Section 016000 - Product Requirements.

B Type: Round, adjustable pattern, stamped or spun, multicore diffuser to discharge air in 360-degree pattern, with sectorizing baffles where indicated. Project diffuser collar not more than 1 inch above ceiling. In plaster ceilings, provide plaster ring and ceiling plaque.

C Fabrication: Steel with baked enamel finish.

D Color: As indicated.

E Color: As selected by Architect/Engineer from manufacturer's standard range.

2.03 RECTANGULAR CEILING DIFFUSERS

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.

B Type: Provide rectangular and square formed adjustable, backpan stamped, core removable, and multi-louvered ceiling diffusers constructed to maintain 360 degree discharge air pattern with sectorizing baffles where indicated.

C Connections: Round.

D Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.

E Frame: To match ceiling type.

F Fabrication: Steel with baked enamel finish.

G Color: As indicated.

H Accessories: Provide radial opposed blade, butterfly, and combination splitter volume control damper; removable core, sectorizing baffle, safety chain, wire guard, equalizing grid, operating rod extension, anti-smudging device, and gaskets for surface mounted diffusers with damper adjustable from diffuser face.

2.04 PERFORATED FACE CEILING DIFFUSERS

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.

B Type: Perforated face with fully adjustable pattern and removable face.

C Fabrication: Steel with steel frame and baked enamel finish.

D Color: As indicated.

E Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.05 CEILING SLOT DIFFUSERS

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.

B Type: Continuous 1/2 inch wide slot, 1 slots wide, with adjustable vanes for left, right, or vertical discharge; integral ceiling fire damper.

C Fabrication: Aluminum extrusions with factory clear lacquer finish.
D Color: As indicated.
E Frame: To match ceiling type.
F Plenum: Integral, galvanized steel, insulated.

2.06 CEILING SUPPLY REGISTERS/GRILLES

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.
B Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, one-way deflection.
C Frame: To match ceiling type.
D Construction: Made of aluminum extrusions with factory enamel finish.
E Color: As indicated.
F Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.07 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.
B Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
C
D Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
E Fabrication: Stainless steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame.
F Color: As indicated.
G Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
H Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.08 CEILING LINEAR EXHAUST AND RETURN GRILLES

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.
4. Substitutions: See Section 016000 - Product Requirements.
B Type: Streamlined blades with 90 degree one-way deflection, 1/8 by 3/4 inch on 1/4 inch centers.
C Frame: To match ceiling type.
D Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
E Color: As indicated.
F Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.09 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.
4. Substitutions: See Section 016000 - Product Requirements.

B Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch grid core.

C Fabrication: Grid core consists of aluminum with mill aluminum finish.

D Color: To be selected by Architect/Engineer from manufacturer's standard range.

E Frame: To match ceiling type.

F Accessories: Provide integral gang and face operated opposed blade damper, 2 inch filter frame, plaster frame, square mesh insect screen, square mesh debris screen, prescored molded fiberglass back, and 45 degree angled eggcrate or other similar provisions for visual blocking such as angled louver or 90 degree duct elbow.

2.10 WALL SUPPLY REGISTERS/GRILLES

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.

B Type: Streamlined and individually adjustable curved blades to discharge air along face of grille with one-way deflection.

C Fabrication: Aluminum extrusions with factory clear lacquer finish.

D Color: As indicated.

E Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

F Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.11 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.
4. Substitutions: See Section 016000 - Product Requirements.

B Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.

C Fabrication: Steel frames and blades, with factory baked enamel finish.

D Color: As indicated on the drawings.

E Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

F Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.12 DOOR GRILLES

A Manufacturers:
1. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com.
2. Price Industries: www.price-hvac.com.
3. Metalaire, a brand of Metal Industries Inc: www.metalaire.com.
4. Substitutions: See Section 016000 - Product Requirements.

B Frame: 20 gauge, 0.0359 inch steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.13 LOUVERS

A Manufacturers:
1. Cook Company: www.lorencookco.com
2. Greenheck:www.greenheck.com
3. Ruskin Company: www.ruskin.com.
4. Substitutions: See Section 016000 - Product Requirements.

B Color: As indicated on the drawings.

C Mounting: Furnish with interior flat flange for installation. Refer to drawing scheudles for Louver Free Area and Static Pressure requirements.

2.14 ROOF HOODS

A Manufacturers:
1. Cook Company: www.lorencookco.com
2. Greenheck:www.greenheck.com
3. Ruskin Company: www.ruskin.com.
4. Substitutions: See Section 016000 - Product Requirements.

B Fabricate air inlet or exhaust hoods in accordance with SMACNA (DCS).

C Fabricate of galvanized steel, minimum 16 gauge, 0.0598 inch base and 20 gauge, 0.0359 inch hood, or aluminum, minimum 16 gauge, 0.0598 inch base and 18 gauge, 0.0598 inch hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory prime coat finish.

D Fabricate louver penthouses with mitered corners and reinforce with structural angles.

E Mount unit on minimum 12 inch high curb base with insulation between duct and curb.

F Make hood outlet area minimum of twice throat area.

2.15 GOOSENECKS

A Manufacturers:
1. Cook Company: www.lorencookco.com
2. Greenheck:www.greenheck.com
3. Ruskin Company: www.ruskin.com.
4. Substitutions: See Section 016000 - Product Requirements.

B Fabricate in accordance with of minimum 18 gauge, 0.0598 inch galvanized steel.

2.16 GRAVITY VENTILATORS

A Hood Intake and Relief Gravity Ventilator:
1. Manufacturers:
   a. Loren Cook Company: www.lorencookco.com
   b. Greenheck:www.greenheck.com
   c. Ruskin Company: www.ruskin.com.
   d. Substitutions: See Section 016000 - Product Requirements.
2. General:
   a. Low silhouette for intake applications with natural gravity or negative pressure system(s).
   b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
   c. Suitable for non-ducted applications.
   d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
3. Hood and Base:
   a. Material: Aluminum.
   b. Hood Construction: Precision formed, arched panels with interlocking seams.
   c. Vertical End Panels: Fully locked into hood end panels.

d. Curb Cap: Pre-punched mounting holes for installation.

4. Birdscreen:
   a. Fabricate in accordance with ASTM B221 (ASTM B221M).
   b. Construction: 1/2 inch Galvanized mesh.
   c. Horizontally mounted across hood intake area.
5. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from base or hinged open.
6. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
         (a) Welded, straight side curb with flashing flange and wood nailer.
         (b) Tabbed and riveted curb with 45 degree cant and wood nailer.
         (c) Welded curb with 45 degree cant and wood nailer.
      2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
      3) Mounted on roof with fan.
      4) Material: Aluminum.
      5) Insulation Thickness: 1 inch.
   b. Provide extended base minimum 7 inch extension to base height making overall base 12 inches in height to prevent snow or moisture intake.
   c. Curb Seal: Rubber seal between fan and roof curb.
   d. Dampers:
      1) Type: Gravity.
      2) Factory designed to prevents outside air from entering back into building when fan is off.
      3) Balanced for minimal resistance to flow.
      4) Galvanized frames with pre-punched mounting holes.
   e. Insect Screen:
      1) Fabricate in accordance with ASTM B221 (ASTM B221M).
      2) Construct of fine mesh aluminum.
      3) Fitted to top of throat to prevent entry of insects.
      4) Coating: Thermo-setting polyester urethane.
   f. Tie-Down Points: Aluminum brackets located on hood supports to secure fan in heavy wind applications.

B Spun Aluminum Intake and Relief Gravity Ventilator:

1. Manufacturers:
   a. Loren Cook Company: www.lorencookco.com
   b. Greenheck:www.greenheck.com
   c. Ruskin Company: www.ruskin.com.
   d. Substitutions: See Section 016000 - Product Requirements.
2. General:
   a. Provide low silhouette configuration for intake applications with natural gravity or negative pressure system.
   b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
   c. Suitable for non-ducted applications.
   d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
3. Hood:
   a. Material: Aluminum.

b. Internal structure constructed of galvanized steel.

4. Birdscreen:
   a. Fabricate in accordance with ASTM B221 (ASTM B221M).
   b. Construction: 1/2 inch galvanized mesh.
   c. Horizontally mounted across hood intake area.
5. Housing:
   a. Curb Cap:
      1) Type: Hinged.
      2) Construction: Aluminum.
      3) Integral deep spun inlet venturi with pre-punched mounting holes to ensure correct attachment to roof.
   b. Windband:
      1) One piece spun aluminum construction with uniform, original material thickness throughout housing.
      2) Include integral rolled bead for strength.
6. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
         (a) Welded, straight side curb with flashing flange and wood nailer.
         (b) Tabbed and riveted curb with 45 degree cant and wood nailer.
         (c) Welded curb with 45 degree cant and wood nailer.
      2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
      3) Mounted upon roof with fan.
      4) Material: Aluminum.
      5) Insulation Thickness: 1 inch.
   b. Curb Seal: Rubber seal between fan and roof curb.
   c. Dampers:
      1) Factory designed to prevent outside air from entering back into building when fan is off.
      2) Balanced for minimal resistance to flow.
      3) Galvanized frames with pre-punched mounting holes.
   d. Flashing Flange:
      1) Construction:
         (a) Aluminum.
         (b) Pre-punched holes for installation without a roof curb.
   e. Hood Insulation: Lined with 1/2 inch fiberglass insulation to prevent condensation and reduce sound levels.
   f. Insect Screen:
      1) Fabricate in accordance with ASTM B221 (ASTM B221M).
      2) Fine mesh aluminum construction.
      3) Fit into top of throat to prevent entry of insects.
   g. Tie-Down Points: Aluminum brackets located on hood supports to secure fan in heavy wind applications.
   h. Reducer/Adapter:
      1) Type: Adapter.
      2) Material: Aluminum.

C Non-Powered Gravity Upblast Roof Ventilator:
1. Manufacturers:
   a. Cook Company: www.lorencookco.com

b. Greenheck:www.greenheck.com
c. Ruskin Company: www.ruskin.com.
d. American Coolair Corporation: www.coolair.com.
e. Greenheck Fan Corporation: www.greenheck.com.
f. Loren Cook Company: www.lorencook.com.
g. Substitutions: See Section 016000 - Product Requirements.

2. General:
   a. Discharge air directly away from mounting surface.
   b. Roof-mounted applications designed for use as weatherproof outlet on vertical, high velocity exhaust systems.
   c. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
3. Butterfly Dampers:
   a. Material: Aluminum.
   b. Designed to provide weather protection and prevent backdraft.
   c. Balanced for minimal resistance to flow.
4. Windband:
   a. Construct from heavy gauge, galvanized steel with reinforced and bolted seams.
   b. Removable windband to gain access through butterfly dampers.
   c. Fit windband to direct exhaust air away from mounting surface.
5. Curb Caps:
   a. Aluminum construction.
   b. Includes pre-punched mounting holes to ensure correct attachment to roof.
6. Options/Accessories:
   a. Curb Seal: Rubber seal between fan and roof curb.
   b. Outlet Guards: Construct of expanded metal mounted in a steel frame to provide protection for non-ducted installations.
   c. Magnetic Damper Latches: Minimizes damper flutter when unit is not exhausting.
   d. Roof Curbs:
      1) Flat Roofs:
         (a) Welded, straight side curb with flashing flange and wood nailer.
         (b) Tabbed and riveted curb with 45 degree cant and wood nailer.
         (c) Welded straight side curb with 45 degree cant and no wood nailer.
         (d) Welded curb with 45 degree cant and wood nailer.
      2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
   e. Tie-Down Points: Aluminum brackets located on hood supports to secure fan in heavy wind applications.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions.
B Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
C Install diffusers to ductwork with air tight connection.
D Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
E Paint ductwork visible behind air outlets and inlets matte black, see Section 099123.

3.02 CLOSEOUT ACTIVITIES

A Demonstrate operational system to Owner's representative.

B Instruct Owner's representative to maintain system and use occupant controls or interfaces, as required.

3.03 PROTECTION

A Protect installed products until completion of project.

B Replace, repair, or touch-up damaged products before Substantial Completion.

END OF SECTION 233700

SECTION 235100

BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Field fabricated breechings.
- B Manufactured breechings.
- C Draft regulators.
- D Type B double wall gas vents.
- E Refractory lined metal stacks.
- F Single wall metal stacks.
- G Double wall metal stacks.
- H Special gas venting.
- I Induced draft fans.
- J Stationary auxiliary power generator engine exhaust piping.

1.02 RELATED REQUIREMENTS
- A Section 230716 - HVAC Equipment Insulation.
- B Section 230719 - HVAC Piping Insulation.
- C Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS
- A ANSI Z21.66 - American National Standard for Automatic Damper Devices for Use with Gas-Fired Appliances; 2015 (Reaffirmed 2020).
- B ANSI Z223.1 - National Fuel Gas Code; 2021.
- C ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges; 2021.
- E ASME B31.9 - Building Services Piping; 2020.
- F ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- G ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- H ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2023.
- I ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both; 2023.
- J ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2022.
- K ASTM C401 - Standard Classification of Alumina and Alumina-Silicate Castable Refractories; 2012 (Reapproved 2022).
- L MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- M NEMA MG 00001 - Motors and Generators; 2024.
- N NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2021.
- O NFPA 54 - National Fuel Gas Code; 2021.
- P NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2019.
R NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2019.
S SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
T UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances; Current Edition, Including All Revisions.
U UL 378 - Standard for Draft Equipment; Current Edition, Including All Revisions.
V UL 441 - Standard for Gas Vents; Current Edition, Including All Revisions.
W UL 705 - Power Ventilators; Current Edition, Including All Revisions.
X UL 959 - Medium Heat Appliance Factory Built Chimneys; Current Edition, Including All Revisions.
Y UL 1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV; Current Edition, Including All Revisions.
Z UL 1777 - Chimney Liners; Current Edition, Including All Revisions.
AA ULC CAN-S635 - Standard for Lining Systems for Existing Masonry or Factory-Built Chimneys and Vents; 2016 (Reaffirmed 2022).

1.04 DEFINITIONS

A Breeching: Vent connector.
B Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
C Smoke Pipe: Round, single wall vent connector.
D Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

1.05 ADMINISTRATIVE REQUIREMENTS

A Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

A See Division 01 Submittal Procedures.
B Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
C Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory-built units are used.
D Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.
E Manufacturer's qualification statement.
F Installer's qualification statement.

1.07 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A Breechings, Chimneys, and Stacks:
1. DuraVent; DuraStack Pro (DIS2): www.duravent.com.
2. Metal-Fab, Inc: www.mtlfab.com.
3. Z-Flex U.S. Inc: www.z-flex.com.

2.02 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS
1. Substitutions: See Section 016000 - Product Requirements.

2.03 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS
A Regulatory Requirements:
1. Comply with applicable codes for installation of natural gas burning appliances and equipment.
2. Factory-built vents and chimneys used for venting natural draft appliances to comply with NFPA 211 and UL listed and labeled.

2.04 MANUFACTURED BREECHINGS
A Manufacturers:
1. AMPCO: www.ampcostacks.com.
2. Selkirk Corporation: www.selkirkcommercial.com.
3. Substitutions: See Section 016000 - Product Requirements.
B Provide factory-built, modular connector and manifold system, tested to UL 103 with positive pressure rating.
C Assembly to be UL listed for use with building equipment in accordance with NFPA 211.
D Fabricate with 1-inch minimum body soluble fiber insulation between walls, and construct inner liner of 20-gauge, 0.0375-inch 304 stainless steel and outer jacket of 24-gauge, 0.0239-inch aluminized steel.
1. Protect aluminized steel surfaces exposed to elements with a minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.
E Design, fabricate, and install gastight to prevent products of combustion from leaking into building.
1. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
2. Design system to compensate for all flue-gas-induced thermal expansion.

