Signal Works Architecture

PROJECT MANUAL

Providence Public School Department
Juanita Sanchez Educational Complex
Dental Lab

Bid Documents
October 14, 2026



Signal Works Project
#2601

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END OF SECTION

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	CIVIL	
	ARCHITECURAL	
A0.1	ABBREVIATIONS, SYMBOLS, & MATERIALS	10/14/2026
A0.2	GENERAL NOTES	10/14/2026
AD1.0	DEMO FLOOR PLAN	10/14/2026
AD1.1	DEMO RC PLAN	10/14/2026
A1.1	NEW WORK FLOOR PLAN	10/14/2026
A1.2	NEW WORK RC PLAN	10/14/2026
A6.0	DOOR & WINDOW SCHEDULE; WALL TYPES AND DETAILS; FINISH SCHEDULE & SPECIFICATIONS	10/14/2026
	MECHANICAL	
M1.1	MECHANICAL PROPOSED FLOOR PLAN - DUCTWORK	10/14/2026
	PLUMBING	
P0.1	PLUMBING LEGEND, NOTES, & SCHEDULES	10/14/2026
PD1.0	PLUMBING DEMO FLOOR PLAN - SANITARY, WASTE, & VENT	10/14/2026
PD1.1	PLUMBING DEMO FLOOR PLAN - DOMESTIC WATER	10/14/2026
P1.0	PLUMBING PROPOSED FLOOR PLAN - SANITARY, WASTE & VENT	10/14/2026
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P2.0	PLUMBING DETAILS	10/14/2026
	ELECTRICAL	
E0.1	ELECTRICAL LEGEND	10/14/2026
ED1.0	ELECTRICAL DEMO FLOOR PLAN - LIGHTING	10/14/2026
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FA0.1	ELECTRICAL PROPOSED FLOOR PLAN - FIRE ALARM	10/14/2026

FIRE PROTECTION

FP0.1	FIRE PROTECTION LEGEND, NOTES & DETAILS	10/14/2026
FPD1.0	FIRE PROTECTION DEMO FLOOR PLAN	10/14/2026
FP1.0	FIRE PROTECTION PROPOSED FLOOR PLAN	10/14/2026

END OF SECTION

SECTION 00 6700
PREVAILING WAGE RATES

Prevailing Wage is the cost per hour, for labor wages set by law, involving construction work for various and related trades. It involves a bidding process for contractors that will use federal, state or municipal monies (tax payer dollars) for work on projects that will be used for the public, by the public.

The successful contractor and sub-contractor shall comply with the provisions of Rhode Island General Laws (RIGL) Chapter 37 pertaining to the "Prevailing Wage Laws" for all municipal funded projects in excess of one thousand ($1,000) dollars. The RI Department of Labor has accepted the prevailing wage rates as determined by the Federal Wage and Hour Division under the Davis-Bacon Act. A copy of the most current wage decision pertaining to this bid is available from the Director of Labor at 457-1860 or on the web site: www.dlt.ri.gov/pw.

As required under RIGL 37-13-13, the successful contractor must certify and submit weekly payroll forms to the Finance Director's Office.

END OF DOCUMENT

DOCUMENT 00 7200
GENERAL CONDITIONS

1. General Conditions: AIA A201, General Conditions of the Contract for Construction.

2. General Conditions: AIA A271, General Conditions of the Contract for Furniture, Furnishings and Equipment.

3. General Conditions Forms: General Conditions are available from the American Institute of Architects, Washington, D.C., 202-626-7300. General Conditions will be prepared and approved for use on the project by the Owner in consultation with an attorney.

END OF DOCUMENT

DOCUMENT 00 73 00
SUPPLEMENTARY CONDITIONS

1. Supplementary Conditions: Supplementary Conditions will be prepared and approved for use on the project by the Owner in consultation with an attorney.

END OF DOCUMENT

SECTION 00 7400

MINORITY BUSINESS ENTERPRISE REQUIREMENTS AND WOMEN BUSINESS ENTERPRISE REQUIREMENT

The bidder will endeavor to obtain a minimum of ten (15%) of the awarded amount to minority business subcontractors and/or suppliers certified by the **State of Rhode Island**.

PART 1 This offer of minority participation will be considered a factor in the contract award

PART 2 The successful bidder shall substantiate this participation within ten (10) days after receipt of Notice of Award. The bidder will endeavor to obtain a minimum of fifteen (15%) of the awarded amount to women business subcontractors and/or suppliers certified by the **State of Rhode Island**.

Under Rhode Island General Laws §37-14.1, Minority business enterprises shall be included in all procurements and construction projects under this chapter and shall be awarded a minimum of fifteen percent (15%) of the dollar value of the entire procurement or project. Of that fifteen percent (15%), minority business enterprises owned and controlled by a minority owner, shall be awarded a minimum of seven and one-half percent (7.5%), and minority business enterprises owned and controlled by a woman shall be awarded a minimum of seven and one-half percent (7.5%).

The City of Providence actively seeks Minority and Women business enterprises to participate in bids to meet the City's procurement needs. Pursuant to the City of Providence Code of Ordinances, Chapter 21, Article II, Sec. 21-52 (Minority and Women's Business Enterprise) and Rhode Island General Laws (as amended), Chapter 31-14, et seq. (Minority Business Enterprise), Minority Business Enterprise (MBE) and Women's Business Enterprise (WBE) participation goals apply to contracts.

- The goal for Minority Business Enterprise (MBE) participation is **10%** of the total bid value.
- The goal for Women's Business Enterprise (WBE) participation is **10%** of the total bid value.
- The goal for combined MBE/WBE participation is **20%** of the total bid value

PART 3

- This offer of minority participation will be considered a factor in the contract award and RIDE Reimbursement

- The successful bidder shall substantiate this participation within ten (10) days after receipt of Notice of Award.

END OF DOCUMENT

SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Project Identification: **JSEC Dental Lab**

B. Project Summary: An interior renovations project to introduce a dental “lab” space into the school’s curriculum while utilizing an adjacent computer lab space as the lab’s supplemental educational space. All FFE is to be procured by the awarded general contractor in coordination with the lab equipment vendor. It is assumed that all FFE will be installed by the lab equipment vendor.

C. Particular Project Requirements:
1. Requirements for sequencing, scheduling and completion date: Winter 2027
2. Separate contracts to be awarded for (as applicable): IT, Security/Low-Voltage, and Signage
3. Prior hazardous waste or asbestos work: Not Applicable
4. Contractor's use of new and existing facilities: To be coordinated with OPM / PPSD.
5. Contractor to provide HEPA filtration at construction spaces, post construction flush-out of air systems and low emitting fixtures/ furniture to maintain clean indoor air quality in pursuit of CHPS credits.

D. Permits and Fees: Apply for, obtain, and pay for permits, fees, and utility company back-charges required to perform the work. Submit copies to Architect.

E. Codes: Comply with applicable codes and regulations of authorities having jurisdiction. Submit copies of inspection reports, notices and similar communications to Architect.

F. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.

G. Existing Conditions: Notify Architect of existing conditions differing from those indicated on the drawings. Do not remove or alter structural components without prior written approval.

H. Coordination:
1. Coordinate the work of all trades.
2. Prepare coordination drawings for areas above ceilings where close tolerances are required between building elements and mechanical and electrical work.
3. Verify location of utilities and existing conditions.

I. Installation Requirements, General:
1. Inspect substrates and report unsatisfactory conditions in writing.
2. Do not proceed until unsatisfactory conditions have been corrected.
3. Take field measurements prior to fabrication where practical. Form to required shapes and sizes with true edges, lines and angles. Provide inserts and templates as needed for work of other trades.
4. Install materials in exact accordance with manufacturer's instructions and approved submittals.
5. Install materials in proper relation with adjacent construction and with proper appearance.
6. Restore units damaged during installation. Replace units which cannot be restored at no additional expense to the Owner.

7. Refer to additional installation requirements and tolerances specified under individual specification sections.

J. Limit of Use: Limit use of work as indicated. Keep driveways and entrances clear.

K. Existing Construction: Maintain existing building in a weathertight condition. Repair damage caused by construction operations. Protect building and its occupants.

L. Definitions:
1. Provide: Furnish and install, complete with all necessary accessories, ready for intended use. Pay for all related costs.
2. Approved: Acceptance of item submitted for approval. Not a limitation or release for compliance with the Contract Documents or regulatory requirements. Refer to limitations of 'Approved' in General and Supplementary Conditions.
3. Match Existing: Match existing as acceptable to the Owner.

M. Intent: Drawings and specifications are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Anything not expressly set forth but which is reasonable implied or necessary for proper performance of the project shall be included.

N. Writing Style: Specifications are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, 'Provide tile' means 'Contractor shall provide tile.'

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION - Not Applicable to This Section

END OF SECTION

SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Project Identification: **JSEC Dental Lab**

B. Project Summary: An interior renovations project to introduce a dental “lab” space into the school’s curriculum while utilizing an adjacent computer lab space as the lab’s supplemental educational space. All FFE is to be procured by the awarded general contractor in coordination with the lab equipment vendor. It is assumed that all FFE will be installed by the lab equipment vendor.

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1. Requirements for sequencing, scheduling and completion date: Winter 2027
2. Separate contracts to be awarded for (as applicable): IT, Security/Low-Voltage, and Signage
3. Prior hazardous waste or asbestos work: Not Applicable
4. Contractor's use of new and existing facilities: To be coordinated with OPM / PPSD.
5. Contractor to provide HEPA filtration at construction spaces, post construction flush-out of air systems and low emitting fixtures/ furniture to maintain clean indoor air quality in pursuit of CHPS credits.

D. Permits and Fees: Apply for, obtain, and pay for permits, fees, and utility company back-charges required to perform the work. Submit copies to Architect.

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F. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.

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1. Coordinate the work of all trades.
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I. Installation Requirements, General:
1. Inspect substrates and report unsatisfactory conditions in writing.
2. Do not proceed until unsatisfactory conditions have been corrected.
3. Take field measurements prior to fabrication where practical. Form to required shapes and sizes with true edges, lines and angles. Provide inserts and templates as needed for work of other trades.
4. Install materials in exact accordance with manufacturer's instructions and approved submittals.
5. Install materials in proper relation with adjacent construction and with proper appearance.
6. Restore units damaged during installation. Replace units which cannot be restored at no additional expense to the Owner.

7. Refer to additional installation requirements and tolerances specified under individual specification sections.

J. Limit of Use: Limit use of work as indicated. Keep driveways and entrances clear.

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L. Definitions:
1. Provide: Furnish and install, complete with all necessary accessories, ready for intended use. Pay for all related costs.
2. Approved: Acceptance of item submitted for approval. Not a limitation or release for compliance with the Contract Documents or regulatory requirements. Refer to limitations of 'Approved' in General and Supplementary Conditions.
3. Match Existing: Match existing as acceptable to the Owner.

M. Intent: Drawings and specifications are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Anything not expressly set forth but which is reasonable implied or necessary for proper performance of the project shall be included.

N. Writing Style: Specifications are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, 'Provide tile' means 'Contractor shall provide tile.'

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION - Not Applicable to This Section

END OF SECTION

SECTION 01 1100

VOLATILE ORGANICE COMPOUND (VOC) LIMITS FOR ADHESIVES, SEALANTS, AND PAINTS

1.0 GENERAL

1.1 Summary

A. The specification section includes requirements for volatile organic compound (VOC) content in adhesives, sealants, paints and coatings used for this project.

1.2 General Requirements

A. The Contractor is required to implement practices and procedures to meet the project's environmental goals, which include achieving NE-CHPS criteria. Specific project goals which may impact this area of work are listed in the applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these goals, as defined in the sections below and in the related sections of the Contract Documents, are implemented to the fullest extent feasible.

1.3 References

A. Rule 1168 – "Adhesive and Sealant Applications," amended January 7, 2005: South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov

B. Rule 1113 – "Architectural Coatings," amended July 9, 2004: South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov

C. Green Seal Standard GS-11 – "Paints," of Green Seal, Inc., Washington, DC, www.greenseal.org

D. Green Seal Standard GC-03 – "Anti-Corrosive Paints," of Green Seal, Inc., Washington, DC, www.greenseal.org

1.4 VOC Requirements for Interior Adhesives

A. The volatile organic compound (VOC) content of adhesives, adhesive bonding primers or adhesive primers used in this project shall not exceed the limits defined in Rule 1168 – "Adhesive and Sealant Applications."

B. The VOC limits defined by SCAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.

1.5 General

A. Unless otherwise specified below, the VOC content of all adhesive, adhesive bonding primers and adhesive primers are to be in excess of 250 grams per liter.

B. For specified building construction related applications, allowable VOC content is as follows:

1. Architectural Applications

a.	Indoor carpet adhesive	50
b.	Carpet pad adhesive	50
c.	Wood floor adhesive	100
d.	Rubber floor adhesive	60
e.	Subfloor adhesive	50
f.	Ceramic tile adhesive	65
g.	VCT and asphalt tile adhesive	50
h.	Drywall and panel adhesive	50
i.	Cove base adhesive	50
j.	Multipurpose construction adhesive	70
k.	Structural glazing adhesive	100

1.6 VOC Requirements for Interior Sealants

A. The VOC content of sealants, or sealant primers used in this project shall not exceed the limits defined in Rule 1168 – “Adhesive and Sealant Applications.”

B. The VOC limits defined by SCAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.

1. Sealants

a.	Architectural	250
b.	Other	420

2. Sealant Primer

a.	Architectural – Nonporous	250
b.	Architectural – Porous	775
c.	Other	750

1.7 VOC Requirements for Interior Paints

A. Paints and Primers: Paints and primers used in non-specialized interior applications (i.e., for wallboard, plaster, wood, metal doors and frames, etc.) shall meet the VOC limitations of the Green Seal Paint Standard GS-11, of Green Seal, Inc., Washington, DC. Product-specific environmental requirements are as follows:

1. Volatile Organic Compounds

a. The VOC concentrations (in grams per liter) of the product shall not exceed those listed below as determined by the U.S. Environmental Protection Agency (EPA) Reference Test Method 24.

1) Interior Paints and Primers (non-flat) – 150 g/l
2) Interior Paints and Primers (flat) – 50 g/l

B. Anti-Corrosive and Anti-Rust Paints

1. Anti-corrosive and anti-rust paints applied to interior ferrous metal substances shall meet the VOC limitations of the Green Seal Paint Standard GS-03 requirements as follows:

a. Volatile Organic Compounds

1) The VOC concentrations (in grams per liter) of the product shall not exceed those listed by the EPA Reference Test Method 24: Anti-Corrosive and Anti-Rust Paints – 250 g/l.

1.8 VOC Requirements for Interior Coatings

A. Clear wood finishes, floor coatings, stains, sealers and shellacs applied to the interior shall meet the VOC limitations defined in Rule 113. The VOC limits defined by SCAQMD, based on 07/09/04 amendments, are as follows. VOC limits are defined in grams per liter, less water and less exempt compounds.

1.	Clear wood finishes - Varnish	350
2.	Clear wood finishes – Sanding Sealers	350
3.	Clear wood finishes – Lacquer	550
4.	Shellac – Clear	730
5.	Shellac – Pigmented	550
6.	Stains	250
7.	Floor Coatings	100
8.	Waterproofing Sealants	250
9.	Sanding Sealers	275
10.	Other Sealers	200

2.0 PRODUCTS

Not Applicable

3.0 EXECUTION

Not Applicable

END OF DOCUMENT

SECTION 01 2000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Price and Payment Procedures:
   1. Alternates
   2. Allowances

1.2 ALTERNATES

A. Total Price: Provide total price for each alternate in Bid Form. Include cost of modifications to other work to accommodate alternate. Include related costs such as overhead and profit.

B. Acceptance of Alternates: Owner will determine which alternates are selected for inclusion in the Contract.

C. Coordination of Alternates: Modify or adjust affected adjacent work as necessary to integrate work of the alternate into Project. Coordinate alternates with related work to ensure that work affected by each selected alternate is properly accomplished.

D. List of Alternates:
   1. Deduct-Alternate #01: Refer to alternate layout as shown on the drawings.

1.3 ALLOWANCES

A. Allowances: Lump sum allowances and unit cost allowances are listed below and as indicated on the Drawings. Amounts shall include all costs including overhead and profit except as specifically noted. Coordinate allowances with requirements for related and adjacent work.

B. Notification of Owner: Notify Owner of date when final decision on allowance items is required to avoid delays in the work.

C. Certification of Quantities: Furnish certification that quantities of products purchased are the actual quantities needed with reasonable allowance for cutting or installation losses, tolerances, mixing, waste, and similar margins.

D. Lump Sum Allowances: Include the following amounts in the base bid for materials, installation, overhead, profit and all costs for the following items.
   1. Not Applicable – Refer to Spec Section 01 2200 – Unit Prices

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION - Not Applicable to This Section

END OF SECTION

SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Administration of Contract: Provide administrative requirements for the proper coordination and completion of work including the following:
   1. Supervisory personnel.
   2. Preconstruction conference.
   3. Project meetings, minimum of two per month; prepare and distribute minutes.

B. Work Schedule: Submit progress schedule, updated monthly.

C. Submittal Schedule: Prepare submittal schedule; coordinate with progress schedule.

D. Schedule of Tests: Submit schedule of required tests including payment and responsibility.

E. Perform Surveys: Lay out the work and verifying locations during construction.

F. Emergency Contacts: Submit and post a list of emergency telephone numbers and address for individuals to be contacted in case of emergency.

G. Record Documents: Submit record drawings and specifications; to be maintained and annotated by Contractor as work progresses.

1.2 SUBMITTALS

A. Types of Submittals: Provide types of submittals listed in individual sections and number of copies required below. All submittals are to be submitted digitally via email
   1. Shop drawings, reviewed and annotated by the Contractor – pdf format.
   2. Product data – pdf format.
   3. Samples - as required to indicate range of color, finish, and texture to be expected.
   4. Inspection and test reports – pdf format.
   5. Warranties – Sample Warranty with Product Data, Executed Warranty with Closeout Documents.
   6. Survey Data – As applicable
   7. Closeout submittals – Physical Thumb drive, 2 copies.

B. Submittal Procedures: Comply with project format for submittals. Comply with submittal procedures established by Architect including Architect's submittal and shop drawing stamp. Provide required resubmittals if original submittals are not approved. Provide distribution of approved copies including modifications after submittals have been approved.
   1. Submittals to be titled per the 32-Divisions of CSI,
      a. Example: 08 4313-001-00 – Aluminum Storefront PD
      b. Example: 08 4313-002-00 – Aluminum Storefront Shop Drawings

C. Samples and Shop Drawings: Samples and shop drawings shall be prepared specifically for this project. Shop drawings shall include dimensions and details, including adjacent construction and related work. Note special coordination required. Note any deviations from requirements of the Contract Documents.

D. Requests for Information (RFIs): RFIs are to be submitted with detailed descriptions of the issue(s) and include potential solutions from the contractor for remedying the issue for the

Architect's evaluation and response. RFIs not containing detailed information may be rejected in part or in whole until the responsible contractor provides the necessary information. The responsible contractor will not dictate the method of response from the Architect, it is at the Architect and/or Design Team's discretion as to the formality of their response. RFIs are to begin at "001"

E. Warranties: Provide warranties as specified; warranties shall not limit length of time for remedy of damages Owner may have by legal statute. The contractor, supplier, or installer responsible for performance of warranty shall sign warranties.

F. Review Periods: Architect and engineers have **10-business days to review submittals**, and **5-business days to review and respond to Requests for Information (RFIs)**. It is the contractor's responsibility to manage the schedule of construction to avoid critical-path issues.

1.3 LEED REQUIREMENTS AND SCORECARD

A. Not Applicable

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION - Not Applicable to This Section

END OF SECTION

SECTION 01 3200
NE-CHPS SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

A. This specification section specifies administrative and procedural requirements for submittals required to achieve the specified NE-CHPS certification.

B. Sustainable Design Intent: Comply with project requirements intended to achieve a Certified Rating, measured and documented according to the Northeast Collaborate for High Performance Schools Criteria (NE-CHPS) Version 3.0.

1.2 GENERAL REQUIREMENTS

A. The Contractor is required to implement practices and procedures to meet the project's environmental goals, which include achieving NE-CHPS criteria. Specific project goals which may impact this area of work are listed in the applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these goals, as defined in the sections below and in the related sections of the Contract Documents, are implemented to the fullest extent feasible.

1.3 SUBMITTAL PROCEDURES

A. NE-CHPS submittal requirements are to include submission of MATERIALS CREDITS DOCUMENTATION SHEET. Information to be supplied for this form includes, but is not limited to, the following:
   1. Cost breakdowns for materials included in the contractor's or subcontractor's work. Cost breakdowns include total cost plus labor, equipment and material costs.
   2. The amount of savaged, refurbished or reused materials and products.
   3. The amount of recycled content in the supplied products, with percentages broken down to indicate post-consumer and pre-consumer percentages.
   4. The location of the raw materials extracted, harvested, or recovered and then used to manufacture the supplied products.
   5. The manufacture location for the supplied products.

B. Submit Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the MATERIALS CREDITS DOCUMENTATION SHEET.

C. Submit Product Data Sheets for materials that meet the NE-CHPS Building Performance criteria.

D. Submit certification required for Construction Waste Management, Construction IAQ Management and Construction Pollution Controls.

E. Submit Material Safety Data Sheets (MSDS) for all applicable products.

F. Submittals shall be provided in approved NE-CHPS format.

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION - Not Applicable to This Section

END OF SECTION

SECTION 01 3300
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Provide types of submittals listed in individual sections and number of copies required below.

1. Shop drawings, reviewed and annotated by the Contractor – pdf format.
2. Product data – pdf format.
3. Samples - as required to indicate range of color, finish, and texture to be expected.
4. Inspection and test reports - 2 copies.
5. Warranties - 2 copies.
6. Survey data - 2 copies.
7. Closeout submittals - 2 copies.

B. Comply with project format for submittals.

C. Comply with submittal procedures established by Architect including Architect's submittal and shop drawing stamp. Provide required resubmittals if original submittals are not approved. Provide distribution of approved copies including modifications after submittals have been approved.

D. Samples and shop drawings shall be prepared specifically for this project. Shop drawings shall include dimensions and details, including adjacent construction and related work. Note special coordination required. Note any deviations from requirements of the Contract Documents.

E. Provide warranties as specified; warranties shall not limit length of time for remedy of damages Owner may have by legal statute. Warranties shall be signed by contractor, supplier, or installer responsible for performance of warranty.

F. Architect and engineers have 10-business days to review submittals, and 5-business days to review and respond to Requests for Information (RFIs).

PART 2 - **PRODUCTS** - Not Applicable to This Section

PART 3 - **EXECUTION** - Not Applicable to This Section

END OF SECTION

SECTION 01 3516

ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Summary: The procedures and administrative requirements of this Section apply to all of the following Sections of the Specification which are involved in alterations to the existing building.

B. Extent Notes: Cut into or partially remove portions of the existing building as necessary to make way for new construction. Include such work as:

1. Cutting, moving or removal of items shown to be cut, moved, or removed.

2. Cutting, moving or removal of items not shown to be cut, moved, or removed, but which must be cut, moved, or removed to allow the new work to proceed. Work or items which are to remain in the finished work shall be patched or reinstalled after their cutting, moving, or removal, and their joints and finishes made to match adjacent or similar work.

3. Removal of existing surface finishes as needed to install new work and finishes.

4. Removal of abandoned items and removal of items serving no useful purpose, such as abandoned piping.

5. Repair or removal of dangerous or unsanitary conditions resulting from alterations work.

C. Patch, match, repair, refinish or reinstall existing items to remain in finished work, to specified condition for each material, with joints and finishes made to match adjacent or similar work.

D. Relocate and reinstall designated existing salvaged materials.

1.02 SCHEDULING AND ACCESS

A. Work Scheduling / Sequence:

1. Any work to be performed during hours other than normal business hours (8:00 A.M. to 5:00 P.M. Monday through Friday unless noted otherwise) must have prior approval of the Project Owner / Manager.