2.05 DRAFT REGULATORS
A General Requirement: Comply with NFPA 54 and ANSI Z223.1.
B Draft Regulator, Individual Appliance:
1. Manufacturers:
a. Enervex, Inc: www.enervex.com/#sle
b. Substitutions: See Section 016000 - Product Requirements.
2. Controller: Pressure modulating using external bidirectional static pressure sensor rated for minus 1 to 1 in-wc service.
3. Regulator: 316 stainless steel single-blade butterfly damper (SBD) with edge seal, graphite bearings, and external 2-second stroke fast-acting modulating actuator.
4. Chimney or Gas Vent Size: 4 inches.
5. Service Temperature: 500 degrees F, maximum.
6. Accessories: Provide encapsulated relay, gas-flow switch, and tubing with fittings.
C Draft Regulator, Manifolded Appliances:
1. Manufacturers:
a. Enervex, Inc: www.enervex.com/#sle
b. US Draft Co, a division of RM Manifold Group, Inc; Overdraft Control System (ODCS): www.usdraftco.com.
c. Substitutions: See Section 016000 - Product Requirements.
2. Controller: Pressure modulating using external bidirectional static pressure sensor rated for minus 1 to 1 in-wc service.

3. Regulator: 316 stainless steel opposed blade damper (OBD) with graphite bearings, and external 2-second stroke fast-acting modulating actuator.
4. Manifold Duct Size: 8 inches.
5. Service Temperature: 500 degrees F, maximum.
6. Accessories: Provide flanged-collar fittings, gas-flow switch, and tubing.

D Draft Inducer, Individual Appliance Vent:
1. Manufacturers:
   a. US Draft Co, a division of RM Manifold Group, Inc; Vent Control Systems (VCS): www.usdraftco.com.
   b. Substitutions: See Section 016000 - Product Requirements.
2. Controller: Pressure modulating using external bidirectional static pressure sensor rated for minus 1 to 1 in-wc service.
3. Standard Regulator:
   a. Surface-mounted aluminum fan with inverter duty TEFC motor.
   b. 6,000 cfm at 5 in-wc of static pressure, maximum.
4. Fan Assembly: Comply with UL 378 and UL 705 listings and ratings.
5. Maximum Service Temperature: 575 degrees F continuous duty and 750 degrees F intermittent duty.

2.06 TYPE B DOUBLE WALL GAS VENTS

A Manufacturers:
1. Amerivent: www.ameri-vent.com.
2. Hart & Cooley, LLC: www.hartandcooley.com.
3. Selkirk Corporation: www.selkirkcommercial.com.
4. Substitutions: See Section 016000 - Product Requirements.

B Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

C Electrically Actuated Vent Dampers: Same size as draft hood collar, constructed of stainless steel or galvanized steel, with corrosion-resistant components, in compliance with ANSI Z21.66.

2.07 REFRACTORY LINED METAL STACKS

A Fabricate jacket for size 36 inches and smaller of 24-gauge, 0.0239-inch galvanized steel with grooved seam joint, or 26-gauge, 0.0179-inch aluminized steel with riveted seams. For sizes 39 inches and larger fabricate of 11-gauge, 0.1196-inch galvanized steel with welded seam joint.

B Weld heavy-gauge stack sections together in factory. Factory-apply heat-resistant paint to each stack section and accessory with primer and finish paint. Touch up or refinish in field.

C Refractory lining to be a minimum 2 inch thick, proprietary material ASTM C401 tested to UL 959 and UL listed to withstand 2000 degrees F without fusion, have maximum acid extraction of 0.2 percent, have minimum of 3200 psi cold crush strength, and be positively bonded to steel jacket, jointed with mortar.

D Accessories, UL Labeled:
1. Anchor Lugs: Acid resistant coated cast iron.
2. Clean Out Section: Welded to base of stack, with gasket, and bolt tightened inspection plate.
3. Branching Sections: Construct with welded joints, lined with refractory, finished with smooth transition and no exposed metal on inside.
4. Spark Screen: Type 304 stainless steel, 16-gauge, 0.0508 inch diameter wire, 1/2 by 1/2 inch mesh, with rolled angle and draw band.
5. Drawbands: 8 inch wide, same material as jacket, fastened with nuts and bolts.
6. Roof Penetration: Factory fabricated thimble, flashing and storm collar.

2.08 SINGLE WALL METAL STACKS

A Manufacturers:
1. AMPCO; Model N: www.ampcostacks.com.
2. Selkirk Corporation; Model G: www.selkirkcommercial.com.
3. Substitutions: See Section 016000 - Product Requirements.

B Provide single-wall metal stacks, tested to UL 1777 or ULC CAN-S635 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 211.

C Fabricate with 20-gauge, 0.0375-inch 304 stainless steel.

D Design, fabricate, and install gastight to prevent products of combustion from leaking into building.
1. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
2. Design system to compensate for flue-gas-induced thermal expansion.

E Accessories, UL Labeled:
1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
2. Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.
3. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

2.09 DOUBLE WALL METAL STACKS

A Manufacturers:
1. AMPCO: www.ampcostacks.com.
2. Selkirk Corporation: www.selkirkcommercial.com.

B Provide double-wall metal stacks, tested to UL 103 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 211.

C Fabricate with 1-inch minimum body soluble fiber insulation between walls, and construct inner liner of 20 gauge, 0.0375-inch 304 stainless steel, and outer jacket of 24 gauge, 0.0239-inch aluminized steel.
1. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.

D Design, fabricate, and install gastight to prevent products of combustion from leaking into building.
1. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
2. Design system to compensate for flue-gas-induced thermal expansion.

E Accessories, UL Labeled:
1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
2. Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.
3. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

2.10 SPECIAL GAS VENTING (CATEGORY II, III, AND IV)

A Single-Wall Special Gas Venting:
1. Manufacturers:
a. Heatfab Saf-T Vent; Model EZ Seal: www.heatfab.com.
b. Z-Flex U.S. Inc; Z-VENT Single Wall: www.z-flex.com.
c. Substitutions: See Section 016000 - Product Requirements.

2. Provide single-wall metal stacks, tested to UL 1738 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 54.
3. Fabricate with 28-gauge, 0.0156-inch 29-4C stainless steel minimum.
4. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.
5. Accessories, UL Labeled:
   a. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
   b. Exit Cone: Consists of inner cone and outer jacket to increase stack exit velocity 1.5 times.
   c. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

B Double-Wall Special Gas Venting:
1. Manufacturers:
   a. Z-Flex U.S. Inc; Z-VENT Double Wall: www.z-flex.com.
2. Provide double-wall metal stacks, tested to UL 1738 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 54.
3. Fabricate with 1-inch minimum air space between walls and construct inner liner of 28-gauge, 0.015-inch 29-4C stainless steel minimum and outer jacket of 24 gauge, 0.025-inch stainless steel minimum.
   a. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.
4. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.
5. Accessories, UL Labeled:
   a. Exit Cone: Consists of inner cone and outer jacket to increase stack exit velocity 1.5 times.
   b. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

2.11 INDUCED DRAFT FANS

A Mechanical Draft Induction Type:
1. Venturi Tube Section Fabrication: Enameled steel for sizes up to 20 inch and Type 304 stainless steel for sizes 22 inch to 48 inch diameter.
2. Fan: Forward curved venturi type, tested to UL 378, with shaded pole, sleeve bearing motor.

B Induced Draft Type:
1. Fabrication: Forward curved fan and scroll of mild steel with direct drive shaded pole motor with ball bearings, internal cooling fan, stainless steel shaft, and internal centrifugal switch, tested to UL 378.

C Electrical Characteristics:
1. Motor: NEMA MG 00001.
2. Wiring Terminations: Provide terminal lugs to match branch-circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.12 STATIONARY AUXILIARY POWER GENERATOR ENGINE EXHAUST PIPING

A Manufactured Exhaust Piping:
1. Manufacturers:

a. AMPCO by Hart & Cooley, LLC; Model IVSI-C2: www.ampcostacks.com.
b. Selkirk Corporation; Model IPS-C2: www.selkirkcommercial.com.

2. Provide factory-built, modular connector and manifold system, tested to UL 103 with positive pressure rating.
3. Assembly to be UL listed for use with building equipment in compliance with NFPA 37 and NFPA 211.
4. Fabricate with 2-inch minimum body soluble fiber insulation between walls and construct inner liner of 20-gauge, 0.0359-inch 304 stainless steel and outer jacket of 24-gauge, 0.0239-inch aluminized steel.
   a. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.
5. Design, fabricate, and install gastight to prevent products of combustion from leaking into building.
   a. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
   b. Design system to compensate for flue-gas-induced thermal expansion.
6. Accessories, UL Labeled:
   a. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
   b. Exit Cone: Consists of inner cone and outer jacket to increase stack exit velocity.
   c. Flip top termination.

B Field-Fabricated Exhaust Piping:
1. Steel Pipe: ASTM A53/A53M, Schedule 40.
   a. Fittings:
      1) Buttweld in accordance with ASTM A234/A234M.
      2) Wall thickness and material same as adjoining pipe.
      3) Built-up miter-welded fittings are acceptable where miter angles of each individual section do not exceed 22.5 degrees total and not more than 11.25 degrees relative to the axis of the pipe at any one cut.
   b. Flanges:
      1) Class 150, slip-on, forged steel welding flanges in accordance with ASME B16.5.
      2) Material in accordance with ASTM A181/A181M, Grade I.
      3) Provide for connections to engines, exhaust silencers, and flexible connectors.
   c. Gaskets:
      1) High temperature asbestos-free material suitable for service.
      2) ASME B16.21 composition ring, 0.0625 inch thick.
   d. Bolts: Alloy-steel, complying with ASTM A193/A193M, Grade B7, and of sufficient strength for full bearing on nuts, projecting not more than two full threads beyond the nut.
   e. Nuts: Alloy-steel, complying with ASTM A194/A194M, Grade 7.
   f. Provide stainless steel counterbalance type rain caps at exhaust pipe termination points.

C Flexible joints:
1. Provide flanged, multiple, corrugated, stainless steel (multi-ply) expansion joints with liners between exhaust manifold and exhaust piping to absorb thermal expansion and vibration.
2. Suitable for operation at 200 degrees F above normal exhaust gas temperature at 100 percent load, 10,000 cycles minimum.

3. Design and construct for diesel engine exhaust application.

D Hangers and Supports: Provide hangers and supports that comply with MSS SP-58.

E Piping Sleeves:

1. Outside Walls Below and Above Grade, Floor, or Roof Slabs: Standard weight zinc coated pipe.
2. Partitions: Zinc coated sheet steel having nominal weight of not less than 0.90 lb per square foot.
3. Piping Insulation: Provide insulation in accordance with Section 230719.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install in accordance with NFPA 54

C Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D Rigidly support breechings from building structure with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12-foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.

E Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.

F Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

G Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

H Coordinate installation of dampers, and induced draft fans. See Section 260583.

I Insulate breechings in accordance with Section 230716.

J For Type B, double-wall gas vents, maintain UL-listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.

K Install vent dampers, locating close to draft hood collar, and secured to breeching.

L Assemble and install stack sections in accordance with NFPA 82, UL Listings, and industry practices. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

M Level and plumb chimney and stacks.

N Clean breechings, chimneys, and stacks during installation, removing dust and debris.

O At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

P Provide maximum 2 feet of breeching to connect appliance to chimney. Provide Type B chimney continuously from appliances.

Q Engine Exhaust:

1. Install engine exhaust piping in accordance with MSS SP-58 and ASME B31.9.
2. Install exhaust silencer provided in accordance with Section 263213.
3. Provide sleeves with sufficient length to pass through entire thickness of walls, floors, roofs, partitions, or slabs.
4. Extend sleeves in floor slabs 2 inches above finished floor.
5. Firmly pack insulation between pipe and sleeve and caulk both ends with plastic waterproof cement.
6. Space Between Pipe Insulation and Sleeve: Not less than 0.25 inch thick.

END OF SECTION 235100

SECTION 235400

FURNACES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Forced air furnaces.
- B Thermostats.

1.02 RELATED REQUIREMENTS
- A Section 221005 - Plumbing Piping: Natural Gas Piping & Connection
- B Section 230513 - Common Motor Requirements for HVAC Equipment: Additional requirements for fan motors.
- C Section 230548 - Vibration and Seismic Controls for HVAC.
- D Section 230713 - Duct Insulation: Duct liner.
- E Section 233100 - HVAC Ducts and Casings.
- F Section 235100 - Breechings, Chimneys, and Stacks: Flue or stack.

1.03 REFERENCE STANDARDS
- A ANSI Z21.47 - American National Standard for Gas-Fired Central Furnaces; 2021.
- B ASHRAE Std 103 - Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; 2022.
- C NFPA 54 - National Fuel Gas Code; 2021.
- D NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- F NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2019.
- G UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

1.06 WARRANTY
- A See Section 017700 - Closeout Procedure for additional warranty requirements.
- B Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.01 MANUFACTURERS
- A Carrier Corporation, a brand of United Technologies Corporation Building & Industrial Systems: www.carrier.com.
- B Rheem Manufacturing Company Inc: www.rheem.com.
- C Trane Technologies, PLC: www.trane.com.
- D York International Corporation / Johnson Controls: www.york.com.

2.02 REGULATORY REQUIREMENTS
- A Comply with NFPA 70.
- B Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

2.03 GAS FIRED FURNACES

A Annual Fuel Utilization Efficiency (AFUE): 0.78 ("non-condensing") in accordance with ASHRAE Std 103.

B Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating element, controls, air filter, humidifier, and accessories; wired for single power connection with control transformer.

1. Safety certified by CSA in accordance with ANSI Z21.47.
2. Venting System: Non-direct.
3. Combustion: Indoor Air.
4. Air Flow Configuration: Upflow.
5. Heating: Natural gas fired.
6. Performance:
   a. Refer to Furnace Schedule. Gas heating capacities are sea level ratings.
7. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner. If not certified for combustible flooring, please provide additional steel base.
8. Heat Exchanger:
   a. Material: Hot-rolled steel.
   b. Shape: Tubular type.
9. Gas Burner:
   a. Atmospheric type with adjustable combustion air supply.
   b. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
   c. Electronic pilot ignition, with electric spark igniter.
   d. Combustion air damper with synchronous spring return damper motor.
   e. Non-corrosive combustion air blower with permanently lubricated motor.
10. Gas Burner Safety Controls:
    a. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
    b. Flame rollout switch: Installed on burner box and prevents operation.
    c. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
    d. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.
11. Supply Fan: Centrifugal type rubber mounted with direct drive with adjustable variable pitch motor pulley.
12. Motor:
    a. 1750 rpm single-speed, permanently lubricated, hinge mounted.
13. Air Filters: 1 inch thick urethane, washable type arranged for easy replacement.
14. Operating Controls:
    a. Room Thermostat: Cycles burner to maintain room temperature setting.
    b. Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation. Provide continuous low speed fan operation.

2.04 THERMOSTATS

A Room Thermostat: Low voltage, electric solid state microcomputer based room thermostat with remote sensor:

1. Preferential rate control to minimize overshoot and deviation from setpoint.

2. Set-up for four separate temperatures per day.
3. Short cycle protection.
4. Programming based on every day of the week.
5. Thermostat Display:
   a. Actual room temperature.
   b. Programmed temperature.
   c. System Mode Indication: Heating, cooling, fan auto, off, and on, auto or on, off.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with manufacturer's instructions and requirements of authorities having jurisdiction.

B Install in accordance with NFPA 90A.

C Install gas fired furnaces in accordance with NFPA 54.

D Provide vent connections in accordance with NFPA 211.

END OF SECTION 235400

SECTION 237416

PACKAGED ROOFTOP AIR-CONDITIONING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Packaged, small-capacity, rooftop air-conditioning units.
- B Packaged, intermediate-capacity, rooftop air-conditioning units.

1.02 RELATED REQUIREMENTS
- A Section 230548 - Vibration and Seismic Controls for HVAC.
- B Section 260583 - Wiring Connections: Installation and wiring of thermostats and other control components; wiring from unit terminal strip to remote panel.
- C Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
- A See Divison 01 Submittal Procedures.
- B Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- C Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
- D Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

1.06 WARRANTY
- A See Section 017700 - Closeout Procedures for additional warranty requirements.
- B Provide a five year warranty to include coverage for refrigeration compressors.

PART 2 PRODUCTS

2.01 MANUFACTURERS
- A Carrier Corporation: www.commercial.carrier.com.
- B Johnson Controls International, PLC: www.johnsoncontrols.com.
- C Rheem Manufacturing Company Inc: www.rheem.com.
- D Trane Technologies, PLC: www.trane.com.

2.02 PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS
- A General: Roof mounted units having gas burner and electric refrigeration that are 6 tons and smaller in capacity.
- B Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, return fan, heat exchanger and burner, heat recovery coil, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

2.03 PACKAGED, INTERMEDIATE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS
- A General: Roof mounted units having gas burner and electric refrigeration that are 7.5 tons to 25 tons in capacity.
- B Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, return fan, heat exchanger and burner, heat recovery coil, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

2.04 CASING

A Cabinet: Steel with baked enamel finish, including access panels with screwdriver-operated flush, cam type fasteners. Structural members to be minimum 18 gauge, 0.0478 inch, with access doors or panels of minimum 20 gauge, 0.0359 inch.

2.05 FANS

2.06 BURNERS

A Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame-sensing device, and automatic 100 percent shutoff pilot.

B Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

2.07 EVAPORATOR COIL

A Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.

B Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

2.08 COMPRESSORS

A Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

2.09 OPERATING CONTROLS

A Provide low voltage, adjustable room thermostat to control burner operation, compressor and condenser fan, and supply fan to maintain temperature setting.

1. Include system selector switch heat-off-cool and auto-on fan control switch.

B Provide remote-mounted auto-on fan control switch.

2.10 OPERATING CONTROLS - SINGLE ZONE UNITS

A Electric solid state microcomputer-based room thermostat, located as indicated in service area with remote sensor located as indicated in service area with remote sensor.

B Room thermostat to incorporate:

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from setpoint.
3. Set up for four separate temperatures per day.
4. Instant override of setpoint for continuous or timed period from one hour to 31 days.
5. Short cycle protection.

2.11 ROOF CURBS

A Roof Mounting Curb: 18 inches high, galvanized steel, channel frame with gaskets, nailer strips.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that roof is ready to receive work and opening dimensions are as required by manufacturer.

B Verify that proper power supply is available.

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

3.03 SYSTEM STARTUP

A Prepare and start equipment. Adjust for proper operation.

END OF SECTION 237416

SECTION 238126.13

SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Air-source heat pumps.
- B Forced air furnaces.
- C Air cooled condensing units.
- D Indoor air handling (fan and coil) units for ducted systems.
- E Indoor air handling (fan and coil) units for ductless systems.
- F Controls.

1.02 RELATED REQUIREMENTS
- A Section 260583 - Wiring Connections: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.

1.03 REFERENCE STANDARDS
- A AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- D NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- E NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- F UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN
- A Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
  1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator; auxiliary electric heat.
  2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B Performance Requirements: See Drawings for additional requirements.
- C Electrical Characteristics:
  1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 260583.

2.02 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS
- A Manufacturers:
  1. Rheem Manufacturing Company Inc: www.rheem.com/#sle.
  2. Trane Technologies, PLC: www.trane.com/#sle.
  3. Mitsubishi.
  4. LG.
- B Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.

C Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
2. Manufacturer: System manufacturer.

2.03 OUTDOOR UNITS

A Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.

B Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
1. Provide thermostatic expansion valves.

D Operating Controls:
1. Control by room thermostat to maintain room temperature setting.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B Verify that proper power supply is available and in correct location.

C Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

A Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B Install in accordance with NFPA 90A and NFPA 90B.

END OF SECTION 238126.13

SECTION 238419

DEHUMIDIFICATION UNIT

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A Dehumidification Unit.

1.02 REFERENCE STANDARDS
- A AMCA 99 - Standards Handbook; 2016.
- B AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
- C AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- D NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- E UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.03 QUALITY ASSURANCE
- A Fan Performance: Bear AMCA Certified Rating Seal - Air Performance.

PART 2 - PRODUCTS

2.01 DEHUMIDIFICATION UNIT
- A Housing:
  1. Heavy gauge steel reinforced and braced with steel angle framework.
  2. 18 gauge 0.05 inch paintable galvanized sheet steel, cleaned and painted with enamel paint.
  3. Removable access panels for coil and fan removal.
  4. Insulate coil and fan section interiors with 1" 0.98 inch thick, 3/4 lb. (12 kg/m³) density fiberglass.
  5. Provide insulated, corrosion resistant drain pan under coil and fan sections.
  6. Provide minimum 12" 11.81 inch x 18" (17.72 inch) hinged access doors on both sides of the fan housing.
- B Fans:
  1. Double width, double inlet, airfoil centrifugal, statically and dynamically balanced.
  2. Grease lubricated ball bearings, selected for 200,000 hours L-50 life at the design operating conditions. Provide extended lubrication lines for all bearings to an easily accessible location.
  3. Provide OSHA belt guards with openings for tachometer readings.
- C Motors and Drives:
  1. Motors shall be per Section 23 05 13.
  2. Motors shall have slide rails, adjusting screws, anchor bolts and bedplates.
  3. Motor mounting bracket shall be adjustable to allow tightening of belts.
  4. Drives shall be V-belt type with adjustable pitch sheaves for units 20 HP (15 kW) and below. Use fixed sheaves on larger units. Contractor shall provide replacement sheaves and belts as required for air balancing.
- D Provide an acoustically lined discharge plenum enclosing the motor and drive assembly.
- E Direct Expansion Coils:
  1. Extended surface type with seamless copper tubes and continuous plate type aluminum fins. Galvanized steel casing.
- F Heat Recovery:
  1. Coil construction shall match DX coil specification and shall be positioned for heat recovery operation.

2. Unit shall utilize hot gas heat recovery as the first stage of space heating. Optional hot water coil shall provide additional heating to meet specified output.

G Filters:
1. Provide an angle filter section for 2" 1.97 inch thick filters. Maximum filter velocity shall not exceed specified value. Provide full size hinged access doors.
2. Provide separate filters for outdoor air and return air.

H Controls:
1. Provide thermostat and humidistat. Thermostat shall cycle system to maintain space temperature. Humidistat shall cycle system to maintain space humidity.
2. Provide guards for thermostat and humidistat.
3. In normal operation, the dehumidification unit shall maintain area at a negative pressure with respect to the rest of the building. Modulating outside air, return and exhaust air dampers shall be used to minimize total energy consumption.

PART 3 - EXECUTION

3.01 INSTALLATION

A Install per manufacturer's instructions.
B Assemble units by bolting sections together.
C Install on vibration isolators as scheduled on the drawings or in Section 23 05 48.
D Comb all coils to repair bent fins.
E Unit startup shall be by qualified manufacturer's representative and shall demonstrate all modes of unit operation to owner's representative.

3.02 ENVIRONMENTAL REQUIREMENTS

A Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 238419

SECTION 260505

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Electrical demolition.

1.02 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT
- A Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION
- A Verify field measurements and circuiting arrangements are as indicated.
- B Verify that abandoned wiring and equipment serve only abandoned facilities.
- C Demolition drawings are based on casual field observation and existing record documents.
- D Report discrepancies to Architect/Engineer before disturbing existing installation.
- E Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION
- A Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B Coordinate utility service outages with utility company.
- C Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
  2. Make temporary connections to maintain service in areas adjacent to work area.
- E Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
  1. Notify Owner before partially or completely disabling system.
  2. Make notifications at least 24 hours in advance.
- F Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  1. Notify Owner at least 24 hours before partially or completely disabling system.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK
- A Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
  1. PCB-containing electrical equipment, including transformers, capacitors, and switches.

2. PCB- and DEHP-containing lighting ballasts.
3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B Remove, relocate, and extend existing installations to accommodate new construction.

C Remove abandoned wiring to source of supply.

D Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F Disconnect and remove abandoned panelboards and distribution equipment.

G Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I Repair adjacent construction and finishes damaged during demolition and extension work.

J Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A Clean and repair existing materials and equipment that remain or that are to be reused.

B Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION 260505

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Single conductor building wire.
- B Underground feeder and branch-circuit cable.
- C Service entrance cable.
- D Metal-clad cable.
- E Variable-frequency drive cable.
- F Wiring connectors.
- G Electrical tape.
- H Heat shrink tubing.
- I Oxide inhibiting compound.
- J Wire pulling lubricant.
- K Firestop sleeves.

1.02 RELATED REQUIREMENTS
- A Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- B Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS
- A ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
- D NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- E NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
  3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
  4. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C Field Quality Control Test Reports.

D Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect/Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

1. Exceptions:

C Nonmetallic-sheathed cable is not permitted.

D Underground feeder and branch-circuit cable is not permitted.

E Armored cable is not permitted.

F Metal-clad cable is permitted only as follows:

1. Where not otherwise restricted, may be used:
   a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      1) Maximum Length: 6 feet.
   b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
      1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
2. In addition to other applicable restrictions, may not be used:
   a. Unless approved by Owner.
   b. Where not approved for use by the authority having jurisdiction.
   c. Where exposed to view.
   d. Where exposed to damage.
   e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
   f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.

g. For patient care areas of health care facilities requiring redundant grounding.

G Manufactured wiring systems are not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A Provide products that comply with requirements of NFPA 70.

B Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

C Comply with NEMA WC 70.

D Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

E Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

F Conductors for Grounding and Bonding: Also comply with Section 260526.

G Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

H Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

I Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.

J Minimum Conductor Size:

1. Branch Circuits: 12 AWG.
2. Control Circuits: 14 AWG.

K Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

L Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
   a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
   a. 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral/Grounded: Gray.
   b. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   c. 240/120 V High-Leg Delta, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B (High-Leg): Orange.
      3) Phase C: Blue.

4) Neutral/Grounded: White.
d. 240/120 V, 1 Phase, 3 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Neutral/Grounded: White.
e. Equipment Ground, All Systems: Green.
f. Isolated Ground, All Systems: Green with yellow stripe.
g. Travelers for 3-Way and 4-Way Switching: Pink.
h. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
i. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com.
b. Encore Wire Corporation: www.encorewire.com.
c. General Cable Technologies Corporation: www.generalcable.com.
d. Service Wire Co: www.servicewire.com.
e. Southwire Company: www.southwire.com.
f. Substitutions: See Section 016000 - Product Requirements.

B Description: Single conductor insulated wire.

C Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D Insulation Voltage Rating: 600 V.

E Insulation:
1. Copper Building Wire: Type THHN/THWN, THHN/THWN-2, or XHHW-2.
a. Installed Underground: Type XHHW-2.

2.04 METAL-CLAD CABLE

A Manufacturers:
1. AFC Cable Systems Inc: www.afcweb.com.
2. Encore Wire Corporation: www.encorewire.com.
3. Service Wire Co: www.servicewire.com.
4. Southwire Company: www.southwire.com.
5. Substitutions: See Section 016000 - Product Requirements.

B Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D Insulation Voltage Rating: 600 V.

E Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F Provide dedicated neutral conductor for each phase conductor where indicated or required.

G Grounding: Full-size integral equipment grounding conductor.
1. Provide additional isolated/insulated grounding conductor where indicated or required.

H Armor: Steel, interlocked tape.

I Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.05 WIRING CONNECTORS

A Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B Connectors for Grounding and Bonding: Comply with Section 260526.

C Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
7. Conductors for Control Circuits: Use crimped terminals for all connections.

E Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

1. Manufacturers:
   a. 3M: www.3m.com.
   b. Ideal Industries, Inc: www.idealindustries.com.
   c. NSI Industries LLC: www.nsiindustries.com.

H Mechanical Connectors: Provide bolted type or set-screw type.

1. Manufacturers:
   a. Burndy LLC: www.burndy.com.
   b. Ilsco: www.ilsco.com.
   c. Thomas & Betts Corporation: www.tnb.com.
   d. Substitutions: See Section 016000 - Product Requirements.

I Compression Connectors: Provide circumferential type or hex type crimp configuration.

1. Manufacturers:
   a. Burndy LLC: www.burndy.com.
   b. Ilsco: www.ilsco.com.
   c. Thomas & Betts Corporation: www.tnb.com.

d. Substitutions: See Section 016000 - Product Requirements.

J Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

1. Manufacturers:
   a. Burndy LLC: www.burndy.com.
   b. Ilsco: www.ilsco.com.
   c. Thomas & Betts Corporation: www.tnb.com.
   d. Substitutions: See Section 016000 - Product Requirements.

2.06 ACCESSORIES

A Electrical Tape:

1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.

B Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

D Wire Pulling Lubricant:

1. Manufacturers:
   a. 3M: www.3m.com.
   b. American Polywater Corporation: www.polywater.com.
   c. Ideal Industries, Inc: www.idealindustries.com.
   d. Substitutions: See Section 016000 - Product Requirements.
2. Listed and labeled as complying with UL 267.
3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
4. Suitable for use at installation temperature.

E Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

F Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

G Fire-Protective Coating for Electrical Conductors and Cables: Field-applied, intumescent or ablative coating designed to prevent ignition and propagation of fire along thermoplastic-insulated conductors and cables.

1. Pass flammability tests of one of the following:
   a. ASTM E84, Class A; maximum flame spread index of 25.
   b. FM 3971.
   c. IEEE 383.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that interior of building has been protected from weather.
B Verify that work likely to damage wire and cable has been completed.
C Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
D Verify that field measurements are as indicated.
E Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
   a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
   b. Increase size of conductors as required to account for ampacity derating.
   c. Size raceways, boxes, etc. to accommodate conductors.
8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B Install products in accordance with manufacturer's instructions.
C Perform work in accordance with NECA 1 (general workmanship).
D Install metal-clad cable (Type MC) in accordance with NECA 120.
E Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F Direct Burial Cable Installation:
1. Install cable with minimum cover of 24 inches unless otherwise indicated or required.
2. Protect cables from damage in accordance with NFPA 70.
3. Provide underground warning tape in accordance with Section 260553 along entire cable length.

G Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

H Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

I Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

J Install conductors with a minimum of 12 inches of slack at each outlet.

K Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

L Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

N Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors or electrical tape.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors or electrical tape.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
      b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

P Insulate ends of spare conductors using vinyl insulating electrical tape.

Q Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

R Identify conductors and cables in accordance with Section 260553.

S Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A See Section 014000 - Quality Requirements, for additional requirements.

B Inspect and test in accordance with NETA ATS, except Section 4.

C Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Grounding and bonding requirements.
- B Conductors for grounding and bonding.
- C Connectors for grounding and bonding.
- D Ground bars.
- E Ground rod electrodes.
- F Ground plate electrodes.
- G Ground access wells.

1.02 RELATED REQUIREMENTS
- A Refer to Division 01 for addtional requirements..
- B Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
  1. Includes oxide inhibiting compound.
- C Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS
- A NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- C NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- D NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E NFPA 99 - Health Care Facilities Code; 2021, with Amendment.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Verify exact locations of underground metal water service pipe entrances to building.
  2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
  3. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B Sequencing:
  1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C Shop Drawings:
  1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
- D Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E Field quality control test reports.

F Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A Do not use products for applications other than as permitted by NFPA 70 and product listing.

B Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect/Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

E Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
   a. Provide continuous grounding electrode conductors without splice or joint.
   b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Metal Underground Water Pipe(s):
   a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
   b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
   c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Metal In-Ground Support Structure:

a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.

4. Concrete-Encased Electrode:
   a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Rod Electrode(s):
   a. Provide two electrodes unless otherwise indicated or required.
   b. Space electrodes not less than 6 feet from each other and any other ground electrode.
   c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
   d. Provide ground access well for first connected electrode.
6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

F Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

H Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
   a. Transformers (except autotransformers such as buck-boost transformers).
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.

5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
   b. Metal gas piping.
8. Provide bonding for metal building frame.
9. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
10. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
11. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

J Isolated Ground System:

1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

K Communications Systems Grounding and Bonding:

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
   a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
   b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
   c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
   d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS

A General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
1. Use insulated copper conductors unless otherwise indicated.
   a. Exceptions:
      1) Use bare copper conductors where installed underground in direct contact with earth.
      2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.

C Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
   a. Exceptions:
      1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
   a. Exceptions:
      1) Use exothermic welded connections for connections to metal building frame.

D Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.

F Ground Plate Electrodes:
1. Material: Copper.
2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.

G Ground Access Wells:
1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
   a. Round Wells: Not less than 8 inches in diameter.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
4. Cover: Factory-identified by permanent means with word "GROUND".