B. Maintenance of Access and Operations:

1. During period of construction, the Owner will continue to perform normal activities in existing building. Maintain proper and safe access to the Owner-occupied areas at all times.

2. Schedule demolition and remodeling operations with Owner in such a manner as to allow Owner operations to continue with minimum interruption.

3. During period of construction, do not obstruct in any manner existing exit ways of Owner-occupied areas. Prior to removal of existing exit ways (stairs, corridors, doors) as part of new Work, provide and maintain new exit ways so as to maintain same number of exit ways. Maintain existing fire doors in an operable condition.

C. Maintenance of Existing Services:

1. Maintain environmental control in existing building, especially temperature,

humidity and dust control.

2. Provide temporary lines and connections as required to maintain existing mechanical and electrical services in building.

3. Notify the Property Owner / Manager a minimum of three (3) days prior to each required interruption of mechanical or electrical services in building. Such interruptions shall be only at such times and for lengths of time as approved by the Property Manager. In no event shall interruption occur without prior approval of the Property Manager.

D. Building Access:

1. Contractor shall access building at time designated by Property Owner / Manager.

2. Access to construction areas within building shall be as designated by the Property Manager.

3. Restrict construction traffic to areas specifically designated by Property Manager.

1.03 ALTERATIONS, CUTTING AND PROTECTION:

A. Do not start any cutting or alterations work until dust protection is in place.

B. Extent:

1. Cutting and removal work shall be performed so as not to cut or remove more than is necessary and so as not to damage adjacent work.

2. Conduct work in such a manner as to minimize noise and to minimize accumulation and spread of dirt and dust.

3. Perform cutting for ductwork and other rectangular openings with carborundum saw with approved dust arrestor.

4. Drill holes for conduit and piping using core drills.

C. Shoring, Bracing and Capping: Provide shores, needling and bracing as needed to keep building structurally secure and free of deflection in all its parts, and as needed for installation of new structural members. In telephone equipment areas, all shoring shall be wood or other approved nonconductive material, and shall not be secured to, braced from, or supported by telephone equipment or cable racks.

D. Responsibility and Assignment to Trades:

1. Contractor shall assign the work of moving, removal, cutting, patching and repair to trades under his supervision so as to cause the least damage to each type of work encountered, and so as to return the building as much as possible to the appearance of new work.

2. Patching of finish materials shall be assigned to mechanics skilled in the work of the finish trade involved.

E. Protection:

1. Protect remaining finishes, equipment, and adjacent work from damage caused by cutting, moving, removal and patching operations. Protect surfaces which will remain a part of the finished work.

2. Protect existing facilities and features, within designated construction limits and along corridor access route to construction area.

3. Cover existing wall and floor finishes in work areas, in adjacent areas and along corridor access route to prevent damage from product delivery and construction operations. Use same UL listed sheeting material as specified for temporary partitions below.

4. Material to be stored on floor must be placed on 1/4 in. tempered hardboard (Masonite) sheeting or other approved substrate. Do not lean material against walls or equipment.

5. During demolition, cutting and construction, provide positive dust control by wetting dust debris and by completely sealing openings to Owner occupied areas with temporary partitions, so as to prevent spread of dust and dirt to adjacent areas.

6. After materials, equipment and machinery are installed, properly protect Work until final acceptance.

7. Any damage resulting from construction operations shall be repaired by the Contractor without cost to the Owner.

8. All access points to the building shall remain secure. Doors remaining open for a period of time for material delivery or removal shall be protected against unauthorized entry.

F. Salvage:

1. Salvage sufficient quantities of cut or removed material to replace damaged work or patch new work where required. Protect and provide dry, secure storage for items to be reused.

2. Salvage items specifically indicated for salvage and reuse, including:

a. Existing doors and frames.

b. Existing access flooring system.

3. Do not incorporate salvaged or used material in new construction, except where small quantities of finish material which are difficult to match or duplicate are approved for patching or extending purposes by Architect or except as specifically indicated.

4. Salvaged items left over after completion of Work shall be disposed of by Contractor, unless scheduled to be turned over to Owner.

G. Temporary Barricades/Partitions: Provide and maintain temporary and dust partitions to seal openings to Owner-occupied areas. Provide partitions as required to maintain dust control. Partition locations may or may not be indicated on the Drawings.

1. Type 1 Partitions: (Maintained in place for 30 days or less) Framing: Commercial softwood species, fire-retardant treated in accordance with AWPA C20, and bearing UL Label FR-S. Provide continuous 2 x 4 top and bottom plates, 2 x 4 studs at 24 in. o.c., and continuous 2 x 4 bridging 4 ft. studs may be used. At Contractor's option, drywall metal studs may be used. Provide 3-5/8 in. wide metal studs at 24 in. o.c., with continuous head and floor channels.

Covering: Central Offices - Griffolyn type 55 FR or Durashield 8000FR reinforced sheeting, listed by Underwriters' Laboratories, Inc., as having a flame spread rating of less than 25 and smoke developed rating of less than 50. Apply double thickness of sheeting, fastened to one side with no-tear fasteners. Tape joints continuously.

Note: In situations where Type 1 Partitioning will be installed within 2 ft. of existing or proposed telecommunications equipment, the sheeting shall be Griffolyn type 55 ASFR or Durashield 8000ASFR, anti-static, fire retardant sheeting.

2. Type II Partitions: (Maintained in place 18 months or less)

Framing: (same as Type I above)

Covering: 1/4 in. thick tempered hardboard or 1/2 in. thick plywood, listed by Underwriters' Laboratories, Inc., as having a flame spread rating of less than 25 and smoke developed rating of less than 50. Apply to one side and fasten to studs with drywall screws at 12 in. o.c., countersunk. Fire-retardant paint or fireproof coating is not required.

3. Type III Partitions: (Maintained in place longer than 18 months)

   Type: One hour fire rated gypsum drywall partition.

   Framing: 3-5/8 in. wide metal drywall studs. Provide continuous head and floor runners. Space studs at 24 in. o.c.

   Covering: One layer of 5/8 in. thick Type "X" gypsum board each side, fastened to studs and runners with drywall screws at 12 in. o.c. Tape and bed panel joints.

4. Doors: Type I and II Partitions: Single acting doors, opening out, with sturdy closer, closing against gasketed stops on frame to reduce passage of dust. Cover one side of each door with same material as used to cover partitions. Provide ample wood push bars and bump plates.

   Type III Partitions: Fire-resistive door and frame assembly bearing UL "C" Labels, complete, including metal frame, door and hardware.

5. Sealing: Seal perimeter of partitions and doors to prevent passage of dust. At Type I and II partitions, tape fastener depressions, joints between panels and joints between panels and floors, ceilings and columns with 2 in. wide pressure sensitive tape.

6. Mats: Provide mats at doors to reduce tracking of dust. Replace or clean daily.

H. Debris:

1. Remove debris promptly from the site each day.

2. Do not let piled material endanger structure.

3. During cutting and coring operations, use metal lined wood box secured tight against surface, to catch falling debris and water.

1.04 PATCHING, EXTENDING AND MATCHING:

A. Skill:

1. Patch and extend existing work using skilled mechanics who are capable of matching the existing quality of workmanship. The quality of patched or extended work shall not

be less than that specified in the Sections of the product and execution Specifications which follow these General Requirements.

B. Patching:

1. In areas where any portion of an existing finished surface is damaged, lifted, stained, or otherwise made or found to be imperfect, patch or replace the imperfect portion of the surface with matching material.

2. Provide adequate support or substrate for patching of finishes.

3. If the imperfect surface was a painted or coated one, repaint or recoat the patched portion in such a way that uniform color and texture over the entire surface results.

4. If the surrounding surface cannot be matched, repaint or recoat the entire surface.

C. Quality:

1. In the Sections of the product and execution of Specifications which follow these General Requirements, no concerted attempt has been made to describe each of the various existing products that must be used to patch, match, extend or replace existing work. Obtain all such products in time to complete the Work on schedule. Such products shall be provided in quality which is in no way inferior to the existing products.

2. The quality of the products that exist in the building, as apparent during pre-quotation site visits, shall serve as the Specification requirement of strength, appearance, and other characteristics.

D. Transitions:

1. Where new work abuts or finishes flush with existing work, make the transition as smooth and workmanlike as possible. Patched work shall match existing adjacent work in texture and appearance so as to make the patch or transition invisible to the eye at a distance of no closer than three (3) feet.

2. Where masonry or other finished surface is cut in such a way that a smooth transition with new work is not possible, terminate the existing surface in a neat fashion along a straight line at a natural line of division and provide trim appropriate to the finished surface.

3. Where two or more spaces are indicated to become one space, rework floors and ceilings so that horizontal planes, without breaks, steps or bulkheads result.

4. In cases of extreme change of level (3 in. or more), obtain instructions from Project Manager as to method of making transition. Either stepping, bulkheading, encasement, ramping, sloping or change of transition line shall be employed, or a combination of these, as directed in each case by the Project Manager.

E. Matching:

1. Restore existing work that is damaged during construction to a condition equal to its condition at the time of the start of the Work.

2. At locations in existing areas where partitions are removed, patch the floors, walls and ceilings with finish materials to match adjacent finishes.

F. Overall Requirement that the Work Be Complete:

1. Where a product or type of construction occurs in the existing building, and it is not specified as a part of the new work, provide such products or types of construction as needed to patch, extend or match the existing work.

2. These Specifications will generally not describe existing products or standards of execution, nor will they enumerate products which are not a part of the new construction. The existing product is its own specification.

3. The presence of any product or type of construction in the old work shall cause its patching, extending, or matching to be performed, as necessary to make the work complete and consistent, to identical standards of quality.

1.05 REPAIR:

A. Replace work damaged in the course of alterations, except at areas approved by the Project Manager for repair.

B. Where full removal of extensive amounts of almost-suitable work would be needed to replace damaged portions, then filling, spackling, straightening, and similar repair techniques, followed by full painting of other finishing, will be permitted.

C. If the repaired work is not brought up to the standard for new work, the Project Manager will direct that it be cut out and replaced with new work.

1.06 FIRESTOPPING:

A. Where existing fire-rated partitions, walls or floors are penetrated by new work, each trade providing such new work shall seal around penetrating conduit, pipe, duct or sleeve in accordance with manufacturer's printed instructions and specifications.

B. Refer to Section 07840 – Firestopping (if applicable)

1.07 CLEANING:

A. Each Successive Trade:

1. As each trade finishes its work on each part of the alterations work and related new work, it shall clean up its work areas and make work surfaces ready for the work of the succeeding trades.

2. Spillage, overspray, collections of dust or debris, and damage to Owner-occupied spaces shall be cleaned or remedied immediately by the responsible trade.

B. Each Area as it is Completed:

1. As soon as work in each area of the alterations is complete, clean up all surfaces, remove equipment, salvage and debris, and return in condition suitable for use by the Owner as quickly as possible.

PART 2 – PRODUCTS – Not Applicable to this Section

PART 3 – EXECUTION – Not Applicable to this Section

END OF SECTION

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Quality Monitoring: Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality. Perform quality control procedures and inspections during installation.

B. Standards: Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

C. Tolerances: Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate. Comply with manufacturers' tolerances.

D. Reference Standards: For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

E. Manufacturer's Field Services: When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to perform the following as applicable, and to initiate instructions when necessary.
   1. Observe site conditions.
   2. Conditions of surfaces and installation.
   3. Quality of workmanship.
   4. Start-up of equipment.
   5. Test, adjust and balance of equipment.

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION - Not Applicable to This Section

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Examine the Contract Documents and become thoroughly acquainted with the detailed material and workmanship requirements.

C. Comply with requirements of the Building Code of the State of Rhode Island for quality, workmanship and requirements for all materials.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality-control and testing services.

B. Quality-control services include inspections, tests, reports and related actions performed by Contractor, independent agencies, governing authorities, engineers hired by the Owner and engineers employed by the Contractor.

C. Inspection and testing services are mandated by the laws and Building Code of the State of Rhode Island and are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with regulatory or Contract Document requirements.

D. Statement of Special Inspections and Contractor’s Statement of Responsibility follow this Section.

1.3 RESPONSIBILITIES

A. Special Inspection: The Owner shall select a Special Inspection Firm and pay for all Special Inspection Services, except as noted herein. The Contractor shall provide, be responsible for, and pay for the services for testing for
1. As Determined in Specification Sections Herein.