H Oxide Inhibiting Compound: Comply with Section 260519.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that work likely to damage grounding and bonding system components has been completed.
B Verify that field measurements are as indicated.
C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.
B Perform work in accordance with NECA 1 (general workmanship).
C Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.
E Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

F Identify grounding and bonding system components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A See Section 014000 - Quality Requirements, for additional requirements.
B Inspect and test in accordance with NETA ATS except Section 4.
C Perform inspections and tests listed in NETA ATS, Section 7.13.
D Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 260526

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS
- A Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.03 REFERENCE STANDARDS
- A MFMA-4 - Metal Framing Standards Publication; 2004.
- B NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
  2. Coordinate work to provide additional framing and materials required for installation.
  3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
  4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
  5. Notify Architect/Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B Sequencing:
  1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Division 01 requirements.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems and post-installed concrete/masonry anchors.
  1. Fiberglass Channel/Strut Framing Systems: Include requirements for strength derating according to ambient temperature.
- C Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D Derating Calculations for Fiberglass Channel/Strut Framing Systems: Indicate load ratings adjusted for applicable service conditions.

E Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
F Installer's qualification statement.
G Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A Maintain at project site one copy of each referenced document that prescribes execution requirements.
B Installer Qualifications for Field Welding: Refer to Division 01 for additional requirements.
C Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A General Requirements:
1. Comply with the following. Where requirements differ, comply with most stringent.
   a. NFPA 70.
   b. Applicable building code.
   c. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of 3. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
   a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
   c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
   d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B Components for Vibration Isolation and/or Seismic Controls: See Section 260548.
C Materials for Metal Fabricated Supports: Refer to Division 01 for additional requirements.
D Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.
E Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

F Metal Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.
3. Channel Material:
   a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.

G Fiberglass Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, fiberglass channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Channel Material: Use polyester resin or vinyl ester resin.
3. Minimum Channel Dimensions: 1-5/8 inch wide by 1 inch high.
4. Flammability: Fire retardant with NFPA 101, Class A flame spread index, maximum of 25, when tested in accordance with ASTM E84; self extinguishing in accordance with ASTM D635.

H Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2-inch diameter.
   b. Busway Supports: 1/2-inch diameter.
   c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
   d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
   e. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
   f. Outlet Boxes: 1/4-inch diameter.
   g. Luminaires: 1/4-inch diameter.

I Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

J Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Hammer-driven anchors and fasteners are not permitted.

12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
    b. Comply with MFMA-4.
    c. Channel Material: Use galvanized steel.
    d. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.
B Verify that mounting surfaces are ready to receive support and attachment components.
C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.
B Install hangers and supports in accordance with NECA 1.
C Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
D Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
E Unless specifically indicated or approved by Architect/Engineer, do not provide support from suspended ceiling support system or ceiling grid.
F Unless specifically indicated or approved by Architect/Engineer, do not provide support from roof deck.
G Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
H Field Welding, Where Approved by Architect/Engineer: See Section 055000.
I Equipment Support and Attachment:
    1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
    2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
    4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad 4 inches in height; see Section 033000.
    5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
J Conduit Support and Attachment: See Section 260533.13 for additional requirements.
K Box Support and Attachment: See Section 260533.16 for additional requirements.
L Interior Luminaire Support and Attachment: See Section 265100 for additional requirements.
M Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
N Secure fasteners in accordance with manufacturer's recommended torque settings.
O Remove temporary supports.
P Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A See Section 014000 - Quality Requirements for additional requirements.

B Inspect support and attachment components for damage and defects.

C Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 260529

SECTION 260533.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Galvanized steel rigid metal conduit (RMC).
- B Galvanized steel intermediate metal conduit (IMC).
- C PVC-coated galvanized steel rigid metal conduit (RMC).
- D Flexible metal conduit (FMC).
- E Liquidtight flexible metal conduit (LFMC).
- F Galvanized steel electrical metallic tubing (EMT).
- G Rigid polyvinyl chloride (PVC) conduit.
- H Electrical nonmetallic tubing (ENT).

1.02 RELATED REQUIREMENTS
- A Refer to Division 01 for additional requirements.
- B Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.
- C Section 260526 - Grounding and Bonding for Electrical Systems.
  1. Includes additional requirements for fittings for grounding and bonding.
- D Section 260529 - Hangers and Supports for Electrical Systems.
- E Section 260533.16 - Boxes for Electrical Systems.
- F Section 260533.23 - Surface Raceways for Electrical Systems.
- G Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS
- A NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- C NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- D NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
  3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
  4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
  5. Notify Architect/Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B Sequencing:
  1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 SUBMITTALS
- A See Division 01 Submittals Procedures.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C Shop Drawings:
1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
2. Include proposed locations of roof penetrations and proposed methods for sealing.

D Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

A Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

B Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C Underground:
1. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), or rigid PVC conduit.
2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), or rigid PVC conduit.
4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC) where emerging from underground.
5. Where rigid polyvinyl (PVC) conduit is provided, use galvanized steel rigid metal conduit (RMC) elbows for bends.
6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth, use corrosion protection tape acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
7. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.

D Embedded Within Concrete:
1. Within Slab on Grade: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC),

galvanized steel electrical metallic tubing (EMT), or rigid PVC conduit. Embed within structural slabs only where approved by Structural Engineer.

2. Within Slab Above Ground: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), or rigid PVC conduit. Embed within structural slabs only where approved by Structural Engineer.
3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), or rigid PVC conduit.
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC) where emerging from concrete.

E Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

F Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

G Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

H Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

I Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

J Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

1. Locations subject to physical damage include, but are not limited to:
   a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
   b. Where exposed below 20 feet in warehouse areas.

K Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC).

1. Locations subject to severe physical damage include, but are not limited to:
   a. High traffic industrial and warehouse areas where exposed below 8 feet, except within electrical and communication rooms or closets.
   b. Where exposed below 20 feet in industrial manufacturing areas.

L Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

M Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC).

1. Exterior locations subject to severe physical damage include, but are not limited to:
   a. Where exposed to vehicular traffic below 20 feet.

N Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

O Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit (RMC).
1. Corrosive locations include, but are not limited to:
a. Cooling towers.
b. Electroplating operations.
c. Swimming pools and associated equipment areas.
d. Wastewater treatment facilities.
e. Marine environments.

P Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).

Q Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
1. Maximum Length: 6 feet.

R Flexible Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit (FMC).
2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
3. Maximum Length: 6 feet unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
a. Transformers.
b. Motors.

S Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC) or galvanized steel electrical metallic tubing (EMT).

2.02 CONDUIT - GENERAL REQUIREMENTS

A Comply with NFPA 70.

B Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
1. Where permitted, existing conduits to be reused may be used as sole equipment grounding conductor only when continuity of conduit pathway, including associated boxes and fittings, is verified; see Section 260526.

C Fittings for Grounding and Bonding: See Section 260526 for additional requirements.

D Provide conduit, fittings, supports, and accessories required for complete raceway system.

E Provide products listed, classified, and labeled as suitable for purpose intended.

F Minimum Conduit Size, Unless Otherwise Indicated:
1. Branch Circuits: 1/2-inch trade size.
2. Branch Circuit Homeruns: 3/4-inch trade size.
3. Control Circuits: 1/2-inch trade size.
4. Flexible Connections to Luminaires: 1/2-inch trade size.
5. Underground, Interior: 3/4-inch trade size.
6. Underground, Exterior: 1-inch trade size.

G Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
2. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
3. Material: Use steel or malleable iron.
   a. Where not subject to severe corrosive influence, stainless steel or aluminum fittings may be used.
   b. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B Fittings:
1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
2. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
3. Material: Use steel or malleable iron.
   a. Where not subject to severe corrosive influence, stainless steel or aluminum fittings may be used.
   b. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.

C Interior Coating: Urethane, minimum thickness of 2 mil, 0.002 inch.

D PVC-Coated Boxes and Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
4. Material: Use steel or malleable iron.
5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
6. Interior Coating: Urethane, minimum thickness of 2 mil, 0.002 inch.

E PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.06 FLEXIBLE METAL CONDUIT (FMC)

A Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
   a. Do not use die cast zinc fittings.

2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
   a. Do not use die cast zinc fittings.

2.08 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
   a. Do not use die cast zinc fittings.
3. Connectors and Couplings: Use compression/gland or set-screw type.
   a. Do not use indenter type connectors and couplings.
4. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.
5. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.09 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 ACCESSORIES

A Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.

B Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

C Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

E Foam Conduit Sealant:

1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
3. Rated to hold minimum of 10 ft water head pressure.

F Conduit Mechanical Seals:

1. Listed as complying with UL 514B.
2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.
3. Suitable for sealing around conductors/cables to be installed.

G Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.

H Sealing Systems for Concrete Penetrations:
1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

I Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

J Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

K Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

L Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.

M Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for casing and conduit/duct arrangement to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that mounting surfaces are ready to receive conduits.

C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Install conduit in accordance with NECA 1.

C Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D Install intermediate metal conduit (IMC) in accordance with NECA 101.

E Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.

F Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

G Conduit Routing:
1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. When conduit destination is indicated without specific routing, determine exact routing required.
3. Conceal conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
   a. Electrical rooms.
   b. Mechanical equipment rooms.
   c. Within joists in areas with no ceiling.
   d. IT rooms..
5. Unless otherwise approved, do not route exposed conduits:
   a. Across floors.
   b. Across roofs.
   c. Across top of parapet walls.
   d. Across building exterior surfaces.

6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
9. Route conduits above water and drain piping where possible.
10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
12. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
13. Group parallel conduits in same area on common rack.

H Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
    a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.
11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

I Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
8. Secure joints and connections to provide mechanical strength and electrical continuity.

J Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
8. Provide metal escutcheon plates for conduit penetrations exposed to public view.
9. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.

K Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.
2. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 260553.

L Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Maximum Conduit Size: 1-inch trade size unless otherwise approved.
2. Install conduits within middle one third of slab thickness.
3. Secure conduits to prevent floating or movement during pouring of concrete.

M Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches on all sides unless otherwise indicated; Refer to Division 01 for additional requirements.

N Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
4. Where conduits are subject to earth movement by settlement or frost.

O Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:

a. Where conduits enter building from outside.
b. Where service conduits enter building from underground distribution system.
c. Where conduits enter building from underground.
d. Where conduits may transport moisture to contact live parts.

2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
   a. Where conduits pass from outdoors into conditioned interior spaces.
   b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
   c. Where conduits penetrate coolers or freezers.
3. Where conduits cross boundaries of hazardous/classified locations, provide identified/listed sealing fittings or conduit mechanical seals as approved by authorities having jurisdiction; locate as indicated or in accordance with NFPA 70.

P Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

Q Provide grounding and bonding; see Section 260526.

R Identify conduits; see Section 260553.

3.03 FIELD QUALITY CONTROL

A Refer to Division 01 for additional requirements.

B Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 260533.13

SECTION 260533.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C Boxes and enclosures for integrated power, data, and audio/video.
- D Floor boxes.
- E Accessories.

1.02 RELATED REQUIREMENTS
- A Refer to Division 01 for additional requirements.
- B Section 260526 - Grounding and Bonding for Electrical Systems.
- C Section 260529 - Hangers and Supports for Electrical Systems.
- D Section 260533.13 - Conduit for Electrical Systems:
  1. Conduit bodies and other fittings.
  2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- E Section 260533.23 - Surface Raceways for Electrical Systems:
  1. Accessory boxes designed specifically for surface raceway systems.
  2. Lay-in wireways and wiring troughs with removable covers.
- F Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- G Section 262726 - Wiring Devices:
  1. Wall plates.
  2. Floor box service fittings.
  3. Poke-through assemblies.
  4. Access floor boxes.
  5. Additional requirements for locating boxes for wiring devices.

1.03 REFERENCE STANDARDS
- A NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).
- G NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A Refer to Division 01 for additional requirements.

B Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures and floor boxes.

C Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

E Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Refer to Division 01 for additional requirements.
2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
4. Use nonmetallic boxes where exposed rigid PVC conduit is used.
5. Use suitable concrete type boxes where flush-mounted in concrete.
6. Use suitable masonry type boxes where flush-mounted in masonry walls.
7. Use raised covers suitable for the type of wall construction and device configuration where required.
8. Use shallow boxes where required by the type of wall construction.
9. Do not use "through-wall" boxes designed for access from both sides of wall.
10. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
11. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
12. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
13. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
14. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
15. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
16. Wall Plates: Comply with Section 262726.

C Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

D Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.

E Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Manufacturer: Same as manufacturer of floor box service fittings.
3. Reference Electrical Symbol Notes on drawings.

2.02 ACCESSORIES

A Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.
B Verify that mounting surfaces are ready to receive boxes.
C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.
B Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
C Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D Provide separate boxes for emergency power and normal power systems.
E Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
F Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
G Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
H Box Locations:
1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes as required for devices installed under other sections or by others.
a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.

b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.

10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.
    e. IT rooms..

I Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide required seismic controls in accordance with Section 260548.
3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J Install boxes plumb and level.

K Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.

M Install boxes as required to preserve insulation integrity.

N Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

O Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

P Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
2. Flush-mount enclosures located in concrete or paved areas.
3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
4. Provide cast-in-place concrete collar constructed in accordance with Section 033000, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

Q Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
R Close unused box openings.
S Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
T Provide grounding and bonding in accordance with Section 260526.
U Identify boxes in accordance with Section 260553.

3.03 CLEANING

A Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 260533.16

SECTION 260533.23

SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Surface raceway systems.
- B Wireways.
- C Wall duct.

1.02 RELATED REQUIREMENTS
- A Section 260526 - Grounding and Bonding for Electrical Systems.
- B Section 260529 - Hangers and Supports for Electrical Systems.
  1. Includes metal channel (strut) used as raceway.
- C Section 260533.13 - Conduit for Electrical Systems.
- D Section 260533.16 - Boxes for Electrical Systems.
- E Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F Section 262726 - Wiring Devices: Receptacles.

1.03 REFERENCE STANDARDS
- A NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
  2. Coordinate rough-in locations of outlet boxes provided under Section 260533.16 and conduit provided under Section 260533.13 as required for installation of raceways provided under this section.
  3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
  4. Wall Duct: Coordinate the work with other trades to provide walls suitable for installation of flush-mounted wall duct where indicated.
  5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B Sequencing:
  1. Do not install raceways until final surface finishes and painting are complete.
  2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
  1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.
- C Shop Drawings:

1. Pre-wired Surface Raceway Systems: Provide plan and elevation views including dimensioned locations of wiring devices and circuiting arrangements.
2. Wireways: Provide dimensioned plan and elevation views including adjacent equipment with all required clearances indicated.

D Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 RACEWAY REQUIREMENTS

A Provide all components, fittings, supports, and accessories required for a complete raceway system.

B Provide products listed, classified, and labeled as suitable for the purpose intended.

C Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

A Surface Metal Raceways: Listed and labeled as complying with UL 5.

B Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.

C Multioutlet Assemblies: Listed and labeled as complying with UL 111.

2.03 WIREWAYS

A Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.

B Wireway Type, Unless Otherwise Indicated:

1. Indoor Clean, Dry Locations: NEMA EN 10250, Type 1, painted steel with screw-cover.
2. Outdoor Locations: NEMA EN 10250, Type 3R, painted steel with screw-cover; include provision for padlocking.

C Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.

D Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.

E Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.04 WALL DUCT

A Description: Metal raceways specifically designed for enclosure of wiring to X-ray machines and similar medical equipment; listed and labeled as complying with UL 870.

B Material: Steel, unless otherwise indicated.

C Mounting Provisions: Suitable for surface- or flush-mounting as indicated.

D Size: As indicated on the drawings.

2.05 SOURCE QUALITY CONTROL

A Refer to Division 01 for additional requirements.

B Factory test each production unit for pre-wired surface raceway systems to verify proper wiring.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.

C Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.

D Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Perform work in accordance with NECA 1 (general workmanship).

C Surface Nonmetallic Raceways: Install in accordance with NEMA PRP 5.

D Install raceways plumb and level.

E Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.

F Secure and support raceways in accordance with Section 260529 at intervals complying with NFPA 70 and manufacturer's requirements.

G Close unused raceway openings.

H Provide grounding and bonding in accordance with Section 260526.

I Identify raceways in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A Refer to Division 01 for additional requirements.

B Inspect raceways for damage and defects.

C Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.

D Correct wiring deficiencies and replace damaged or defective raceways.

3.04 CLEANING

A Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

A Protect installed raceways from subsequent construction operations.

END OF SECTION 260533.23

SECTION 260548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Vibration isolation requirements.
- B Seismic control requirements.
  1. Includes requirements for seismic qualification of equipment not specified in this section.
- C Vibration-isolated equipment support bases.
- D Vibration isolators.
- E External seismic snubber assemblies.
- F Seismic restraint systems.

1.02 RELATED REQUIREMENTS
- A Refer to Division 01 for additional requirements.
- B Section 260529 - Hangers and Supports for Electrical Systems.

1.03 DEFINITIONS
- A Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., conduit, cable tray).
- B Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS
- A ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- C NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
  2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  4. Seismic Controls:
     a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
     b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
  5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B Sequencing:
  1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.06 SUBMITTALS

A See Division 01 Submittal Procedures.

B Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
2. Seismic Controls: Include seismic load capacities.

D Shop Drawings - Vibration Isolation Systems:
1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E Shop Drawings - Seismic Controls:
1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify mounting conditions required for equipment seismic qualification.
3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
4. Indicate proposed arrangement of distributed system trapeze support groupings.
5. Indicate proposed locations for distributed system flexible fittings and/or connections.
6. Indicate locations of seismic separations where applicable.
7. Include point load drawings indicating design loads transmitted to structure at each attachment location.

F Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
   a. Component operating weight and center of gravity.
   b. Component elevation in the building in relation to the roof elevation (z/h).
   c. Component importance factor (Ip).
   d. For distributed systems, component materials and connection methods.
   e. Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
   f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

G Certification for seismically qualified equipment; identify basis for certification.

H Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

I Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

J Evidence of qualifications for seismic controls designer.

K Evidence of qualifications for manufacturer.

L Manufacturer's detailed field testing and inspection procedures.
M Field quality control test reports.

1.07 QUALITY ASSURANCE

A Comply with NFPA 70.
B Comply with applicable building code.
C Maintain at the project site a copy of each referenced document that prescribes execution requirements.
D Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
1. Designer may be employed by the manufacturer of the seismic restraint products.
E Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.
B Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
C General Requirements:
1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
D Equipment Isolation:
1. Transformers:
a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
b. Floor-Mounted Transformers, Nonseismic Applications: Use resilent material isolator pads, resilient material isolator mounts, or open (unhoused) spring isolators.
c. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
d. Suspended Transformers, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
e. Suspended Transformers, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
f. Wall-Mounted Transformers, Nonseismic Applications: Use resilient material isolator mounts.

g. Wall-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts.
h. Minimum Static Deflection:
1) Transformers Mounted on Grade-Level Slabs: 0.25 inch deflection unless otherwise indicated.
2) Transformers Mounted at Above-Grade Levels: 0.5 inch deflection unless otherwise indicated.

2. Engine Generators:
a. Specified vibration isolators are in addition to any factory-installed internal vibration isolators between generator set and integral base unless otherwise indicated; obtain generator set manufacturer approval of applied vibration isolation.
b. Nonseismic Applications, Isolators Not Located Below Sub-Base Fuel Tank: Use housed spring isolators or restrained spring isolators.
c. Nonseismic Applications, Isolators Located Below Sub-Base Fuel Tank: Use restrained spring isolators.
d. Seismic Applications: Use seismic type restrained spring isolators.
e. Provide vibration-isolated concrete inertia bases where indicated.
f. Minimum Static Deflection:
1) Generators Mounted on Grade-Level Slabs: 1 inch deflection unless otherwise indicated.
2) Generators Mounted at Above-Grade Levels: 2 inch deflection unless otherwise indicated.

E Conduit Isolation:
1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.
a. Minimum Length: 3 feet unless otherwise indicated.
2. Vibration Isolators:
a. Provide vibration isolators for conduit supports:
1) Located within 50 feet of connected vibration-isolated equipment where flexible connection to equipment is not possible.
2) For conduits over 2 inch trade size located below or within 50 feet of noise-sensitive areas indicated.
b. Minimum Static Deflection:
1) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
2) Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
c. Suspended Conduits, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
d. Suspended Conduits, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
e. Use modular seal or approved resilient material where vibration-isolated conduits penetrate building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.02 SEISMIC CONTROL REQUIREMENTS

A Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating

loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.

B Seismic Design Criteria: Obtain from project Structural Engineer of Record.

C Component Importance Factor (Ip): Electrical components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:
1. Electrical components required to function for life safety purposes after an earthquake.
2. Electrical components that support or otherwise contain hazardous substances.
3. Life Safety Branch and Critical Branch wiring and equipment in health care settings.

D Seismic Qualification of Equipment:
1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
3. Notify Architect/Engineer and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

E Premanufactured Modular Electrical Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.

F Seismic Restraints:
1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
2. Seismic Restraint Exemptions:
   a. Exemptions for Seismic Design Category C:
      1) Electrical components where either of the following apply:
         (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
         (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
   b. Exemptions for Seismic Design Category D, E, and F:
      1) Discrete electrical components that are positively attached to the structure where either of the following apply:
         (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (Ip) is 1.0.
         (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
   c. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
      1) Raceways with component importance factor (Ip) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:

(a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
(b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.
(c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
(d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.

2) Conduits less than 2-1/2 inch trade size.

d. Lighting Exemptions, All Seismic Design Categories:
1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
2) Lay-in luminaires weighing less than 56 pounds secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.

3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
a. ASHRAE (HVACA).
b. FEMA 413.
c. FEMA E-74.
d. SMACNA (SRM).
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Type Vibration Isolators:
a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
6. External Seismic Snubber Assemblies:
a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
7. Seismic Restraint Systems:
a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.

c. Use only one restraint system type for a given electrical component or distributed system (e.g., conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.

G Seismic Attachments:
1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
   a. Increase size of pad as required to comply with anchor requirements.
   b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

H Seismic Interactions:
1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

I Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
a. Relative displacements at connections between components, including distributed systems (e.g., conduit, cable tray); do not exceed load limits for equipment utility connections.
b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
c. Design displacements at seismic separations.
d. Anticipated drifts between floors.

2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES
A Vibration-Isolated Structural Steel Bases:
1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
B Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.

2.04 VIBRATION ISOLATORS
A General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
a. Color code or otherwise identify springs to indicate load capacity.
b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
f. Selected to function without undue stress or overloading.
3. Seismic Snubbing Elements for Seismic Isolators:
a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.
B Vibration Isolators for Nonseismic Applications:
1. Resilient Material Isolator Pads:
a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Resilient Material Isolator Mounts, Nonseismic:

a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.

3. Open (Unhoused) Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
   b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
4. Housed Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
   b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
   c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
   d. Furnished with integral leveling device for positioning and securing supported equipment.
5. Restrained Spring Isolators, Nonseismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
   b. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

C Vibration Isolators for Seismic Applications:

1. Resilient Material Isolator Mounts, Seismic:
   a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
2. Restrained Spring Isolators, Seismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
   b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

B Seismic Snubbing Elements:
   1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
   2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.06 SEISMIC RESTRAINT SYSTEMS

A Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

B Cable Restraints:
1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

C Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION
A Verify that field measurements are as shown on the drawings.
B Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
C Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS
A Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect/Engineer and statement of special inspections as required by applicable building code.
B Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C Seismic special inspections include, but are not limited to:
1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
2. Anchorage of electric equipment for emergency and standby power systems for Seismic Design Categories C, D, E, and F; periodic inspection.
3. Anchorage of electrical equipment other than for emergency and standby power systems for Seismic Design Categories E and F; periodic inspection.
4. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
5. Verification of required clearances between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

D Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
E Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION
A Install products in accordance with manufacturer's instructions.
B Install products in accordance with applicable requirements of NECA 1 (general workmanship).

C Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
D Secure fasteners according to manufacturer's recommended torque settings.
E Field-Welding (where approved by Architect/Engineer): Comply with Section 055000.
F Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
G Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
a. Provide specified minimum clearance beneath base.
2. Spring Isolators:
a. Position equipment at operating height; provide temporary blocking as required.
b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
3. Isolator Hangers:
a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
H Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
a. Size in accordance with seismic design to meet anchor requirements.
b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.

b. Install restraints within permissible angles in accordance with seismic design.
c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

A Refer to Division 01 for additional requirements.
B Inspect vibration isolation and/or seismic control components for damage and defects.
C Provide services of a manufacturer's authorized representative for vibration isolation systems and seismic controls to observe installation and assist in inspection and testing. Include manufacturer's detailed testing and inspection procedures and field reports with submittals.
D Vibration Isolation Systems:
1. Verify isolator static deflections.
2. Verify required clearance beneath vibration-isolated equipment support bases.
3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
E Seismic Controls:
1. Verify snubbing element air gaps.
F Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
G Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 260548

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Electrical identification requirements.
- B Identification nameplates and labels.
- C Wire and cable markers.
- D Voltage markers.
- E Underground warning tape.
- F Floor marking tape.
- G Warning signs and labels.

1.02 RELATED REQUIREMENTS
- A Refer to Division 01 for additional requirements.
- B Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.03 REFERENCE STANDARDS
- A NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- C UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B Sequencing:
  1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
  2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- D Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE
- A Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS
- A Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS
- A Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
   a. Switchboards:
      1) Identify power source and circuit number. Include location when not within sight of equipment.
      2) Use identification nameplate to identify main overcurrent protective device.
      3) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
   b. Panelboards:
      1) Identify power source and circuit number. Include location when not within sight of equipment.
      2) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
      3) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
   c. Transformers:
      1) Identify power source and circuit number. Include location when not within sight of equipment.
      2) Identify load(s) served. Include location when not within sight of equipment.
   d. Enclosed switches, circuit breakers, and motor controllers:
      1) Identify power source and circuit number. Include location when not within sight of equipment.
      2) Identify load(s) served. Include location when not within sight of equipment.
   e. Time Switches:
      1) Identify load(s) served and associated circuits controlled. Include location.
   f. Enclosed Contactors:
      1) Identify load(s) and associated circuits controlled. Include location.
2. Service Equipment:
   a. Use identification nameplate to identify each service disconnecting means.
   b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
5. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
6. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
   a. Service equipment.
7. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
   a. Minimum Size: 3.5 by 5 inches.

b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
c. Service Equipment: Include the following information in accordance with NFPA 70.
1) Nominal system voltage.
2) Available fault current.
3) Date label applied.

8. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
9. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

B Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use underground warning tape to identify direct buried cables.

C Identification for Raceways:
1. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.
a. Maximum Intervals: 20 feet.
b. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
1) Field-Painting: Comply with Section 099123.
2) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
c. Color Code:
1) Emergency Power System: Red.
2) Fire Alarm System: Red.
2. Use underground warning tape to identify underground raceways.

D Identification for Boxes:
1. Use voltage markers or color coded boxes to identify systems other than normal power system.
a. Color-Coded Boxes: Field-painted in accordance with Section 099123 per the same color code used for raceways.
1) Emergency Power System: Red.
2) Fire Alarm System: Red.
b. For exposed boxes in public areas, do not color code.
2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
a. For exposed boxes in public areas, use only identification labels.

E Identification for Devices:
1. Wiring Device and Wallplate Finishes: Comply with Section 262726.

2. Factory Pre-Marked Wallplates: Comply with Section 262726.
3. Use identification label to identify fire alarm system devices.
   a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
4. Use identification label to identify serving branch circuit for all receptacles.
   a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
5. Use identification label to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
6. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

F Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A Identification Nameplates:
1. Materials:
   a. Indoor Clean, Dry Locations: Use plastic nameplates.
   b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
   a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. System designation where applicable:
      1) Emergency Power System: Identify with text "EMERGENCY".
      2) Fire Alarm System: Identify with text "FIRE ALARM".
   b. Equipment designation or other approved description.
   c. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. System Designation: 1 inch.
   b. Equipment Designation: 1/2 inch.
   c. Other Information: 1/4 inch.

5. Color:
   a. Normal Power System: White text on black background.
   b. Emergency Power System: White text on red background.
   c. Fire Alarm System: White text on red background.

D Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.
   a. Exceptions:
      1) Provide white text on red background for general information or operational instructions for emergency systems.
      2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

G Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

H Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

A Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C Legend: Power source and circuit number or other designation indicated.

D Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E Minimum Text Height: 1/8 inch.
F Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS
A Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
B Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
C Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
D Legend:
1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:
a. Emergency Power System: Text "EMERGENCY".
E Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE
A Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
B Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
C Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
D Legend: Type of service, continuously repeated over full length of tape.
E Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 WARNING SIGNS AND LABELS
A Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
B Warning Signs:
1. Materials:
a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches unless otherwise indicated.
C Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
a. Do not use labels designed to be completed using handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION
A Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C Install identification products centered, level, and parallel with lines of item being identified.

D Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G Secure rigid signs using stainless steel screws.

H Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A See Section 014000 - Quality Requirements, for additional requirements.

B Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 260553

SECTION 260583

WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Electrical connections to equipment.

1.02 RELATED REQUIREMENTS
- A Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B Section 260533.13 - Conduit for Electrical Systems.
- C Section 260533.16 - Boxes for Electrical Systems.
- D Section 262726 - Wiring Devices.
- E Section 262816.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS
- A NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
  2. Determine connection locations and requirements.
- B Sequencing:
  1. Install rough-in of electrical connections before installation of equipment is required.
  2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.
- B Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE
- A Comply with requirements of NFPA 70.
- B Products: Listed, classified, and labeled as suitable for the purpose intended.
- C Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS
- A Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  1. Colors: Comply with NEMA WD 1.
  2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.
C Wiring Devices: As specified in Section 262726.
D Flexible Conduit: As specified in Section 260533.13.
E Wire and Cable: As specified in Section 260519.
F Boxes: As specified in Section 260533.16.

2.02 EQUIPMENT CONNECTIONS

A Refer to drawing plans for equipment connection.:

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A Make electrical connections in accordance with equipment manufacturer's instructions.
B Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
C Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
D Provide receptacle outlet to accommodate connection with attachment plug.
E Provide cord and cap where field-supplied attachment plug is required.
F Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
G Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
H Install terminal block jumpers to complete equipment wiring requirements.
I Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
J Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION 260583

SECTION 260923

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Occupancy sensors.
- B Outdoor motion sensors.
- C Time switches.
- D In-wall time switches.
- E In-wall interval timers.
- F Outdoor photo controls.
- G Daylighting controls.
- H Lighting contactors.
- I Accessories.

1.02 RELATED REQUIREMENTS
- A Section 260526 - Grounding and Bonding for Electrical Systems.
- B Section 260529 - Hangers and Supports for Electrical Systems
- C Section 260533.16 - Boxes for Electrical Systems.
- D Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
  1. Includes finish requirements for wall controls specified in this section.
- F Section 262813 - Fuses.
- G Section 265100 - Interior Lighting.

1.03 REFERENCE STANDARDS
- A ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
- B ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2020.
- C NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2020.
- G NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- H NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.
- I NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).
- J NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- L UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- M UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- N UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

O UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
P UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
Q UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
5. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B Sequencing:
1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A Refer to Division 01 for additional requirements.
B Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
C Shop Drawings:
1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
D Field Quality Control Reports.
E Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
F Operation and Maintenance Data: Include detailed information on device programming and setup.
G Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Locking Receptacle-Mounted Outdoor Photo Controls: Five percent of total quantity installed for each type, but not less than two of each type.
3. Electronic Trip Circuit Breakers: Provide one portable test set.
4. Indicating Lights: Two of each different type.
H Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
D Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION
A Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS
A Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY
A Refer to Division 01 for additional requirements.
B Provide five year manufacturer warranty for all occupancy sensors.
C Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.
D Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS
A Provide products listed, classified, and labeled as suitable for the purpose intended.
B Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
C Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS
A All Occupancy Sensors:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.

5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
11. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
12. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.

B Wall Switch Occupancy Sensors:

1. All Wall Switch Occupancy Sensors:
   a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
   b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
   c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
   d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
   e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
   f. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet.
4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

C Wall Dimmer Occupancy Sensors:

1. General Requirements:
   a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
   b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
   c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.

d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
e. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.

2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D Ceiling Mounted Occupancy Sensors:

1. All Ceiling Mounted Occupancy Sensors:
   a. Description: Low profile occupancy sensors designed for ceiling installation.
   b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
   c. Provide field selectable setting for disabling LED motion detector visual indicator.
   d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
3. Ultrasonic Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.

E Directional Occupancy Sensors:

1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
   a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
   b. Provide field selectable setting for disabling LED motion detector visual indicator.
2. Passive Infrared (PIR) Directional Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.

F Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.

1. Fluorescent High Bay Luminaire Mounted Occupancy Sensors: Passive infrared (PIR) type with a field of view of 360 degrees unless otherwise indicated.
   a. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
   b. Circular Coverage Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 20 feet.
   c. Linear Aisle Coverage Sensors: Capable of detecting motion within an area of 20 feet wide by 60 feet long at a mounting height of 40 feet.

G Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating: As required to control the load indicated on drawings.