B. The Contractor shall provide a Site Safety Program or Plan during all phases of construction.

C. Inspection and Testing Responsibilities other than those mandated by the State of Rhode Island as Special Inspections: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services are included in the Contract Sum.

1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.

2. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.
    a. Where the Owner has engaged a testing agency for testing and inspecting part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Owner, unless agreed to in writing by the Owner.
3. The costs of the following tests and inspections shall be accounted for separately and reported to the Owner.
    a. Tests and inspection of materials and workmanship not conforming to contract requirements.
    b. Tests and inspection necessitated by any other noncompliance with contract requirements.
    c. Acceptance tests for materials because of changes in properties or changed sources.
    d. Costs of inspector's time and expenses wasted because of cancellations or delays of the work.
    e. Tests and services of inspectors required by a public authority.
    f. Energy performance inspections and test required to demonstrate compliance with Enterprise Green Communities certification Mandatory Building Performance Standard criteria.

B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.

1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.
2. No part of the time lost to retesting shall be made the subject of a claim for extension of time or for excess cost or damages by the Contractor

C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:

1. Provide access to the Work.
2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
4. Provide facilities for storage and curing of test samples.
5. Deliver samples to testing laboratories.
6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
7. Provide security and protection of samples and test equipment at the Project Site.

D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Architect and the Contractor in performance of the agency's duties.

1. The Testing Laboratory shall make all necessary arrangements with the General Contractor to ensure the presence of the required inspectors at all contract operations

specified to be included under the Testing and Inspection Agreement. The General Contractor shall notify the Testing Laboratory a reasonable time in advance (not less than 24 hours) of the time when operations requiring inspection or testing are scheduled to start.

2. Provide necessary personnel, equipment and facilities for tests and inspection. Personnel shall be experienced and competent in their particular specialties.
3. The Testing Laboratory shall conduct its work so as not to cause a delay in the progress of construction. Any non-compliance with the Contract Documents shall be immediately reported to the General Contractor and the Architect.
4. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies observed in the Work during the performance of its services.
5. Nothing herein specified permits the Testing Laboratory to allow the General Contractor to deviate from the requirements of the Contract Documents.
6. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
7. The agency shall not perform any duties of the Contractor.

E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.
2. A complete set of Drawings and Specifications for the project work will be made available by the Owner at the project site. The Testing Laboratory personnel shall become thoroughly familiar with all provisions of these documents which apply for the testing and inspection services.

1.4 SUBMITTALS

A. Qualifications: Submit qualifications of testing laboratories proposed for use for approval.

B. Schedule: Submit a schedule of required tests and inspections for review.

C. Reports: Unless the Contractor is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:
   a. Date of issue, Project Title, and Project Number
   b. Name, address, and telephone number of testing agency.
   d. Dates and locations of samples and tests or inspections.
   e. Names of individuals making the inspection or test.
   f. Designation of the Work and test method.
   g. Identification of product and Specification Section.
   h. Complete inspection or test data.
   i. Test results and an interpretation of test results.
   j. Ambient conditions at the time of sample taking and testing.

k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
l. Name and signature of laboratory inspector.
m. Recommendations on retesting.

1.5 QUALITY ASSURANCE

A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.

1.6 REFERENCE

A. American Society for Testing and Materials: ASTM E. 329-77: Inspection and Testing Agencies for Concrete Steel and Bituminous Materials as used in Construction.

B. Wherever the source or characteristics of materials change, or the quality of materials provided indicates lack of compliance with contract requirements, full or partial acceptance tests shall be performed as directed by the Structural Engineer of Record through the Architect.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
1. Date of test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to applicable Engineer and Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Engineer’s, Architect’s and Construction Manager’s (if applicable) reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Documents requirements for Division 01 Section “Cutting and Patching”.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are the Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Temporary Services: Provide temporary services and utilities, including payment of utility costs including the following, as applicable to the project.
   1. Water (potable and non-potable).
   2. Lighting and power.
   3. Metering.
   4. Telephone.
   5. Toilet facilities.
   6. Materials storage.

B. Construction Facilities: Provide construction facilities, including payment of utility costs including the following, as applicable to the project.
   1. Construction equipment.
   2. Dewatering and pumping.
   3. Enclosures.
   4. Heating.
   5. Lighting.
   6. Elevator.
   7. Access.
   8. Roads.

C. Security and Protection: Provide security and protection requirements including the following, as applicable to the project.
   1. Fire extinguishers.
   2. Site enclosure fence, barricades, warning signs, and lights.
   3. Building enclosure and lock-up.
   4. Temporary jobsite protection.
   5. Environmental protection.
   6. Pest control during and at the end of construction.
   7. Snow and ice removal if applicable.

D. Personnel Support: Provide personnel support facilities including the following, as applicable to the project.
   1. Architect's field office with telephone, fax and data connection.
   2. Contractor's field office.
   3. Sanitary facilities.
   4. Drinking water.
   5. Project identification sign.
   6. Cleaning.

PART 2 PRODUCTS - Not Applicable to this Section

PART 3 EXECUTION – Not Applicable to this Section

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Manufacturers: Provide products from one manufacturer for each type or kind as applicable. Provide secondary materials as acceptable to manufacturers of primary materials.

B. Product Selection: Provide products selected or “equal” approved by Architect. Products submitted for substitution shall be submitted with complete documentation and include construction costs of substitution including related work. It is the responsibility of the contractor to “prove” the product substitution can be considered “an equal”

C. Substitutions: Request for substitution must be in writing. Conditions for substitution include:
1. An 'or equal' phrase in the specifications.
2. Specified material cannot be coordinated with other work.
3. Specified material is acceptable to authorities having jurisdiction.
4. Substantial advantage is offered to the Owner in terms of cost, time, or other valuable consideration.

D. Substitution Requests: Substitutions shall be submitted prior to award of contract, unless otherwise acceptable. Approval of shop drawings, product data, or samples containing substitutions is not an approval of a substitution unless an item is clearly presented as a substitution at the time of submittal.

PART 2 PRODUCTS - Not Applicable to this Section

PART 3 EXECUTION - Not Applicable to this Section

END OF SECTION

SUBSTITUTION REQUEST
(After the Bidding/Negotiating Phase)

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

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SECTION 01 6350

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Sections:

1. Division 01 Section "Allowances" for products selected under an allowance.
2. Division 01 Section "Alternates" for products selected under an alternate.
3. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
4. Divisions 02 through 32 Sections for specific requirements and limitations for substitutions.

1.3 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 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.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer an advantage to Contractor or Owner (IE. Schedule Improvements and/or Cost Savings).

1.4 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use **CSI Form 13.1A** (included following 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 modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
   c. Detailed comparison of ALL qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Qualities may include, but are not limited to attributes such as performance, weight, size, durability, visual effect, aesthetic characteristics, 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.
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: If necessary, Architect will request additional information or documentation for evaluation within fourteen days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within **15** days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately upon 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. Substitution request is fully documented and properly submitted.
   c. Requested substitution will not adversely affect Contractor's construction schedule.
   d. Requested substitution has received necessary approvals of authorities having jurisdiction.

e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within **60 days after the Notice of Award**. Requests received after that time may be considered or rejected at the sole 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. Substitution request is fully documented and properly submitted.
   e. Requested substitution will not adversely affect Contractor's construction schedule.
   f. Requested substitution has received necessary approvals of authorities having jurisdiction.
   g. Requested substitution is compatible with other portions of the Work.
   h. Requested substitution has been coordinated with other portions of the Work.
   i. Requested substitution provides specified warranty.
   j. 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.

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION

SECTION 01 7000
EXECUTION & CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Substantial Completion: The following are prerequisites to substantial completion. Provide the following.
   1. Punch list prepared by Contractor and subcontractors as applicable.
   2. Supporting documentation.
   3. Warranties.
   4. Certifications.
   5. Occupancy permit.
   6. Start-up and testing of building systems.
   7. Change over of locks.
   8. Meter readings.
   9. Commissioning documentation.

B. Final Acceptance: Provide the following prerequisites to final acceptance.
   1. Final payment request with supporting affidavits.
   2. Completed punch list.

C. As-Built Drawings: Provide a marked-up set of drawings including changes, which occurred during construction.

D. Project Closeout: Provide the following during project closeout.
   1. Submission of record documents.
   2. Submission of maintenance manuals.
   3. Training and turnover to Owner's personnel.
   4. Final cleaning and touch-up.
   5. Removal of temporary facilities.

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

A. General Coordination: Coordinate the required cutting, patching and service interruption procedures with the actual project phasing. Identify anticipated shutdowns and temporary conditions that could affect school operations

B. Cutting and Patching: Provide cutting and patching work to properly complete the work of the project, complying with project requirements for:
   1. Structural work.
   2. Mechanical/electrical systems.
   3. Visual requirements, including detailing and tolerances.
   4. Operational and safety limitations.
   5. Fire resistance ratings.
   6. Inspection, preparation, and performance.
   7. Cleaning.

C. Means and Methods: Do not cut and patch in a manner that would result in a failure of the work to perform as intended, decrease energy performance, increase maintenance,

decrease operational life, or decrease safety performance.

D. Inspection: Inspect conditions prior to work to identify scope and type of work required. Protect adjacent work. Notify Owner of work requiring interruption to building services or Owner's operations.

E. Performance of Operations: Perform work with workmen skilled in the trades involved. Prepare sample area of each type of work for approval.

F. Cutting: Use cutting tools, not chopping tools. Make neat holes. Minimize damage to adjacent work. Inspect for concealed utilities and structure before cutting.

G. Patching: Make patches, seams, and joints durable and inconspicuous. Comply with tolerances for new work.

H. Cleaning: Clean work area and areas affected by cutting and patching operations.

END OF SECTION

SECTION 01 7310
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Division 01 Section "Selective Demolition" for demolition of selected portions of the building for alterations.
2. Divisions 02 through 32 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
    a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 23 and 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut structural elements without the prior consent of the Architect

B. Operational Elements: Do not cut and patch the following 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.

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-protection systems.
4. Control systems.
5. Communication systems.
6. Conveying systems.
7. Electrical wiring systems.
8. Operating systems of special construction in Division 13 Sections.

C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut, if necessary.

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

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid or minimize interruption of services to occupied areas. Coordinate cutting or patching that might require interruptions in services with Architect and Owner.

3.3 PERFORMANCE

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

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

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete, [Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION

Section 01 81 13 Sustainable Design Requirements

PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 specification sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. General requirements and procedures for compliance with certain **NECHPS regulations prerequisites**
    a. Other **NECHPS regulations prerequisites** needed to obtain certification depend on material selections and may not be specifically identified as **NECHPS** requirements. Compliance with requirements needed to obtain **NECHPS prerequisites and credits** may be used as one (1) criterion to evaluate substitution requests and comparable product requests.
    b. Additional **NECHPS regulations prerequisites** needed to obtain the indicated certification depend on Architect's design and other aspects of project that are not part of the Work of the Contract.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Divisions 01 through 26 sections for HPB regulations requirements specific to the work of each of these sections. Requirements may or may not include reference to HPB regulations

1.3 DEFINITIONS

A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

B. LEED: Leadership in Energy & Environmental Design.

C. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

D. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

E. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

F. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

G. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 Section 01 33 00 "Submittal Procedures."

B. General: Submit additional **NECHPS regulations** submittals required by other specification sections.

C. HPB regulations submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated **NECHPS regulations** requirements.

D. Project Materials Cost Data: Provide statement indicating total cost for building materials used for project, excluding mechanical, electrical, and plumbing components, and specialty items such as elevators and equipment.

E. NECHPS regulations Action Plans: Provide preliminary submittals within **30** days of date established for **commencement of the Work** indicating how the following requirements will be met:

1. Waste Management Plan complying with Construction Waste Management and Disposal.
2. Salvaged and Refurbished Materials List: Identify each material that will be salvaged or refurbished, including its source and cost.
3. Recycled Content Materials List: Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
4. Certified Wood Products List: Indicate each product containing certified wood, including its source and cost of certified wood products.
5. Construction Indoor-air-quality Management Plan complying with Construction IAQ Management Plan.

F. NECHPS regulations Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with **NECHPS** regulations action plans for the following:

1. Waste Reduction Progress Reports complying with Division 01 Section 01 74 19 "Construction Waste Management and Disposal."
2. Salvaged and refurbished materials.
3. Recycled content.
4. Regional materials.
5. Certified wood products.

G. NECHPS regulations Documentation Submittals:

1. Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over a period of not less than one (1) year of post-construction occupancy.
2. Waste Management Plan: Comply with Division 01 Section 01 74 19 "Construction Waste Management and Disposal."
3. Salvaged and Refurbished Materials: Receipts for salvaged and refurbished materials used for project, indicating sources and costs for salvaged and refurbished materials.
4. Recycled Content: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
5. Regional Materials: Product data indicating location and distance from project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
6. Certified Wood Products: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
7. Indoor Environmental Quality:
    a. Construction indoor-air-quality management plan.
    b. Product data for temporary filtration media.
    c. Product data for filtration media used during occupancy.
    d. Construction Documentation: Six (6) photographs at three (3) different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
8. Indoor Environmental Quality:

a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.

b. Product data for filtration media used during flush-out and during occupancy.

c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.

9. Adhesives and Sealants: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L.

10. Paints and Coatings: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L.

11. Carpet Systems: Product data for carpet and carpet cushion installed in the building interior indicating that the product complies with the CRI Green Label Plus testing program. Product data for carpet adhesives used in the building indicating VOC content in g/L.

12. Composite Wood, Agrifiber or Wood Glues: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

PART 2 - PRODUCTS

2.1 SALVAGED AND REFURBISHED MATERIALS

A. Salvaged or Refurbished Materials: Provide salvaged or refurbished materials for **five (5)** percent of building materials (by cost). The following materials may be salvaged or refurbished materials:

1. No anticipated salvage per this scope.

2.2 RECYCLED CONTENT OF MATERIALS

A. Recycled Content Materials: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of [**10**] percent of cost of materials used for project.

1. Cost of post-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.

2. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.

3. Do not include mechanical and electrical components in the calculation.

2.3 REGIONAL MATERIALS

A. Regional Materials: Provide [**10**] percent of building materials (by cost) that are regional materials.

2.4 CERTIFIED WOOD

A. Certified Wood Products: Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:

a. Rough carpentry.

b. Miscellaneous carpentry.

c. Heavy timber construction.

d. Wood decking.

e. Metal-plate-connected wood trusses.

f. Structural glued-laminated timber.

g. Finish carpentry.

h. Architectural woodwork.
i. Wood paneling.
j. Wood veneer wall covering.
k. Wood flooring.
l. Wood lockers.
m. Wood cabinets.

2.5 LOW-EMITTING MATERIALS

A. Adhesives, Sealants, and Sealant Primers: For field applications that are inside the weatherproofing system, use adhesives, sealants, and sealant primers that comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168 effective July 1, 2005 and the rule amendment dated January 7, 2005.

1. Aerosol Adhesives: Comply with the requirements of the Green Seal Standard for Commercial Adhesives GS-36 in effect on October 19, 2000.

B. Paints and Coatings: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content:

1. Architectural Paints, Coatings, and Primers Applied to Interior Walls and Ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition dated May 20, 1993:
   a. Flats: 50 g/L.
   b. Non-flats: 150 g/L.
2. Anti-corrosive and Anti-rust Paints Applied to Ferrous Metal Substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition dated January 7, 1997.
3. Clear Wood Finishes, Floor Coatings, Stains, Sealers, and Shellacs Applied to Interior Elements: Do not exceed the VOC content limits established in the South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings in effect on January 1, 2004:
   a. Clear Wood Finishes: Varnish - not more than 350 g/L; Lacquer - not more than 550 g/L.
   b. Floor Coatings: VOC not more than 100 g/L.
   c. Sealers: Waterproofing sealers - not more than 250 g/L; Sanding sealers - not more than 275 g/L; All other sealers - not more than 200 g/L.
   d. Shellacs, Clear: VOC not more than 730 g/L.
   e. Shellacs, Pigmented: VOC not more than 550 g/L.
   f. Stains: VOC not more than 250 g/L.

C. Carpet Systems:

1. Carpet: Meet the requirements of the Carpet and Rug Institute's (CRI) Green Label Plus Program.
2. Carpet Cushion: Meet the requirements of CRI's Green Label Program.
3. Carpet Adhesive: VOC content of not more than 50 g/L.

D. Composite Wood and Agrifiber Products: Do not use composite wood or agrifiber products or adhesives that contain added urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 [REFRIGERANT] [AND] [CLEAN-AGENT FIRE-EXTINGUISHING-AGENT] REMOVAL

A. Fundamental Refrigerant Management: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 23 sections.

B. Enhanced Refrigerant Management: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. Refer to Division 21 sections additional requirements.

3.2 MEASUREMENT AND VERIFICATION

A. Measurement and Verification: Implement measurement and verification plan consistent with [Option B - Energy Conservation Measure Isolation] in the EVO's "International Performance Measurement and Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction," and as further defined by the following:

B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.

C. Evaluate energy performance and efficiency by comparing actual to predicted performance.

D. Measurement and verification period shall cover at least one year of post-construction occupancy.

3.3 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Comply with Division 01 Section 01 74 19 "Construction Waste Management and Disposal."

3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Construction IAQ Management Plan During Construction: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section 01 50 00 "Temporary Facilities and Controls", install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy.

B. Construction IAQ Management Plan Before Occupancy:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu ft of outdoor air per sq ft of floor area while maintaining an internal temperature of at least 60 degrees F and a relative humidity no higher than 60 percent.
2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu ft of outdoor air per sq ft of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq ft of outside air or the design minimum outside air rate determined in Sections 4 through 7 of ASHRAE Standard 62.1-2004, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three (3) hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu ft/sq ft of outside air has been delivered to the space.

E. Air-Quality Testing:

1. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air and as additionally detailed in the USGBC's "LEED-NC Reference Guide."
2. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
   a. Formaldehyde: 50 ppb.
   b. Particulates (PM10): 50 micrograms/cu. m.
   c. Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
   d. 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
   e. Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
3. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements

are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from same locations as in the first test.

4. Air-sample testing shall be conducted as follows:
   a. All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
   b. Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
   c. Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq ft or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
   d. Air samples shall be collected between three (3) and six (6) feet from the floor to represent the breathing zone of occupants, and over a minimum four (4) hour period.

END OF SECTION 01 81 13

SECTION 01 9000
LIFE CYCLE ACTIVITIES

PART 1 GENERAL

1.1 SUMMARY

A. Commissioning: Provide commissioning of building systems, subsystems and equipment including:
   1. HVAC components and equipment.
   2. Building automation systems.
   3. Lighting control systems.

B. Commissioning Agent: The Owner will engage a commissioning agent to prepare a commissioning plan and report, and to perform functional tests and inspections of building systems.

C. Cooperation: Cooperate with the Owner's commissioning agent, including attendance at commissioning meetings and activities, coordinating scheduling, access to the work and utility services for commissioning activities.

D. Access: Provide access to project documentation, shop drawings, wiring diagrams, operations and maintenance manuals and similar items when requested by the Owner's commissioning agent.

E. Remedial Work: Modify, adjust, balance, repair or replace systems, subsystems and equipment which does perform to code requirements or to requirements specified in the Contract Documents at no additional expense to the Owner. Pay for retesting and additional modifications until satisfactory results are obtained.

PART 2 PRODUCTS - Not Applicable to This Section

PART 3 EXECUTION - Not Applicable to This Section

END OF SECTION

SECTION 01 91 13 GENERAL COMMISSIONING REQUIREMENTS

PART 1 Commissioning is a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meet defined objectives and criteria. The Commissioning process begins at project inception (during the pre-design phase) and continues through the life of the facility. The commissioning process includes specific tasks to be conducted during each phase in order to verify that design, construction, and training meet the Owner's Project Requirements.

PART 2 The Goals of the Commissioning Process are to:

2.1 Verify that applicable equipment and systems are installed according to the contract documents, manufacturer’s recommendations, and industry accepted minimum standards, and that they receive adequate operational checkout by installing contractors.

2.2 Verify and document proper performance of equipment and systems.

2.3 Verify that O&M documentation left on site is complete.

2.4 Verify that the owner’s operating personnel are adequately trained.

2.5 Comply with the requirements for Commissioning services by the Rhode Island Department of Education (RIDE) and the Northeast Collaborative for High Performance Schools (NE-CHPS)

PART 3 The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions, Division 1, and other trade specific specification sections shall apply to this section.

B. Owner’s Project Requirements and Basis of Design documents are included by reference for information only.

C. ASHRAE Guideline 0-2005, The Commissioning Process

1.3 SUMMARY

A. This section includes general requirements that apply to the implementation of the commissioning process without regard to specific systems, assemblies, and components.

B. Related sections include the following:1. Section 01 33 00 Submittal Procedures 2. Section 01 78 23 Operation and Maintenance Data 3. Section 01 79 00 Demonstration and Training 4. Section 22 08 00 Commissioning of Plumbing Systems 5. Section 23 08 00 Commissioning of HVAC Systems 6. Section 26 08 00 Commissioning of Electrical Systems 7. Division 22 Plumbing 8. Division 23 Heating Ventilating and Air Conditioning 9. Division 26 Electrical 10. Division 28 Electronic Safety and Security

1.4 DEFINITIONS

A. Acceptance - A formal action, taken by a person with appropriate provider (which may or may not be contractually defined) to declare that some aspect of the project meets defined requirements, thus permitting subsequent activities to proceed.

B. Approval - Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the contract documents.

C. Basis of Design - A document that records the concepts, calculations, decisions, and product selections used to meet the Owner’s Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

D. Checklists, Construction Checklists, Installation Checklists, or Pre-Functional Checklists - Checklists that are developed by the CxA and completed by the Construction Team during all phases of the construction process to verify that materials, equipment, assemblies, and systems are installed in accordance with the Contract Documents.

E. Commissioning Authority or Agent (CxA) - The entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process.

F. Commissioning Plan (CxP) - A document developed by the CxA that outlines the organization, schedule, roles and responsibilities, and documentation requirements of the Commissioning Process. The CxP is initially developed in the design phase and updated throughout the construction and closeout process.

G. Commissioning Process - A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

H. Commissioning Team - The individuals who through coordinated actions are responsible for implementing the commissioning process.

I. Data logging -The monitoring and recording of flows, currents, status, pressures, etc., of equipment using stand-alone data recorders separate from the control system or the trending capabilities of control systems.

J. Deferred Performance Tests (DPTs) - Performance tests that are performed, at the discretion of the CxA, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.

K. Deficiency, Non-Compliance, Non-Conformance - A condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the contract documents.

L. Factory Testing - Testing of equipment on-site or at the factory, by factory personnel, with or without an owner's representative present.

M. Issues Log - A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the commissioning team during the course of the commissioning process.

N. Owner's Project Requirements - A written document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This is also referred to as the Project Intent or Design Intent.

Pre-Functional Testing – testing performed by the contractors to verify complete system operation and system readiness.

Quality Based Sampling - A process for evaluating a sub-set (sample) of the total population. The sample is based upon a known or estimated probability distribution of expected values; an assumed statistical distribution based upon data from a similar product, assembly, or system; or a random sampling that has scientific statistical basis.

Seasonal Performance Tests - Performance tests that are deferred until the system(s) will experience conditions closer to their design conditions based on weather conditions.

Startup - The initial starting or activating of dynamic equipment, including completing construction checklists.

Systems Manual - A system-focused composite document that includes the operation manual, maintenance manual, and additional information of use to the owner during the occupancy and operations phase.

Functional Performance Test (FPT) - A protocol written by the CxA that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems. Performance testing includes the dynamic functions and operations of equipment and systems using manual or monitoring methods under various levels of operation. Systems are tested under various modes, such as during low cooling loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to respond as the sequences state.

Training Plan or Instruction Program - A written document that details the expectations, schedule, and deliverables related to the training of project operating and maintenance personnel, users, and occupants.

Verification - The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

Trending – The monitoring, by a building management system or other electronic data gathering equipment, and analyzing of the data gathered over a period of time.