H Power Packs for Wireless Occupancy Sensors:
1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Rating: As required to control the load indicated on drawings.
4. Provide auxiliary contact closure output.
5. Rated Life of Relay: One million cycles.

2.03 OUTDOOR MOTION SENSORS

A Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

B Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

C Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

D Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

E Integral Photocell: For dusk to dawn operation.

F Manual Override: Activated by switching power off to unit and then back on.

G Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.

H Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

2.04 TIME SWITCHES

A Digital Electronic Time Switches:
1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
   a. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
3. Schedule Capacity: Not less than 16 programmable on/off operations.
4. Provide automatic daylight savings time and leap year compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Input Supply Voltage: As indicated on the drawings.
8. Output Switch Configuration: As required to control the load indicated on drawings.
9. Output Switch Contact Ratings: As required to control the load indicated on drawings.
10. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:
    a. Indoor clean, dry locations: Type 1.

b. Outdoor locations: Type 3R.

11. Provide flush-mounted unit where indicated, where mounted in public areas, or where mounted adjacent to flush-mounted equipment.

B Electromechanical Time Switches:

1. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, listed and labeled as complying with UL 917.
2. Program Capability:
   a. Astronomic Time Switches: With same schedule for each day of the week and skip-a-day feature to omit selected days with automatic adjustment for seasonal changes in sunrise and sunset times.
3. Schedule Capacity:
   a. Astronomic Time Switches: Capable of turning load on at sunset and off at either sunrise or selected fixed time.
4. Provide spring reserve backup to maintain clock during power outage.
5. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
6. Input Supply Voltage: As indicated on the drawings.
7. Output Switch Configuration: As required to control the load indicated on drawings.
8. Output Switch Contact Ratings: As required to control the load indicated on drawings.
9. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:
   a. Indoor clean, dry locations: Type 1.
   b. Outdoor locations: Type 3R.
10. Provide flush-mounted unit where indicated, where mounted in public areas, or where mounted adjacent to flush-mounted equipment.

2.05 IN-WALL TIME SWITCHES

A Digital Electronic In-Wall Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
   a. Astronomic Time Switches: Capable of different schedule for each day of the week and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
3. Schedule Capacity: Not less than 40 programmable on/off operations.
4. Provide automatic daylight savings time compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Switch Configuration: Suitable for use in either SPST or 3-way application.
8. Contact Ratings: As required to control the load indicated on drawings.

B Electromechanical In-Wall Time Switches:

1. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, suitable for mounting in standard wall box, and listed and labeled as complying with UL 917.
2. Program Capability: 24-hour time switch with same schedule for each day of the week.
3. Schedule Capacity: Accommodating not less than 24 selected on/off operations per day.
4. Manual override: Capable of permanently overriding current schedule.

5. Switch Configuration: SPST.
6. Contact Ratings: As required to control the load indicated on drawings.

2.06 IN-WALL INTERVAL TIMERS

A Digital Electronic In-Wall Interval Timers:
1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
2. Program Capability: Designed to turn load off at end of preset time interval.
3. Time Interval: Field selectable range of presets available up to 12 hours.
4. Provide field selectable audible and visual indication to warn that end of interval operation is about to turn off load.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of both turning load off and resetting timer to original preset time interval.
7. Switch Configuration: Suitable for use in either SPST or 3-way application.
8. Contact Ratings: As required to control the load indicated on drawings.

B Spring Wound In-Wall Interval Timers:
1. Description: Factory-assembled controller with mechanical spring wound timing mechanism requiring no electricity to operate; suitable for mounting in standard wall box; rotary control operator with matching wall plate factory marked with time interval units; listed and labeled as complying with UL 916 or UL 917.
2. Program Capability: Designed to turn load off at end of preset time interval.
3. Time Interval: User selectable from zero up to 15 minutes.
4. Manual override: Provide hold feature to disable timer for constant on operation.
5. Switch Configuration: SPST.
6. Contact Ratings: As required to control the load indicated on drawings.

2.07 OUTDOOR PHOTO CONTROLS

A Stem-Mounted Outdoor Photo Controls:
1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
2. Housing: Weatherproof, impact resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.

B Locking Receptacle-Mounted Outdoor Photo Controls
1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.

8. Surge Protection: 160 joule metal oxide varistor.

C Button Type Outdoor Photo Controls
1. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.
2. Housing: Weather resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.

2.08 DAYLIGHTING CONTROLS

A System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

B Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
1. Sensor Type: Filtered silicon photo diode.
2. Sensor Range:
a. Indoor Photo Sensors: 5 to 100 footcandles.
b. Outdoor Photo Sensors: 5 to 250 footcandles.

C Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.

D Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
3. Control Capability:
a. Single Zone Switching Modules: Capable of controlling one programmable channel.

E Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
2. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
3. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
4. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
5. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.

F Power Packs for Low Voltage Daylighting Control Modules:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Ratings: As required to control the load indicated on drawings.

G Accessories:
1. Where indicated, provide compatible accessory wall switches for manual override control.

2.09 LIGHTING CONTACTORS

A Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.

B Short Circuit Current Rating:
1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

C Enclosures:
1. Comply with NEMA ICS 6.
2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
a. Indoor Clean, Dry Locations: Type 1 or Type 12.
b. Outdoor Locations: Type 3R or Type 4.
3. Finish: Manufacturer's standard unless otherwise indicated.

2.10 ACCESSORIES

A Auxiliary Contacts:
1. Comply with NEMA ICS 5.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.

B Pilot Devices:
1. Comply with NEMA ICS 5; heavy-duty type.
2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
4. Indicating Lights: Push-to-test type unless otherwise indicated.
5. Provide LED lamp source for indicating lights and illuminated devices.

C Control and Timing Relays:
1. Comply with NEMA ICS 5.
2. Provide number and type of relays indicated or required to perform necessary functions.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D Verify that final surface finishes are complete, including painting.

E Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
F Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
G Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A Provide extension rings to bring outlet boxes flush with finished surface.
B Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
B Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
1. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
2. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect/Engineer to obtain direction prior to proceeding with work.
C Install lighting control devices in accordance with manufacturer's instructions.
D Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
E Install lighting control devices plumb and level, and held securely in place.
F Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.
G Provide required supports in accordance with Section 260529.
H Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
I Identify lighting control devices in accordance with Section 260553.
J Occupancy Sensor Locations:
1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
K Outdoor Photo Control Locations:
1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.
L Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
M Daylighting Control Photo Sensor Locations:

1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize control and avoid conflicts or problems affecting proper detection of light levels.
2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

N Combination Enclosed Lighting Contactors:
1. Except where indicated to be mounted adjacent to the equipment they supply, mount lighting contactors such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
2. Provide fuses complying with Section 262813 for fusible switches as indicated.

O Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

P Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

Q Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

R Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

S Where indicated or required, provide cabinet or enclosure in accordance with Section 260533.16 for mounting of lighting control device system components.

3.04 FIELD QUALITY CONTROL

A Refer to Division 01 for additional requirements.

B Inspect each lighting control device for damage and defects.

C Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D Test time switches to verify proper operation.

E Test outdoor photo controls to verify proper operation, including time delays where applicable.

F Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

G Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

A Adjust devices and wall plates to be flush and level.

B Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect/Engineer.

C Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect/Engineer. Record settings in written report to be included with submittals.

F Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect/Engineer.

G Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect/Engineer.

3.06 CLEANING

A Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A Refer to Division 01 for additional requirements.

B Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
4. Location: At project site.

END OF SECTION 260923

SECTION 262416

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Power distribution panelboards.
- B Lighting and appliance panelboards.
- C Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS
- A Refer to Division 01 for additional requirements.
- B Section 260526 - Grounding and Bonding for Electrical Systems.
- C Section 260529 - Hangers and Supports for Electrical Systems.
- D Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS
- A NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- C NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D NEMA PB 1 - Panelboards; 2011.
- E NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- F NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- G NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H UL 67 - Panelboards; Current Edition, Including All Revisions.
- I UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- J UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- K UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
  4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D Field Quality Control Test Reports.

E Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

F Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A ABB: www.electrification.us.abb.com.

B Eaton Corporation: www.eaton.com.

C Schneider Electric: www.se.com.

D Siemens Industry, Inc: www.new.siemens.com.

E Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A Provide products listed, classified, and labeled as suitable for the purpose intended.

B Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature:
   a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G Bussing: Sized in accordance with UL 67 temperature rise requirements.
1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H Conductor Terminations: Suitable for use with the conductors to be installed.

I Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.
2. Boxes: Galvanized steel unless otherwise indicated.
   a. Provide wiring gutters sized to accommodate the conductors to be installed.
3. Fronts:
   a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
   b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
   c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided, list and label panelboards as a complete assembly including surge protective device.

L Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

M Load centers are not acceptable.

N Provide the following features and accessories where indicated or where required to complete installation:
1. Feed-through lugs.
2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

A Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C Bussing:
1. Phase and Neutral Bus Material: Aluminum.
2. Ground Bus Material: Aluminum.

D Circuit Breakers:
1. Provide bolt-on type.

E Enclosures:
1. Provide surface-mounted enclosures unless otherwise indicated.
2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum.
3. Ground Bus Material: Aluminum.

D Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      2) 14,000 rms symmetrical amperes at 480 VAC.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Copper, suitable for terminating copper conductors only.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.

b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.

7. Do not use tandem circuit breakers.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide the following features and accessories where indicated or where required to complete installation:
   a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
   b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.06 SOURCE QUALITY CONTROL

A Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.
B Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
C Verify that mounting surfaces are ready to receive panelboards.
D Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Perform work in accordance with NECA 1 (general workmanship).
B Install products in accordance with manufacturer's instructions.
C Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
D Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
E Provide required support and attachment in accordance with Section 260529.
F Install panelboards plumb.
G Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
H Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
I Provide grounding and bonding in accordance with Section 260526.
J Install all field-installed branch devices, components, and accessories.
K Provide filler plates to cover unused spaces in panelboards.
L Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
   1. Emergency and night lighting circuits.
   2. Fire detection and alarm circuits.
   3. Communications equipment circuits.
   4. Intrusion detection and access control system circuits.
   5. Video surveillance system circuits.
M Identify panelboards in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A See Section 014000 - Quality Requirements, for additional requirements.
B Inspect and test in accordance with NETA ATS, except Section 4.
C Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
D Test GFCI circuit breakers to verify proper operation.
E Test shunt trips to verify proper operation.

F Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B Adjust alignment of panelboard fronts.

3.05 CLEANING

A Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262416

SECTION 262726

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Wall switches.
- B Wall dimmers.
- C Fan speed controllers.
- D Receptacles.
- E Floor box service fittings.

1.02 RELATED REQUIREMENTS
- A Refer to Division 01 for additional requirements.
- B Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- C Section 260526 - Grounding and Bonding for Electrical Systems.
- D Section 260533.16 - Boxes for Electrical Systems.
- E Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F Section 260583 - Wiring Connections: Cords and plugs for equipment.
- G Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

1.03 REFERENCE STANDARDS
- A FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- B NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- D NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- E NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- F NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- H UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- I UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.
- J UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
  2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
  3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
  4. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
  5. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.

B Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C Operation and Maintenance Data:
1. Wall Dimmers: Include information on operation and setting of presets.
2. GFCI Receptacles: Include information on status indicators.

D Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Keys for Locking Switches: Two of each type.
3. Extra Wall Plates: Two of each style, size, and finish.
4. Extra Flush Floor Service Fittings: Two of each type.
5. Extra Poke-Through Core Hole Closure Plugs: Two for each core size.

1.06 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Products: Listed, classified, and labeled as suitable for the purpose intended.

C Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A Provide wiring devices suitable for intended use and with ratings adequate for load served.

B For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D Provide GFCI protection for receptacles installed within 6 feet of sinks.

E Provide GFCI protection for receptacles installed in kitchens.

F Provide GFCI protection for receptacles serving electric drinking fountains.

G Unless noted otherwise, do not use combination switch/receptacle devices.

H For flush floor service fittings, use tile rings for installations in tile floors.

I For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.02 WIRING DEVICE FINISHES

A Provide wiring device finishes as described below unless otherwise indicated.

B Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.

C Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.

D Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.

E Isolated Ground Convenience Receptacles: Orange.

F Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

G Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.

2.03 WALL SWITCHES

A Manufacturers:
1. Hubbell Incorporated: www.hubbell.com.
2. Leviton Manufacturing Company, Inc: www.leviton.com.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us.

B Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

D Lighted Wall Switches: Industrial specification grade, 20 A, 120/277 V with illuminated standard toggle type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

E Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

F Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

G Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.

H Locking Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed three position switch actuator and momentary contacts; switches keyed alike; single pole double throw, off with switch actuator in center position.

2.04 WALL DIMMERS

A Manufacturers:
1. Leviton Manufacturing Company, Inc: www.leviton.com.
2. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us.

B Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

C Control: Slide control type with separate on/off switch.

D Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:

E Provide locator light, illuminated with load off.

2.05 RECEPTACLES

A Manufacturers:
1. Hubbell Incorporated: www.hubbell.com.
2. Leviton Manufacturing Company, Inc: www.leviton.com.
3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us.

B Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C Convenience Receptacles:
1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

2. Automatically Controlled Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
3. Isolated Ground Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
4. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

D USB Charging Devices:
1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.
3. USB Charging Noncombination Devices: Four-port (Type A); rectangular decorator style.

E Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.
1. Standard Locking Convenience Receptacles: Single, 20A, 125V, NEMA L5-20R.

2.06 FLOOR BOX SERVICE FITTINGS

A Manufacturers:
1. Hubbell Incorporated: www.hubbell.com.
2. Thomas & Betts Corporation: www.tnb.com.
3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us.

B Description: Service fittings compatible with floor boxes provided under Section 260533.16 with components, adapters, and trims required for complete installation.

C Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
   a. Cover: Rectangular.
   b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
2. Single Service Flush Communications Outlets:
   a. Cover: Rectangular.
   b. Voice and Data Jacks:
3. Dual Service Flush Combination Outlets:
   a. Cover: Rectangular.
   b. Configuration:
      1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
      2) Communications:
      3) Voice and Data Jacks:
4. Accessories:
   a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
   b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
C Verify that wall openings are neatly cut and will be completely covered by wall plates.
D Verify that final surface finishes are complete, including painting.
E Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
F Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A Provide extension rings to bring outlet boxes flush with finished surface.
B Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
B Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
1. Mounting Heights: As indicated on the drawings.
2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect/Engineer to obtain direction prior to proceeding with work.
5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
C Install wiring devices in accordance with manufacturer's instructions.
D Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
E Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
F Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
G Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
H For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
I Install wiring devices plumb and level with mounting yoke held rigidly in place.
J Install wall switches with OFF position down.
K Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
L Do not share neutral conductor on branch circuits utilizing wall dimmers.
M Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
N Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P Identify wiring devices in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

A Refer to Division 01 for additional requirements.

B Inspect each wiring device for damage and defects.

C Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D Test each receptacle to verify operation and proper polarity.

E Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A Adjust devices and wall plates to be flush and level.

3.06 CLEANING

A Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

SECTION 262813

FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Fuses.

1.02 RELATED REQUIREMENTS
- A Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- B Section 262816.16 - Enclosed Switches: Fusible switches.

1.03 REFERENCE STANDARDS
- A NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
  2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
  3. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.
- B Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
- C Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. Extra Fuses: One set(s) of three for each type and size installed.
  2. Fuse Pullers: One set(s) compatible with each type and size installed.

1.06 QUALITY ASSURANCE
- A Comply with requirements of NFPA 70.
- B Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS
- A Bussmann, a division of Eaton Corporation: www.cooperindustries.com.
- B Littelfuse, Inc: www.littelfuse.com.
- C Mersen: ep-us.mersen.com.

2.02 APPLICATIONS
- A Service Entrance:
  1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
  2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- B Feeders:
  1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
  2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

C General Purpose Branch Circuits: Class RK1, time-delay.
D Individual Motor Branch Circuits: Class RK1, time-delay.

2.03 FUSES
A Provide products listed, classified, and labeled as suitable for the purpose intended.
B Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
C Provide fuses of the same type, rating, and manufacturer within the same switch.
D Comply with UL 248-1.
E Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
F Voltage Rating: Suitable for circuit voltage.
G Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
H Provide the following accessories where indicated or where required to complete installation:
1. Fuseholders: Compatible with indicated fuses.
2. Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for fuses with larger ampere ratings.