1.5 COORDINATION

A. Coordination of the Cx process is the responsibility of all Cx Team members.

B. The CxA coordinates the commissioning activities through the construction manager or general contractor. All members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

C. The CxA, through the Owner or CM, will provide sufficient notice to the contractor for scheduling commissioning activities with respect to the Owner's participation. The CM will integrate all commissioning activities into the overall project schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1.6 REMOBILIZATION AND RETESTING FEES

A. In general, CxA testing will include one test of each system or equipment. The cost of any additional testing will be submitted to the Owner for review and direction. Following Owner review, the cost for additional testing to verify that performance is in accordance with the design intent may be deducted from the Contractor's final payment by the Owner.

B. In the event that a CxA site visit is scheduled in advance with the Contractor and testing is unable to be performed through no fault of the Owner and the CxA is not notified within 48 hours, the cost of the travel and time will be deducted from the contractor's final payment by the Owner.

1.7 COMMISSIONING PLAN

A. Commissioning during construction begins with an initial commissioning meeting conducted by the CxA where the commissioning process is reviewed with the project commissioning team members. This meeting shall be scheduled by the CM. Generally, the initial Cx Meeting will be scheduled within 60 days of the award of contracts related to commissioned systems and equipment.

B. Additional meetings will be required throughout construction, scheduled by the CxA, through the owner or CM, with necessary parties attending to plan, scope, coordinate, schedule future activities, and resolve problems. In general these meetings will be

monthly with the frequency increasing towards substantial completion to accommodate start-ups, balancing, scheduling testing, and training.

C. The CxA reviews submittals for commissioned equipment and systems parallel with the Design Team for compliance with the OPR.

D. The construction checklists, developed by the CxA, are to be completed by the contractor (or its subcontractors), before and during the startup process and verified by the CxA.

E. The CxA witnesses selected assembly mock-ups, equipment, and system start-ups.

F. The CxA develops equipment and system functional performance test (FPT) procedures. The FPT's are executed by the contractor and witnessed and documented by the CxA.

G. The CxA reviews the O&M documentation for completeness.

H. The CxA coordinates the training plan provided by the contractor.

I. Deferred performance testing will be conducted as required.

1.8 COMMISSIONING TEAM

A. Members appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of each contractor, including project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members appointed by Owner:

1. CxA - An entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.

2. Representatives of the facility Users and Operation and Maintenance personnel.

3. Architect and engineering design professionals.

1.9 RESPONSIBILITIES

Understanding and defining the roles of each participant are vital to the success of the Commissioning Process. This provides an outline of the responsibilities of each participant in the Commissioning Process. These responsibilities are typically formalized in the contracts between the Owner and the various parties and this section is not intended to supersede or negate any contracted relationships.

A. Owner (or Designated Representative)

1. Include the design professionals' Commissioning related responsibilities and scope of work in the design request for proposal and contract.

2. Oversee the development of the Owner's Project Requirements and approve any changes.

3. Designate a representative, ideally from the building's operations and maintenance team, to participate in the Commissioning Process including: a. Design Phase coordination meetings b. Construction Phase coordination meetings c. Informal owner-training as equipment is installed and started d. Maintenance orientation and inspections e. System testing and verification meetings f. Functional procedure review meetings before testing of systems g. Training sessions h. Verification demonstrations i. Systems and assemblies tests j. Final review at acceptance meeting

4. Review and approve any changes made to the Owner's Project Requirements.

5. Review, comment on, and accept the Commissioning Authority's progress and final reports.

B. Commissioning Authority (CxA)

C. The Commissioning Authority is responsible to verify that the Owner's Project Requirements for the project are satisfactorily achieved. The CxA leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Specific tasks performed by the CxA include: Design Phase 1. Assemble a commissioning team, hold a scoping meeting and identify responsibilities. 2. Attend commissioning meetings as needed with project coordinator and design team. 3. Review the Owner's Project Requirements for clarity and completeness. 4. Develop and update the design phase commissioning plan. 5. Perform focused review of the design, drawings and specifications at various stages of development (during design development and contract document phases) as required. 6. Review the development and maintenance of the Basis of Design documentation by design team members. 7. Develop a draft construction phase commissioning plan using an Owner-approved outline. 8. Develop full commissioning specifications for all commissioned equipment. Coordinate with and integrate into the specifications of the architect and engineers. The specifications will be consistent in content, rigor and format to the referenced standards. a. A detailed description of the responsibilities of all parties. b. Details of the commissioning process. c. Reporting and documentation requirements, including formats; alerts to coordination issues, deficiency resolution; construction checklist and start up requirement.

10.

Coordinate control integration meetings where the owner, electrical engineers, mechanical engineers and CxA discuss integration issues between equipment, systems and disciplines to ensure that integration issues and responsibilities are clearly described in the specifications.

Review documents and responses from A/E to ensure that all previous comments have been addressed by the appropriate party.

The functional testing process. Specific functional test requirements, including testing conditions and acceptance criteria for each piece of equipment being commissioned.

Bid Phase 1. Answer commissioning related questions throughout the bid process.

Construction Phase

1. Perform the tasks and functions to be incorporated in the specifications ascribed to the CxA.

2. Coordinate and direct the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties.

3. Coordinate the commissioning work, with the Construction Manager, Contractor, Architect and Owner's representatives to ensure that commissioning activities are being scheduled into the master schedule.

4. Revise the construction phase commissioning plan developed during the design phase as required to include refined scope and schedule.

5. Plan and conduct commissioning meetings and distribute minutes.

6. Request and review information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures. Before startup, gather and review current control sequence and interlocks. Work with the architect so that the CxA/A/E comments are combined into one review submitted to the contractor.

7. Review coordination drawings to ensure that trades are making a reasonable effort to coordinate work. Coordinate submittal review with the architect so that the CxA/A/E comments are combined into one review submitted to the contractor.

8. Write and distribute construction checklists for commissioned equipment.

9. Develop an enhanced start-up and initial systems checkout plan with contractors for selected equipment.

10. Perform site visits to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.

11. Witness initial HVAC piping pressure test and flushing efforts to be confident that proper procedures were followed in accordance with specifications.

12. Witness select ductwork testing and cleaning sufficient to be confident that proper procedures were followed in accordance with specifications. Include documentation in the Commissioning Record.

13. Provide construction checklists for equipment/systems within the scope of work to the contractors.

14. Document construction checklist completion by reviewing completed checklists and by site observation.

15. Document system startup by reviewing start-up reports and by selected site observations.

16. Approve air and water systems balancing by spot testing and by reviewing completed reports and by selected site observation. Coordinate submittal review with the architect so that the CxA/A/E comments are combined into one review submitted to the contractor.

17. With assistance and review from the installing contractor, CxA will write functional performance test procedures for equipment and systems.

Analyze functional performance trend logs and monitoring data to verify performance. Coordinate, witness and document manual functional performance tests performed by installing contractors. Maintain a master issues log and report all issues as they occur directly to the Owner's representative and the architect.

Review equipment warranties to ensure that the Owner's responsibilities are clearly defined. Oversee and approve the training of the Owner's operating personnel. Review and approve the preparation of the O&M manuals for commissioned equipment. Coordinate submittal review with the architect so that the CxA/A/E comments are combined into one review submitted to the contractor.

Compile a final commissioning Report, which shall include:

a. A brief summary report that includes a list of participants and roles, brief building description, overview of commissioning and testing scope, and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the CxA regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications 2) Equipment installation 3) Functional performance and efficiency 4) Equipment documentation 5) Operator training

b. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non- compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented.

c. Also included in the Commissioning Record shall be the issues log, commissioning plan, progress reports, submittal and O&M manual reviews, training record, test schedules, construction checklists, start-up reports, functional tests, and trend log analysis.

Comply with the requirements of any applicable green-building rating systems (i.e. LEED, High Performance Buildings, Green Guide for Healthcare, etc.).

Period Coordinate and supervise required opposite season or deferred testing as needed. Return to the site at 10 months warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have with operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports and documents and requests for services to remedy outstanding problems. The CxA is not responsible for correcting deficiencies.

D. Design Team

The primary role of the Design Team is to translate the Owner's Project Requirements into a complete design. Relative to commissioning, the design team's responsibilities vary depending on the specific project and contract, but may include:

1. Participate in the development and documentation of the initial Owner's Project Requirements.
2. Document revisions to the Owner's Project Requirements as approved by the Owner.
3. Document the Basis of Design.
4. Integrate the Commissioning Process requirements provided by CxA in the Contract Documents.
5. Respond to Commissioning Team design review comments.
6. Adequately detail the Operations and Maintenance of the systems and assemblies in Contract Documents.
7. Review and incorporate the CxA's comments from submittal reviews.
8. Participate in the initial Operation and Maintenance personnel training sessions. Include a presentation of the project's Basis of Design and descriptions of the associated systems.
9. Review functional test procedures.
10. Review the CxA's reports and logs and comment as appropriate.
11. Review and comment on the final Cx Report.

Construction Manager

The Construction Manager provides management, technical, and administrative expertise during the Construction phase to ensure the building Owner's goals relating to schedule and quality are met. The Construction Manager's responsibilities related to the Commissioning Process typically include:

1. Include any costs for Commissioning Process activities in the contract price. 2. Include Commissioning Process requirements and activities in all contractors'

contracts. 3. Include Cx-related milestones in the construction schedule. 4. Ensure necessary accessibility to all equipment to allow for proper operation and

maintenance of the building. 5. Provide individuals with the required background and authority to implement the

Commissioning Process activities as outlined in the Contract Documents. 6. Issue a statement at the end of the project certifying that all work has been completed

in accordance with the Contract Documents and the facility is operational. 7. Respond to Commissioning Process reports and correct deficiencies identified during

installation verification or functional testing. 8. Review and comment on the final Cx Report.

Contractors

Many different contractors will be involved in the Commissioning Process. The various contractors may include the building contractors (general, mechanical and electrical), the testing, adjusting, and balancing contractor, the building automation system contractor and others as required by the contract documents. As a member of the Commissioning Team, the responsibilities of the various building contractors include:

1. Include any costs for Commissioning Process activities in the contract price. 2. Include Commissioning Process requirements and activities in all subcontracts or

equipment purchases. 3. Ensure the cooperation and participation of all subcontractors and manufacturers of

equipment or systems to be commissioned. 4. Attend Commissioning Team meetings. 5. Include Cx-related milestones in the construction schedule. 6. Implement the training program as described in the Contract Documents. Coordinate

related activities with the CxA. 7. Provide submittals to the Owner, Design Team, and CxA as detailed in the Contract

Documents. 8. Respond to and resolve issues identified in the Cx Issues Log. 9. Notify the CxA when systems and assemblies are ready for installation verification

and testing. For repetitive assemblies, notify the CxA upon the completion of the prototype for a First Piece or Mock-Up review.

10. Complete system and equipment checklists developed by the CxA. Complete the Checklists as the work is completed. Provide completed copies to the CxA at regular intervals for verification.

11. Complete Pre-Functional test procedures. Functional testing will not take place until all Pre-Functional Tests have been fully executed.

12. Functional testing. Once pre-functional tests are complete, functional test verification will be scheduled and demonstrated in the presence of the CxA.

13. Maintain the Project Record Documents in accordance with the requirements of the Contract Documents.

Manufacturers

The suppliers of major equipment are required to support the Commissioning Team in the following manner:

1. Provide all information required for the proper Start-up and Operation and Maintenance of the system or assembly in the initial submittal, as detailed in the Contract Documents.

2. A qualified technician fluent in the programming and system operation (not a salesman) shall attend and participate in controls integration meetings to discuss how equipment with unitary or packaged controls will be integrated into the facility's central Building Management Control System (BMCS). All aspects of equipment controls will be discussed and defined to ensure compliance with the overall design intent. At a minimum the following will be discussed: communication protocols, integration with the BMCS, monitoring points, controllability, sequence of operations, alarming, etc...

3. Provide the requirements to maintain the warranty in the initial submittal, as detailed in the Contract Documents.

4. Coordinate and provide results of all factory tests required in the Contract Documents.

5. Participate in the training process as detailed in the Contract Documents.

6. Demonstrate operation and performance of equipment and assemblies as detailed in the Contract Documents.

7. A qualified technician will be on site as needed to support testing and balancing, controls integration with the BMCS, and functional testing of their equipment.

Operations and Maintenance Staff

The Operations and Maintenance staff will participate in the Commissioning Process in the following areas: 1. Define Operations and Maintenance related requirements of the building. 2. Participate in design review for O&M impacts.

3. Review maintenance manual, record drawing and documentation requirements developed by the Design Team.

4. Define training program requirements. 5. Participate/witness functional performance testing. 6. Attend contractor and vendor training sessions.

1.10 EQUIPMENT/SYSTEMS TO BE COMMISSIONED A. The following equipment/systems will be commissioned in this project:

HVAC Systems: Heating, ventilation, air conditioning and refrigeration systems and associated controls Plumbing: Domestic hot water system

Electrical: Lighting and daylighting controls Building Automation and Controls: Interface of these systems with HVAC systems

PART 2 PRODUCTS 2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required performance testing shall be provided by the contractor for the equipment being tested. This includes, but is not limited to, two-way radios, meters, and data recorders. Data recorders may be provided by the CxA at the option of the CxA.

B. Special equipment, tools, and instruments required for testing equipment according to these contract documents shall be included in the contractor's base bid price and shall be turned over to the owner at Project close-out.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration to NIST traceable standards within the past year to an accuracy of 0.5 degree F and a resolution of + or - 0.1 degree F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 EXECUTION

. 3.1 OVERVIEW Through the Construction Phase of the project, it is the responsibility of the CxA to coordinate and direct the Commissioning Process activities in a logical, sequential, and efficient manner using protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties.

. 3.2 CONDUCT PRE-CONSTRUCTION MEETING The Pre-Construction Meeting is an opportunity for the CxA to meet with the Construction Team and discuss the general Commissioning Process. It is the ideal time to identify Commissioning Team members, discuss the integration of the Commissioning Process Schedule with the Construction Schedule, review the submittal review requirements, review the inspection and testing process, and develop the formal lines of communication between all parties.

. 3.3 CONDUCT REGULAR COMMISSIONING MEETINGS Once the Commissioning Team (Cx Team) has been formed, regular Commissioning Meetings are held. These meetings vary in frequency based upon the activity level at the time, but will generally be held monthly and will be coordinated to coincide with Construction Meeting days for convenience. At the Commissioning Meetings, past Commissioning Process activities are reviewed, future Commissioning Process activities are planned and coordinated, Commissioning documentation is requested and exchanged, and the Commissioning Schedule is updated and integrated into the Construction

Schedule. The CxA will request all documentation necessary to develop the installation checklists, requirements for equipment start-ups, pre-functional and

functional performance tests at these meetings and review the draft versions of these documents with the contractors that are responsible for implementing them. The CxA leads these meetings, records the minutes, and distributes the minutes with action items to all Cx Team members.

. 3.4 CONTRACTOR SUBMITTAL REVIEW The CxA will review the Contractor submittals coincident with the Design Team and provide comments to the Design Team for inclusion with their review so a single set of review comments can be provided to the Contractors. The reviewed submittals will include commissioned equipment and coordination drawings that include commissioned equipment and systems, control drawings and sequences, and interfaces and interlocks between systems. In addition, the CxA will periodically review the final Design Team comments to ensure a quality review process. The review will focus on operations, maintenance, and commissioning related issues with the goal of ensuring the submitted equipment complies with the Owner's Project Requirements. The CxA review will NOT include a detailed review of system capacities, sizes, and other technical data that are the responsibility of the Engineer of Record. CxA submittal reviews will frequently request additional information from the Contractors, including specific operations and maintenance data, performance curves, and targeted coordination drawings for areas of concern.

. 3.5 MAINTAIN ISSUES LOGS Throughout the Construction Process, the CxA will maintain a Commissioning Issues Log. This log will document all Construction Phase issues through a sortable database that identifies the following fields.

A. The responsible party, either Construction Team member, Design Team member, or Owner

B. The exact location of the issue (floor and room)

C. The applicable system component, i.e. lighting, ductwork, pump, etc.

D. The project impact

E. A severity

F. A deficiency code, i.e. craftsmanship, non-compliance, etc.

G. A reference to the Contract Documents (if applicable)

H. A detailed description of the issue

I. A status, i.e. complete, incomplete, accepted, unverifiable

. The issues log will be distributed and reviewed at each Commissioning Meeting and each issue will be tracked by the CxA until it is resolved.

. 3.6 CONSTRUCTION CHECKLISTS The Contractors will be responsible for completing documentation related to the installation, start- up, and testing of all commissioned equipment and systems. This documentation will be kept on- site and be completed through the use of paper forms. The CxA will develop the installation checklists and provide them in Adobe's portable document format (pdf) to the Construction Team. The Construction Team will be responsible for completing the installation checklists for 100% of the commissioned systems and equipment. The checklists will include best practices related to the specific equipment or system, highlights of required

installation details from the drawings and specifications, and equipment manufacturer, model number, serial number, and capacity verification information.

The construction manager or general contractor will be responsible for maintaining an up-to-date book of printed checklists. These checklists will be reviewed at every commissioning meeting with the expectation that checklists will be completed as the work progresses.

The CxA will use sampling strategies to field verify the proper completion of the checklists with sampling rates determined based upon the success of the verification process, the quantity of each type of equipment, and the relative importance of the equipment's operation related to the overall building operation.

The Functional Testing of the equipment and systems will not be scheduled until all relevant Installation Checklists are submitted to the Commissioning Agent.

. 3.7 PRE-FUNCTIONAL CHECKLISTS In order to verify that the systems and equipment are ready for final Functional Testing witnessed by the CxA, the Contractor will perform Pre-Functional Testing independent of the CxA. Pre- Functional Testing shall consist of performing the complete Functional Testing (described below) with tests provided by the CxA. Through this process, the Contractor will validate the test procedure and provide a marked-up version of the test complete with results. Once a completed test is provided indicating successful operation of the system, the CxA will schedule the Functional Testing as described below.

. 3.8 SITE OBSERVATIONS Periodically throughout the Construction process, the CxA will perform site visits to observe component and systems installations. These visits will be planned to coincide with selected planning and job-site meetings, installation milestones, component and assembly mock-ups, and equipment and system start-ups. The CxA will use these site visits to verify the proper completion of installation and start-up checklists, witness HVAC pipe and duct cleaning and testing, review the air and water systems balancing by selective testing, and generally track the progress of the construction. A field report will be provided at the conclusion of each visit documenting the tasks accomplished during the visit.

. 3.9 FUNCTIONAL TESTING The performance of the testing of all commissioned equipment and systems is the responsibility of the Contractors. The CxA will develop the functional performance tests with the assistance of the installing contractors, and upon the successful completion of Pre-Functional Testing as described above, will coordinate the testing process, and witness the tests that are performed by the Contractors. In addition, the CxA will prepare plans for, assist with execution of, and document tests of commissioned equipment overseen by

regulatory authorities and ensure that such tests meet the rigor desired by the Owner. The CxA will coordinate the retesting of equipment until satisfactory performance is achieved. The functional performance testing will include operating the systems and components through each of the written sequences of operation, other significant modes and miscellaneous alarms, power failure, and security alarm when impacted by and interlocked with commissioned equipment. Sensors and actuators shall be calibrated during construction check listing by the installing contractors and spot checked by the CxA during functional testing. Tests on HVAC equipment shall be done, if possible, in their proper operating season (cooling in summer, heating in winter). Any equipment that operates in both seasons, such as the heat pumps, should ideally be tested in both seasons. However, if this is not possible, some manipulation of setpoints and control points will be done to simulate the necessary conditions. Functional testing will be done using conventional manual methods, control system trend logs, and stand-alone data loggers as required

to provide a high level of confidence in proper system function, as deemed appropriate by the CxA and the Owner. A report will be provided that includes all of the issues identified during the testing process.

As a component of the test procedures, the CxA will identify specific system trends to be set up and then analyze the trend and monitoring data as a method of verifying performance.

3.10 TRAINING AND O&M REVIEW

Planning for the training of the Owner's operations and maintenance staff begins in the design phase with the development of training requirements.

The Owner's operations and maintenance staff will commence training sessions during the construction phase through a combination of formal and informal training activities. Although the informal training sessions, such a project walkthroughs or submittal reviews, will take place throughout the construction process, the formal training program should not be initiated until the successful completion of functional testing to ensure that the operations and maintenance personnel receive accurate training and are able to witness the systems operating properly during the training.

The CxA will oversee and approve the Contractor-provided training of the Owner's operating personnel. The training agendas, attendance logs, and materials will be documented by the CxA and any additional or supplemental training required for the Owner's operating personnel to properly and efficiently operate the building will be highlighted to the Owner by the CxA.

The CxA will attend select training sessions to participate, document, monitor, and provide quality control. The sessions will be video recorded by the Contractors or Owner without CxA involvement or coordination of the recording.

The CxA will review and approve the commissioned systems and equipment sections of the Operations and Maintenance (O&M) manuals prepared by the Contractors. Comments will be provided to the Design Team to allow one submittal review to be sent to the Contractor. The Contractor is to have the O&M manuals ready and available for use in the training process.

PART 4 OCCUPANCY AND OPERATIONS PHASE

. 4.1 FINAL COMMISSIONING PROCESS REPORT At the completion of the Commissioning Process, the CxA will provide a final report based on the framework of the Commissioning Plan. An Executive Summary will be included that provides a summary of the participants and their roles, a brief building description, an overview of the commissioning and testing scope, and a general description of testing and verification methods. Included with the summary will be a matrix that provides the disposition of the CxA regarding the adequacy of the commissioned equipment and system in the following five areas: equipment meeting the equipment specifications, equipment installation, functional performance and efficiency, equipment documentation, and operator training. The final report will specifically identify all outstanding non-compliance issues, recommendations for improvement to equipment or operations, future actions required, and recommended changes to the Commissioning Process. In addition, the Report shall include a final issues log with all issues identified through the Commissioning Process, progress and field reports, submittal and O&M manual reviews, training record, test schedules, construction checklists, start-up reports, functional tests, and trend log analysis.

. 4.2 SEASONAL TESTING

Any equipment or system that cannot be adequately tested at the time of the initial testing due to seasonal operating issues will be retested in their primary operating season. Whenever possible, systems will be tested under load to verify system capacity and function.

. 4.3 WARRANTY REVIEW The CxA will return to the site 10 months into the 12 month warranty period and review with facility staff the current building operation and condition of outstanding issues related to the original and seasonal commissioning. Any issues that may come under warranty or under the original construction contract will be identified and the CxA will assist the facility staff in developing reports, documents, and requests for services to remedy outstanding problems. The CxA is not responsible for correcting deficiencies.

. 4.4 HIGH PERFORMANCE BUILDING RATING SYSTEMS In addition to the reports described above, all paperwork required to satisfy the RIDE Regulations will be provided.

END OF SECTION

SECTION 02 4113
SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

B. Removal and disposal of obsolete equipment.

C. Abandonment and removal of obsolete utilities and conduit.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of benchmarks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Project Record Documents: Accurately record actual locations of capped and active utilities.

PART 2 PRODUCTS – Not Applicable to this Section

PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of the existing construction as required to install new work.

B. Remove equipment being replaced.

C. Remove & Provide Safe Storage for Existing-to-Remain Equipment as Applicable

D. Remove MEP and other items being upgraded or replaced.

E. Remove items so noted on the drawings.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. 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.
   3. Provide, erect, and maintain temporary barriers and security devices.

4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
6. 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.

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

C. Protect existing structures and other elements that are not to be 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.

D. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

E. 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.

3.03 EXISTING UTILITIES

A. Protect existing utilities to remain from damage.

B. 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.

C. 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.

D. 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.

E. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Separate areas in which demolition is being conducted from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.

B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

C. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.

D. 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 that are to remain in operation; 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. Verify that abandoned services serve only abandoned facilities before removal.

4. 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.

E. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

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

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

END OF SECTION

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Provide rough carpentry.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Lumber Standards and Grade Stamps: DOC PS 20, American Softwood Lumber Standard and inspection agency grade stamps.