PART 3 EXECUTION

3.01 EXAMINATION
A Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
B Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION
A Do not install fuses until circuits are ready to be energized.
B Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION 262813

SECTION 262816.13

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS
- A Section 260526 - Grounding and Bonding for Electrical Systems.
- B Section 260529 - Hangers and Supports for Electrical Systems.
- C Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS
- A FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- G UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
  2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  4. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS
- A Refer to Division 01 for additional requirements.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
  1. Include characteristic trip curves for each type and rating of circuit breaker upon request.
- C Field Quality Control Test Reports.
- D Project Record Documents: Record actual installed locations of enclosed circuit breakers.

1.06 QUALITY ASSURANCE
- A Comply with requirements of NFPA 70.
- B Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A ABB: www.electrification.us.abb.com.

B Eaton Corporation: www.eaton.com.

C Schneider Electric: www.se.com.

D Siemens Industry, Inc: www.new.siemens.com.

E Source Limitations: Provide enclosed circuit breakers and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.02 ENCLOSED CIRCUIT BREAKERS

A Description: Units consisting of molded case circuit breakers individually mounted in enclosures.

B Provide products listed, classified, and labeled as suitable for the purpose intended.

C Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between 23 degrees F and 104 degrees F.

D Short Circuit Current Rating:

1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.

E Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

F Conductor Terminations: Suitable for use with the conductors to be installed.

G Provide thermal magnetic circuit breakers unless otherwise indicated.

H Provide electronic trip circuit breakers.

I Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

J Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.

K Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
3. Provide surface-mounted enclosures unless otherwise indicated.

L Provide externally operable handle with means for locking in the OFF position.

M Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

2.03 MOLDED CASE CIRCUIT BREAKERS

A Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

B Interrupting Capacity:
1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
   a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
   b. 14,000 rms symmetrical amperes at 480 VAC.
2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C Conductor Terminations:
1. Provide mechanical lugs unless otherwise indicated.
2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

E Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.

F Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

G Provide the following features and accessories where indicated or where required to complete installation:
1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
2. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.

C Verify that mounting surfaces are ready to receive enclosed circuit breakers.

D Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.

B Perform work in accordance with NECA 1 (general workmanship).

C Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D Provide required support and attachment in accordance with Section 260529.

E Install enclosed circuit breakers plumb.

F Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G Provide grounding and bonding in accordance with Section 260526.

H Set field-adjustable ground fault protection pickup and time delay settings as indicated.

3.03 FIELD QUALITY CONTROL

A Refer to Division 01 for additional requirements.

B Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.

C Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

D Test shunt trips to verify proper operation.

E Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.04 ADJUSTING

A Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.

B Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816.13

SECTION 262816.16

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Enclosed safety switches.

1.02 RELATED REQUIREMENTS
- A Section 260526 - Grounding and Bonding for Electrical Systems.
- B Section 260529 - Hangers and Supports for Electrical Systems.
- C Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D Section 262813 - Fuses.

1.03 REFERENCE STANDARDS
- A NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- D NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
- A Coordination:
  1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
  2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  4. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS
- A See Division 1 for submittal procedures.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
  2. Include wiring diagrams showing all factory and field connections.

3. Identify mounting conditions required for equipment seismic qualification.

D Manufacturer's equipment seismic qualification certification.

E Field Quality Control Test Reports.

F Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G Project Record Documents: Record actual locations of enclosed switches.

H Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Division 1 for product requirements additional provisions.
2. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A Comply with requirements of NFPA 70.

B Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A ABB: www.electrification.us.abb.com.

B Eaton Corporation: www.eaton.com.

C Schneider Electric: www.se.com.

D Siemens Industry, Inc: www.new.siemens.com.

E Substitutions: See Division 1 for Product Requirements..

F Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B Provide products listed, classified, and labeled as suitable for the purpose intended.

C Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D Horsepower Rating: Suitable for connected load.

E Voltage Rating: Suitable for circuit voltage.

F Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study.
2. Minimum Ratings:
   a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
   b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
   c. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.

G Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

H Provide with switch blade contact position that is visible when the cover is open.

I Fuse Clips for Fusible Switches: As required to accept fuses indicated.
1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

J Conductor Terminations: Suitable for use with the conductors to be installed.

K Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

L Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

M Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

N Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

O Heavy Duty Switches:
1. Comply with NEMA BS 31047.
2. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Provide compression lugs where indicated.
   c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
   a. Provide means for locking handle in the ON position where indicated.

P Provide the following features and accessories where indicated or where required to complete installation:
1. Hubs: As required for environment type; sized to accept conduits to be installed.
2. Integral fuse pullers.
3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
4. Interlocked Receptacle: Integral pre-wired three phase, three wire, grounded type receptacle interlocked with switch mechanism to prevent insertion or removal of plug with switch in the ON position and to prevent switch from being placed in the ON position

without matching plug inserted. Provide receptacle configuration as required to accept plug as indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.
B Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
C Verify that mounting surfaces are ready to receive enclosed safety switches.
D Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A Install products in accordance with manufacturer's instructions.
B Perform work in accordance with NECA 1 (general workmanship).
C Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D Provide required support and attachment in accordance with Section 260529.
E Install enclosed switches plumb.
F Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
G Provide grounding and bonding in accordance with Section 260526.
H Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
I Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
J Identify enclosed switches in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A See Division 1 for additional quality requirements.
B Inspect and test in accordance with NETA ATS, except Section 4.
C Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
D Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
B Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816.16

SECTION 265100

INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Interior luminaires.
- B Emergency lighting units.
- C Exit signs.
- D Ballasts and drivers.
- E Fluorescent emergency power supply units.
- F Lamps.
- G LED replacement lamps.
- H LED retrofit luminaire conversion kits.
- I Accessories.

1.02 RELATED REQUIREMENTS
- A Section 260529 - Hangers and Supports for Electrical Systems.
- B Section 260533.16 - Boxes for Electrical Systems.
- C Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D Section 260923 - Lighting Control Devices.
  1. Includes automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
  2. Includes lighting contactors.
- E Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.
- F Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS
- A 47 CFR 15 - Radio Frequency Devices; current edition.
- B ANSI C82.4 - American National Standard for Lamp Ballasts - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps; 2017, with Editorial Revision (2022).
- C ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts; 2023.
- D IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- E IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- F IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
- G IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- H IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- I NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- J NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- K NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- L NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2020.
- M NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012 (Reaffirmed 2018).

N NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
O NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
P UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
Q UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
R UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
S UL 1029 - High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
T UL 1598 - Luminaires; Current Edition, Including All Revisions.
U UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
V UL 1993 - Self-Ballasted Lamps and Lamp Adapters; Current Edition, Including All Revisions.
W UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A Coordination:
1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A See Division 01 Submittal Procedures.
B Shop Drawings:
1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution.
C Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
1. LED Luminaires:
a. Include estimated useful life, calculated based on IES LM-80 test data.
2. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
4. Fluorescent Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
5. Air Handling Luminaires: Include air handling performance data.
6. LED Retrofit Luminaire Conversion Kits: Include list of compatible luminaires and/or criteria for compatibility.

D Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.
E Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
F Field quality control reports.
G Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
H Operation and Maintenance Data: Instructions for each product including information on replacement parts.
I Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Division 1 - Product Requirements, for additional provisions.
2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
4. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
J Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE
A Comply with requirements of NFPA 70.
B Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
D Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION
A Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
B Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS
A Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY
A See Division 1 - Closeout Submittals, for additional warranty requirements.
B Provide 3-year manufacturer warranty for LED luminaires, including drivers.
C Provide 2-year manufacturer warranty for linear fluorescent ballasts.
D Provide 5-year pro-rata warranty for batteries for emergency lighting units.
E Provide 10-year pro-rata warranty for batteries for self-powered exit signs.
F Provide 3-year full warranty for fluorescent emergency power supply units.
G Provide 3-year manufacturer warranty for LED replacement lamps.
H Provide 3-year manufacturer warranty for LED retrofit luminaire conversion kits.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A Manufacturers:
1. Acuity Brands, Inc: www.acuitybrands.com.
2. Alloy LED: www.alloyled.com.
3. California Accent Lighting, Inc: www.calilighting.com.
4. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com.
5. Electro-Matic Visual, Inc: www.empvisual.com.
6. Hubbell Lighting, Inc: www.hubbelllighting.com.
7. KURTZON Lighting, Inc; www.kurtzon.com.
8. Lutron Electronics Company, Inc: www.lutron.com.
9. Paraflex: www.paraflex.com.
10. Philips Lighting North America Corporation: www.lightingproducts.philips.com.
11. RAB Lighting, Inc: www.rablighting.com.
12. Substitutions: See Division 1 - Product Requirements.

B Provide products that comply with requirements of NFPA 70.

C Provide products that are listed and labeled as complying with UL 1598, where applicable.

D Provide products listed, classified, and labeled as suitable for the purpose intended.

E Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

G Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

H Recessed Luminaires:
1. Ceiling Compatibility: Comply with NEMA LE 4.
2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
4. Air-Handling Recessed Fluorescent Luminaires: Suitable for air supply/return, heat removal, or combination as indicated.
   a. Luminaires for Air Supply/Return: Provide air control blades where indicated.
   b. Luminaires for Heat Removal: Provide heat removal dampers where indicated.

I Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.

J Fluorescent Luminaires:
1. Provide ballast disconnecting means complying with NFPA 70 where required.
2. Fluorescent Luminaires Controlled by Occupancy Sensors: Provide programmed start ballasts.
3. Fluorescent Luminaires Controlled by Dual-Level Switching: Provide with two ballasts.
   a. Luminaires with Two Lamps: Each ballast controls one lamp.
   b. Luminaires with Three Lamps: One ballast controls two outer lamps and one ballast controls inner lamp.
   c. Luminaires with Four Lamps: One ballast controls two outer lamps and one ballast controls two inner lamps.

K HID Luminaires:
1. HID High Bay Luminaires: Provide safety chain or power hook unless otherwise indicated.

2. HID Luminaires with Quartz Restrike Systems: Factory-installed supplementary quartz lamp automatically switches on when power interruption causes primary HID lamp to drop out or during cold startup.

L LED Luminaires:
1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

M LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
1. LED Tape - General Requirements:
   a. Listed.
   b. Designed for field cutting in accordance with listing.
   c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
2. White LED Tape:
   a. Correlated Color Temperature (CCT): 5000 K unless otherwise indicated.
   b. Color Rendering Index (CRI): Not less than 90.

N Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.

O Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

A Manufacturers:
1. Acuity Brands, Inc: www.acuitybrands.com.
2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com.
3. Hubbell Lighting, Inc: www.hubbelllighting.com.
4. Substitutions: See Division 1 - Product Requirements.

B Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

C Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

D Battery:
1. Sealed maintenance-free nickel cadmium unless otherwise indicated.
2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

E Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

F Provide low-voltage disconnect to prevent battery damage from deep discharge.

G Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

H Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.

I Accessories:
1. Provide compatible accessory mounting brackets where indicated or required to complete installation.

2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
3. Provide compatible accessory wire guards where indicated.
4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 EXIT SIGNS

A Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
1. Number of Faces: Single- or double-face as indicated or as required for installed location.
2. Directional Arrows: As indicated or as required for installed location.

B Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
1. Manufacturers:
a. Acuity Brands, Inc: www.acuitybrands.com.
b. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com.
c. Hubbell Lighting, Inc: www.hubbelllighting.com.
d. Philips Lighting North America Corporation: www.lightingproducts.philips.com.
e. Substitutions: See Division 1 - Product Requirements.
2. Self-Powered Exit Signs:
a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
d. Provide low-voltage disconnect to prevent battery damage from deep discharge.
e. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

C Self-Luminous Exit Signs: Internally illuminated by tritium gas sealed inside phosphor-lined gas tubes, requiring no electrical power or batteries to operate, and with a service life of 20 years unless otherwise indicated.
1. Manufacturers:
a. Acuity Brands, Inc: www.acuitybrands.com.
b. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com.
c. Hubbell Lighting, Inc: www.hubbelllighting.com.
d. Philips Lighting North America Corporation: www.lightingproducts.philips.com.
e. Substitutions: See Division 1 - Product Requirements.

D Photoluminescent Exit Signs: Illuminated with photoluminescent-pigmented material for emergency illumination, activated by ambient light, and requiring no electrical power or batteries to operate.
1. Manufacturers:
a. Ecoglo, Inc; EX Standard Series Photoluminescent Exit Sign: www.ecoglo.us.
b. Safe-T-Nose, LLC; EUL Series Photoluminescent Exit Sign: www.safetnose.com.
c. Substitutions: See Division 1 - Product Requirements.

E Powered Photoluminescent Exit Signs: Illuminated with photoluminescent-pigmented material for emergency illumination, activated by ambient light and auxiliary integral LED illumination, and requiring no batteries to operate.
1. Manufacturers:

a. Ecoglo, Inc; EXH Series Hybrid Exit Sign: www.ecoglo.us.
b. Substitutions: .

F Accessories:
1. Provide compatible accessory high-impact polycarbonate vandal shields where indicated.
2. Provide compatible accessory wire guards where indicated.

2.05 BALLASTS AND DRIVERS

A Manufacturers:
1. Alloy LED: www.alloyled.com.
2. California Accent Lighting, Inc: www.calilighting.com.
3. General Electric Company/GE Lighting: www.gelighting.com.
4. Lutron Electronics Company, Inc: www.lutron.com.
5. OSRAM Sylvania, Inc: www.osram.us/ds.
6. Philips Lighting North America Corporation: www.usa.lighting.philips.com.
7. Substitutions: See Division 1 - Product Requirements.
8. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
9. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B Ballasts/Drivers - General Requirements:
1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

C Fluorescent Ballasts:
1. All Fluorescent Ballasts: Unless otherwise indicated, provide high frequency electronic ballasts complying with ANSI C82.11 and listed and labeled as complying with UL 935.
a. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
b. Total Harmonic Distortion: Not greater than 20 percent.
c. Power Factor: Not less than 0.95.
d. Ballast Factor: Normal ballast factor between 0.85 and 1.15, unless otherwise indicated.
e. Thermal Protection: Listed and labeled as UL Class P, with automatic reset for integral thermal protectors.
f. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
g. Lamp Compatibility: Specifically designed for use with the specified lamp, with no visible flicker.
h. Lamp Operating Frequency: Greater than 20 kHz, except as specified below.
1) Do not operate lamp(s) within the frequencies from 30 kHz through 40 kHz in order to avoid interference with infrared devices.
i. Lamp Current Crest Factor: Not greater than 1.7.
j. Lamp Wiring Method:
1) Instant Start Ballasts: Parallel wired.
2) Rapid Start Ballasts: Series wired.
3) Programmed Start Ballasts: Provide parallel or series/parallel wired where available; otherwise series wired is acceptable.
k. Provide automatic restart capability to restart replaced lamp(s) without requiring resetting of power.

l. Provide end of lamp life automatic shut down circuitry for T5 and smaller diameter lamp ballasts.
m. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
n. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class A, non-consumer application.
o. Provide high efficiency T8 lamp ballasts certified as NEMA premium where indicated.
p. Provide lamp striation reduction circuitry where indicated.
q. Ballast Marking: Include wiring diagrams with lamp connections.

2. Non-Dimming Fluorescent Ballasts:
   a. Lamp Starting Method:
      1) T8 Lamp Ballasts: Instant start unless otherwise indicated.
      2) T5 Lamp Ballasts: Programmed start unless otherwise indicated.
      3) Compact Fluorescent Lamp Ballasts: Programmed start unless otherwise indicated.
   b. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of 0 degrees F, and energy saving lamp(s) at a minimum of 60 degrees F unless otherwise indicated.
3. Dimming Fluorescent Ballasts:
   a. Dimming Range: Continuous dimming from 100 percent to 10 percent relative light output unless dimming capability to lower level is indicated, without flicker and with even tracking across multiple lamps.
   b. Control Compatibility: Fully compatible with the dimming controls to be installed.
      1) Wall Dimmers: See Section 262726.
      2) Daylighting Controls: See Section 260923.
   c. Lamp Starting Method: Programmed start unless otherwise indicated.
   d. Lamp Starting Temperature: Capable of starting lamp(s) at a minimum of 50 degrees F.
   e. Dimmed Lamp Starting: Capable of starting lamp(s) at any dimmed preset without transitioning first to full light output.
   f. Product(s):
      1) Lutron Hi-lume: 3-wire control; dimming range of 100 percent to one percent relative light output for T4 compact and T5-HO lamps; total harmonic distortion (THD) less than 10 percent; www.lutron.com.
      2) Lutron Hi-lume 3D: 3-wire and digital control; dimming range of 100 percent to less than one percent relative light output for T8, T5 and T5HO, and five percent relative light output for T5 twin-tube lamps; total harmonic distortion (THD) less than 10 percent typical (15 percent for select models); www.lutron.com.
      3) Lutron EcoSystem: 3-wire and digital control; dimming range of 100 to ten percent relative light output for T8, T5, T5HO, and T5 twin-tube, and five percent relative light output for T4 compact lamps; total harmonic distortion (THD) less than 10 percent typical (15 percent for select models); www.lutron.com.
      4) Lutron EcoSystem H-Series: Digital control; dimming range of 100 to less than one percent relative light output for T8, and one percent relative light output for T5 and T5HO lamps; total harmonic distortion (THD) less than 10 percent typical (15 percent for select models); www.lutron.com.
4. Bi-Level Stepped Dimming Linear Fluorescent Ballasts:

a. Bi-Level Operation: Capable of being switched between full light output on all lamps, 50 percent of full light output on all lamps, and all lamps off.
b. Control Compatibility: Capable of being controlled by standard manual light switches or occupancy sensors unless otherwise indicated.
c. Lamp Starting Method: Programmed start unless otherwise indicated.
d. Lamp Starting Temperature: Capable of starting lamp(s) at a minimum of 50 degrees F.

D Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.
   a. Wall Dimmers: See Section 262726.
3. Product(s):
   a. Lutron Hi-Lume Premier 0.1% Constant Voltage (L3D0-Series): 3-wire and digital control; 0.1 percent dimming with Soft-On and Fade-to-Black low end performance; www.lutron.com.
   b. Lutron Hi-Lume 1% (LTE-Series): Forward phase (neutral wire required); one percent dimming; www.lutron.com.
   c. Lutron Hi-Lume 1% (L3D-Series): 3-wire and digital control; one percent dimming; www.lutron.com.
   d. Lutron 5-Series (LDE5-Series): Digital control; five percent dimming; www.lutron.com.
   e. Lutron Hi-lume 1% Soft-on Fade-to-Black (LDE1-Series): Digital control; one percent dimming with Soft-On and Fade-to-Black low end performance; www.lutron.com.

E High Intensity Discharge (HID) Ballasts: Complying with ANSI C82.4 and listed and labeled as complying with UL 1029.
1. Electronic Metal Halide Ballasts:
   a. All Electronic Metal Halide Ballasts:
      1) Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
      2) Total Harmonic Distortion: Not greater than 15 percent.
      3) Power Factor: Not less than 0.90.
      4) Provide thermal protection with automatic reset.
      5) Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
      6) Lamp Operating Frequency: Less than 200 Hz or as required to avoid acoustic resonance in lamp arc tube.
      7) Lamp Current Crest Factor: Not greater than 1.5.
      8) Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of -22 degrees F.
      9) Provide end of lamp life automatic shut down circuitry.
      10) Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
      11) Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class A, non-consumer application.
   b. Dimming Electronic Metal Halide Ballasts:
      1) Dimming Range: Continuous dimming from 100 percent to 50 percent relative light output, without flicker.

2) Control Compatibility: Fully compatible with the dimming controls to be installed.
(a) Wall Dimmers: See Section 262726.
3) Lamp Starting: Integral delay to allow lamp to warm up for 15 minutes prior to dimming.

c. Bi-Level Stepped Dimming Electronic Metal Halide Ballasts:
1) Bi-Level Operation: Capable of being switched between full light output, 50 percent of full light output, and off.
2) Control Compatibility: Capable of being controlled by standard manual light switches or occupancy sensors unless otherwise indicated.
3) Lamp Starting: Integral delay to allow lamp to warm up for 15 minutes prior to dimming.

2. Electromagnetic Metal Halide Ballasts:
a. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 5 percent.
b. Power Factor: Not less than 0.90 unless otherwise indicated.
c. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of minus 22 degrees F.

2.06 FLUORESCENT EMERGENCY POWER SUPPLY UNITS

A Manufacturers:
1. Iota Engineering, LLC: www.iotaengineering.com.
2. Lithonia Lighting: www.lithonia.com.
3. Philips Emergency Lighting/Bodine: www.bodine.com.
4. Substitutions: See Division 1 - Product Requirements.
5. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B Description: Self-contained fluorescent emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

C Compatibility:
1. Ballasts: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.
2. Lamps: Compatible with low-mercury lamps.

D Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the fluorescent emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

E Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated.

F Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.

G Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status and field selectable audible alert.

H Operating Temperature: From 32 degrees F to 122 degrees F unless otherwise indicated or required for the installed location.

I Accessories:
1. Provide compatible accessory remote combination test switch/indicator light where indicated.

2.07 LAMPS

A Manufacturers:
1. General Electric Company/GE Lighting: www.gelighting.com.
2. Osram Sylvania: www.sylvania.com.
3. Philips Lighting North America Corporation: www.usa.lighting.philips.com.
4. Substitutions: See Division 1 - Product Requirements.
5. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B Lamps - General Requirements:
1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect/Engineer to be inconsistent in perceived color temperature.

C Lamps - Sustainable Design Requirements:
1. Maximum Mercury Content:
   a. T8 Linear Fluorescent, 96 Inch: 10 mg.
   b. T8 Linear Fluorescent, 48 Inch: 3.5 mg.
   c. T8 Linear Fluorescent, 36 Inch and 24 Inch: 3.5 mg.
   d. T8 Linear Fluorescent, U-Bent: 6 mg.
   e. T5 Linear Fluorescent: 2.5 mg.
   f. T5 Circular Fluorescent: 9 mg.
   g. Compact Fluorescent, Nonintegral Ballast: 3.5 mg.
   h. Compact Fluorescent, Integral Ballast: 3.5 mg (ENERGY STAR qualified).
   i. High Pressure Sodium, Up to 400 W: 10 mg.
   j. High Pressure Sodium, Greater Than 400 W: 32 mg.
2. Minimum Rated Lamp Life:
   a. T8 Linear Fluorescent, 96 Inch: 24,000 hours for standard output lamps on instant start ballasts; 18,000 hours for high output lamps on instant start or programmed start ballasts; based on three hours per start.
   b. T8 Linear Fluorescent, 48 Inch: 30,000 hours for standard and high output lamps on instant start ballasts; 36,000 hours on programmed start ballasts; based on three hours per start.
   c. T8 Linear Fluorescent, 36 Inch and 24 Inch: 24,000 hours on instant start or programmed start ballasts; based on three hours per start.
   d. T8 Linear Fluorescent, U-Bent: 18,000 hours on instant start ballasts; 24,000 hours on programmed start ballasts; based on three hours per start.
   e. T5 Linear Fluorescent: 25,000 hours for standard and high output lamps on programmed start ballasts.
   f. T5 Circular Fluorescent: 25,000 hours for standard and high output lamps on programmed start ballasts.
   g. Compact Fluorescent, Nonintegral Ballast: 12,000 hours.

h. Compact Fluorescent, Integral Ballast: 10,000 hours for bare bulbs; 8,000 hours for covered models such as globes, reflectors, and A-19 lamps.
i. High Pressure Sodium: Use only non-cycling type lamps.

D Compact Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
2. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
3. Color Rendering Index (CRI): Not less than 80.

E Linear Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
2. T8 Linear Fluorescent Lamps:
a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
b. Color Rendering Index (CRI): Not less than 80.
3. T5 Linear Fluorescent Lamps:
a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
b. Color Rendering Index (CRI): Not less than 80.

F High Intensity Discharge (HID) Lamps: Wattage as indicated, with bulb type, burning position, and base type as required for luminaire.
1. Metal Halide Lamps:
a. Non-Reflector Type Metal Halide Lamps: Phosphor coated lamp finish unless otherwise indicated.
b. Provide ANSI type O-rated protected metal halide lamps where required for open luminaires provided with compatible exclusionary sockets.
c. Ceramic Metal Halide Lamps:
1) Correlated Color Temperature (CCT): 3,000 K unless otherwise indicated.
2) Color Rendering Index (CRI): Not less than 80.

2.08 LED REPLACEMENT LAMPS

A Manufacturers:
1. RAB Lighting, Inc: www.rablighting.com.
2. Substitutions: See Division 1 - Product Requirements..

B Description: Light-emitting diode (LED) self-ballasted lamps listed as complying with UL 1993; intended for replacement of existing lamps of other light source types, including but not limited to, incandescent, fluorescent, and high intensity discharge (HID); suitable for installation in luminaire to be retrofitted.

C LED Estimated Useful Life:
1. Calculated based on IES LM-80 test data.
2. Fluorescent Lamp Replacements: Minimum of 50,000 hours at 70 percent lumen maintenance.
3. High Intensity Discharge (HID) Lamp Replacements: Minimum of 50,000 hours at 70 percent lumen maintenance.
4. Incandescent Lamp Replacements: Minimum of 15,000 hours at 70 percent lumen maintenance.

2.09 LED RETROFIT LUMINAIRE CONVERSION KITS

A Manufacturers:
1. OSRAM Sylvania, Inc: www.osram.us/ds.
2. RAB Lighting, Inc: www.rablighting.com.

3. Substitutions: See Division 1 - Product Requirements.

B Description: Light-emitting diode (LED) retrofit luminaire conversion kits, including but not limited to LED lamps and arrays, control modules, drivers, power supplies, wiring, lampholders, brackets, wire connectors, reflectors, and diffusers, intended for replacement of existing light sources in existing luminaires; listed as complying with UL 1598C; suitable for installation in luminaire to be converted.

2.10 ACCESSORIES

A Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C Provide accessory plaster frames for luminaires recessed in plaster ceilings.

D Tube Guards for Linear Fluorescent Lamps: Provide clear virgin polycarbonate sleeves with endcaps where indicated.

E Fire-Rated Luminaire Enclosures:

1. Manufacturers:
   a. Fire Rated Product Specialties Corp: www.frpsonline.com.
   b. Specialty Products & Insulation (SPI); SafeLite: www.spi-co.com.
   c. Substitutions: See Division 1 - Product Requirements.
2. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 EXAMINATION

A Verify that field measurements are as indicated.

B Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C Verify that suitable support frames are installed where required.

D Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A Provide extension rings to bring outlet boxes flush with finished surface.

B Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B Perform work in accordance with NECA 1 (general workmanship).

C Install products in accordance with manufacturer's instructions.

D Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

E Provide required support and attachment in accordance with Section 260529.

F Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

G Suspended Ceiling Mounted Luminaires:

1. Do not use ceiling tiles to bear weight of luminaires.
2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.

4. Secure pendant-mounted luminaires to building structure.
5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

H Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

I Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
4. Install canopies tight to mounting surface.
5. Unless otherwise indicated, support pendants from swivel hangers.

J Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

K Install accessories furnished with each luminaire.

L Bond products and metal accessories to branch circuit equipment grounding conductor.

M Fluorescent Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding lamps in each luminaire.

N Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units.

O Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units.

P Fluorescent Emergency Power Supply Units:
1. For field-installed units, install inside luminaire unless otherwise indicated. Where installation inside luminaire is not possible, install on top of luminaire.
2. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.
3. Install lock-on device on branch circuit breaker serving units.

Q Remote Ballasts: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

R Identify luminaires connected to emergency power system in accordance with Section 260553.

S Install lamps in each luminaire.

T Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.04 FIELD QUALITY CONTROL

A See Section 014000 - Quality Requirements, for additional requirements.

B Inspect each product for damage and defects.

C Operate each luminaire after installation and connection to verify proper operation.

D Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Engineer.

3.05 ADJUSTING

A Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.

B Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect/Engineer or authority having jurisdiction.

C Air-Handling Luminaires with Air Control Blades or Heat Removal Dampers: Adjust as indicated or as required for proper airflow as directed by Architect/Engineer.

D Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect/Engineer or authority having jurisdiction.

3.06 CLEANING

A Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A See Division 1 - Closeout Submittals, for closeout submittals.

B See Division 1 - Demonstration and Tra, for additional requirements.

C Demonstration: Demonstrate proper operation of luminaires to Architect/Engineer, and correct deficiencies or make adjustments as directed.

D Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A Protect installed luminaires from subsequent construction operations.

END OF SECTION 265100

SECTION 270533.13

CONDUIT FOR COMMUNICATIONS SYSTEMS

PART 2 PRODUCTS

1.01 CONDUIT - GENERAL REQUIREMENTS

A Comply with NFPA 70 and TIA-569.

B Provide conduit, fittings, supports, and accessories required for complete communications pathway.

C Provide products listed, classified, and labeled as suitable for purpose intended.

D Where conduit size is not indicated, size to comply with NFPA 70, TIA-569, and BICSI TDMM, but not less than applicable minimum size requirements specified. Where specified standards differ, comply with most stringent.

END OF SECTION 270533.13

SECTION 284600

FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES
- A Fire alarm system design and installation, including all components, wiring, and conduit.
- B Transmitters for communication with supervising station.
- C Maintenance of fire alarm system under contract for specified warranty period.

1.02 REFERENCE STANDARDS
- A 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

1.03 SUBMITTALS
- A See Division 01 Submittal Procedures.
- B Evidence of designer qualifications.
- C Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
  1. Copy (if any) of list of data required by authority having jurisdiction.
  2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
  3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
  4. System zone boundaries and interfaces to fire safety systems.
  5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
  6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
  7. List of all devices on each signaling line circuit, with spare capacity indicated.
  8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
  9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
  10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
  11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
  12. Certification by Contractor that the system design complies with Contract Documents.
- D Evidence of installer qualifications.
- E Evidence of maintenance contractor qualifications, if different from installer.
- F Inspection and Test Reports:

1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test Form," filled out.

G Operating and Maintenance Data: Revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

H Project Record Documents: Have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

I Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

1.04 QUALITY ASSURANCE

A Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer , with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.

C Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

1.05 WARRANTY

A Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

B Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 FIRE ALARM SYSTEM

A Fire Alarm System: Provide a new automatic fire detection and alarm system:
1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
2. Protected Premises: Entire building shown on drawings.
3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
   a. ADA Standards.
   b. Applicable local codes.
   c. Contract Documents (drawings and specifications).
   d. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
7. Program notification zones and voice messages as directed by Owner.
8. Fire Command Center: Location indicated on drawings.
9. Fire Alarm Control Unit: New, located at fire command center.

B Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By on-premises supervising station.
2. On-Premises Supervising Station: Existing proprietary station operated by Owner.
3. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.

C Circuits:
1. Initiating Device Circuits (IDC): Class B, Style A.
2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
3. Notification Appliance Circuits (NAC): Class B, Style W.

D Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
4. Each Computer System: Provide uninterruptible power supply (UPS).

2.02 FIRE SAFETY SYSTEMS INTERFACES

A Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
1. Sprinkler water control valves.

B Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
1. Sprinkler water flow.

2.03 COMPONENTS

A General:

1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C Master Control Unit:

D Initiating Devices:

1. Addressable Systems:
   a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
   b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
2. Manual Pull Stations:
3. Smoke Detectors:
4. Duct Smoke Detectors:
5. Heat Detectors:

E Notification Appliances:

F Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.

G Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

H Locks and Keys: Deliver keys to Owner.

I Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.

1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
2. Provide one for each control unit where operations are to be performed.
3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

A Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.

B Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C Obtain Owner's approval of locations of devices, before installation.

D Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

A Notify Owner 7 days prior to beginning completion inspections and tests.

B Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E Provide all tools, software, and supplies required to accomplish inspection and testing.

F Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.03 CLOSEOUT

A Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
1. Be prepared to conduct any of the required tests.
2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
3. Have authorized technical representative of control unit manufacturer present during demonstration.
4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
5. Repeat demonstration until successful.

B Occupancy of the project will not occur prior to Substantial Completion.

C Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
1. Approved operating and maintenance data has been delivered.
2. All aspects of operation have been demonstrated to Owner.
3. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.

3.04 MAINTENANCE

A See Section 017700 - Closeout Procedures, for additional requirements relating to maintenance service.

B Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
3. Record keeping required by NFPA 72 and authorities having jurisdiction.

C Provide trouble call-back service upon notification by Owner:
1. Provide on-site response within 2 hours of notification.
2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

E Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

F Comply with Owner's requirements for access to facility and security.

END OF SECTION 284600

CITY OF TULSA