C. Construction Panel Standards: DOC PS 1, U.S. Product Standard for Construction and Industrial Plywood; APA PRP-108.

D. Wood Framing Standards: NFPA House Framing Manual.
1. Exterior Wall Framing: 2 inch by 6-inch nominal (38 mm by 140 mm actual) studs, 24 inches (61 cm) on center.
2. Exterior Wall Framing: 2 inch by 4-inch nominal (38 mm by 89 mm actual) studs, 16 inches (40 cm) on center.
3. Interior Wall Framing: 2 inch by 4-inch (38 mm by 89 mm actual) studs, 16 inches (40 cm) on center.

E. Preservative Treatment: AWPA C2 for lumber and AWPA C9 for plywood; waterborne pressure treatment. Provide for wood in contact with soil, concrete, masonry, roofing, flashing, damp-proofing and waterproofing.

F. Fire-Retardant Treatment: AWPA C20 for lumber and AWPA C27 for plywood; noncorrosive type. Provide at building interior where required by code.

PART 2 PRODUCTS

2.1 MATERIALS

A. Rough Carpentry Applications:
1. Manufacturers, Wood Sheathing: Refer towww.arcat.com/divs/sec/sec06100.html
2. Application: Rooftop equipment bases and support curbs.
3. Application: Wood grounds, nailers, and blocking.
4. Application: Wood furring.
5. Application: Backing panels.
6. Application: Wood sheathing.
7. Application: Subflooring.
8. Application: Building wrap.
9. Building Wrap:

a. Material: Air-retarder sheeting made from polyolefins; cross-laminated films, woven strands, or spun-bonded fibers; coated or uncoated; with or without perforations; ASTM E 1677, Type I.

PART 3 EXECUTION

3.1 INSTALLATION

A. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

B. Plywood: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial"

C. Provide nailers, blocking and grounds where required. Set work plumb, level and accurately cut.

D. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with other work.

E. Comply with manufacturer's requirements for cutting, handling, fastening and working treated materials.

F. Restore damaged components. Protect work from damage.

END OF SECTION

SECTION 07 9005
JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants and joint backing.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping: Firestopping sealants.

B. Section 09 9000 - Painting

1.03 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2010.

B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

C. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005 (Reapproved 2010).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating sealant chemical characteristics.

1.06 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

PART 2 PRODUCTS

2.01 SEALANTS

A. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
   1. Applications: Use for:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and wall surfaces.
      c. Other interior joints for which no other type of sealant is indicated.

B. Epoxy Concrete Floor Joint Filler: Self-leveling, pourable, semi-rigid sealant intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Composition: Single or multi-part,100 percent solids by weight.
   2. Hardness: 85, minimum, after 7 days, when tested in accordance with ASTM D2240, Shore A.
   3. Color: Concrete gray.
   4. Joint Width, Minimum: 1/8 inch.
   5. Joint Width, Maximum: 3/4 inch.
   6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.

2.02 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.

D. Install bond breaker where joint backing is not used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Tool joints concave.

H. Concrete Floor Joint Filler: Install concrete floor joint filler per manufacturer's written instructions. After floor joint filler is fully cured, shave joint filler flush with top of concrete slab.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION

A. Protect sealants until cured.

END OF SECTION

SECTION 08 1416

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with **Veneer**
2. Factory fitting flush wood doors to frames and factory machining for hardware.
3. Factory installed glazing

B. Related Requirements:
1. Section 081100 Hollow Metal Doors & Frames
2. Section 087100 Door Hardware
3. Section 088000 Factory Glazing for glass view panels in flush wood doors.
4. Section **099300 Staining and Transparent Finishing** for field finishing doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, vision kits for openings and factory finishing**.**

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Use same unit designations used in Contract Documents.
2. Hardware and [wiring chase] preparation.
3. Glazed openings
4. Blocking dimensions and locations
5. Fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: Available standard **Stain color**

D. Samples for Verification:

1. Factory finish applied to actual door face material, approximately 8 x 10 inches, for each material and finish.

2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

3. Plastic Laminate, 5” square, for each color, texture and pattern selected.

4. Frames for light openings, 6 inches long, for each material, type, and finish when required.

1.4 QUALITY ASSURANCE

A. Quality Standard: WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors”.

B. Security Standard: Filti Testing and Development (FTD), “Shooter Attack Test Method (SA)”

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags and wrap bundles of doors in plastic sheeting.

C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

A. Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

A. Masonite Architectural, Aspiro Series Defend'r Door System
   1. Or Approved equal

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: Provide WDMA I.S.1-A
   1. Performance Grade: Extra Heavy Duty.
   2. Aesthetic Grade: **A grade faces.**

B. Security Standard: FTD-SA
   1. Performance Class:
      a. Non-rated-Class 6
      b. 20-Minute rated – Class 3
      c. 45- Minute rated –Class 6

C. Fire-Rated Wood Doors: Conforming to NFPA 80; listed and labeled for required ratings based on testing at pressure NFPA 252 OR UL 10C by UL or other testing agency acceptable to authorities having jurisdiction.

   1. Ratings**; Refer to Door Schedule in Drawings**
   2. Cores:
      a. 20-minute rated: Extra heavy-duty particle board
      b. 45-minute fire rated: Fire-resistant wood-based particleboard
   3. Vertical Edges:
      a. Category A Positive Pressure: Integral intumescent seals concealed by outer stile where required.
      b. Category B Positive Pressure: Intumescent seals applied to door frame per requirements of section 08 71 00 where required.
   4. Blocking: Provide blocking with improved screw holding capability approved for use in doors of fire protection ratings indicated as follows:
      a. 5-inch in doors indicated to have closers and overhead stops
      b. Blocking is not required in structural composite lumber core doors

D. Smoke and Draft Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784 for I occupancy projects.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

   1. Aesthetic Grade: Custom, with Grade A faces
   2. Species**: Veneer**
   3. Cut: **Rotary cut**
   4. Match between Veneer Leaves: **Slip** match.
   5. Assembly of Veneer Leaves on Door Faces: Center balanced match.

6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Vertical Edges: Matching / Compatible Veneer edge band over structural composite lumber
8. Core: Extra Heavy-Duty Particle Board
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.

2.4 LIGHT FRAMES

A. Metal Vision Frames for Light Openings:
1. 18 gauge cold-rolled steel
2. Through-bolted through the door
3. Bite: Minimum 3/8” overlap
4. Finish: **Powder-coated** finish; and approved for use in doors of fire-protection rating indicated.
5. All Metal Stamping-118D or 118

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings:

1. Light Openings: Factory cut and install with vision kits indicated above.
1. Glass: Factory install glass in doors per manufacturer’s instructions.
   a. Non-rated glass to be Armoured One AOTSG516
   b. 20-minute glass to be Armoured One AOSTG1016FR-45
   c. 45-minute glass to be Armoured One AOSTG1016FR-45

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

B. Transparent Finish:

1. Grade: Premium

2. Finish: WDMA TR-8 UV Cured Acrylated Polyester/Urethane.
3. Staining: To be Determined
4. Sheen: Satin

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 Door Hardware.

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.

    a. Comply with NFPA 80 for fire-rated doors.
    b. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

2. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 4313
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 07 9005 - Joint Sealers: Perimeter sealant and back-up materials.

B. Section 08 8000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; American Architectural Manufacturers Association; 2012.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.

C. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2013.

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware 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. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design 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. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

1.07 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.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, 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 FRAMING FOR INSULATING GLAZING~~

~~A. Front-Set Style, Thermally-Broken:~~
~~1. Basis of Design: Basis of Design Efco, 526 or YKK, YHS 50 FS.~~
~~2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.~~

~~B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:~~
~~1. C.R. Laurence Co., Inc; U.S. Aluminum: www.crl-arch.com.~~
~~2. EFCO, a Pella Company: www.efcocorp.com.~~
~~3. YKK AP America Inc: www.ykkap.com.~~

2.02 CONCEALED FRAME WINDOWS

A. Concealed vent, Thermally-Broken:
1. Basis of Design:
2. Mullion Dimensions: 1-13/16” wide by 2-3/4 inches deep.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
1. C.R. Laurence Co., Inc; U.S. Aluminum: www.crl-arch.com.
2. EFCO, a Pella Company: www.efcocorp.com.
3. YKK AP America Inc: www.ykkap.com.

2.03 SWINGING DOORS

A. Narrow Stile, Insulating Glazing, Interior Door(s):
1. Basis of Design: Kawneer Company, Inc., 450 Standard Entrances.
2. Thickness: 2-1/4 inches (57.1 mm).

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
1. C.R. Laurence Co., Inc; U.S. Aluminum: www.crl-arch.com.
2. EFCO, a Pella Company: www.efcocorp.com.
3. YKK AP America Inc: www.ykkap.com.

~~2.04 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.
b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

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 (95 degrees C) 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.

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: As specified in Section 08 8000 - Glazing.
   1. For Exterior Framing: Type G-8 or G-9.

C. Swing Doors: Glazed aluminum.
   1. Finish: Same as storefront.

D. Operable Sash: Aluminum project-out awning; structural silicone glazed concealed frame, finished to match storefront; pivot shoe roto-operator, insect screen with full wicket.

2.06 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Fasteners: Stainless steel.

D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.07 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating or AAMA 612 clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils (0.018 mm) thick.

B. Pigmented Organic Coating System: AAMA 2603; polyester or acrylic baked enamel finish.

2.08 HARDWARE

A. Other Door Hardware: Storefront manufacturer's standard type to suit application.
   1. Finish on Hand-Contacted Items: Polished chrome.
   2. For each door, include butt hinges, pivots, push handle, pull handle, exit device, narrow stile handle latch, and closer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor 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. Coordinate attachment and seal of perimeter air and vapor barrier materials.

I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

J. Install operating sash.

K. Set thresholds in bed of mastic and secure.

L. Install hardware using templates provided.

M. 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 inches every 3 ft (1.5 mm/m) non-cumulative or 1/16 inches per 10 ft (1.5 mm/3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 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. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 7100
FINISH 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. Section Includes

1. Furnishing and installation of all mechanical finish hardware necessary for all doors, and hardware as specified herein and as enumerated in hardware sets and as indicated and required by actual conditions at the building. The hardware shall include the furnishing of all necessary screws, bolts, expansion shields, drop plates, and all other devices necessary for the proper application of the hardware. Installation shall include field modification and preparation of existing doors and/or frames for new hardware being installed. Provide necessary fillers, Dutchmen, reinforcements, and fasteners for mounting new hardware and to cover existing door/frame preps.

B. Related Sections

1. Division 8 Section – Aluminum-Framed Storefronts

2. Division 8 Section – Flush Wood Doors

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:

1. Windows

2. Cabinets of all kinds, including open wall shelving and locks.

3. Signage, except as noted.

4. Complete toilet accessories including coat hooks, unless note otherwise.

5. Overhead doors, unless noted otherwise.

1.03 REFERENCES

A. Applicable state and local building codes and standards.

B. FIRE/LIFE SAFETY

1. NFPA - National Fire Protection Association

a. NFPA 70 – National Electric Code
b. NFPA 80 - Standard for Fire Doors and Fire Windows
c. NFPA 101 - Life Safety Code
d. NFPA 105 - Smoke and Draft Control Door Assemblies

C. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies

2. UL 10C - Positive Pressure Test of Fire Door Assemblies

3. UL 1784 - Air Leakage Tests of Door Assemblies

4. UL 305 - Panic Hardware

D. Accessibility

1. ADA - Americans with Disabilities Act

2. Rhode Island Accessibility Code – SBC-14, 15, 16

E. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule

2. Recommended Locations for Builders Hardware

F. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 requirements. Prior to submittal field verify existing doors and/or frames receiving new hardware and/or existing conditions receiving new openings. Verify new hardware is compatible with the existing door/frame preparation and/or existing conditions. Advise architect within the submittal package of incompatibility or issues.

B. Catalog Cuts: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

C. Final Hardware Schedule Content: Submit schedule with hardware sets in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, Include the following information:

1. Door Index; include door number, heading number, and Architects hardware set number.

2. Opening Lock Function Spreadsheet; list locking device and function for each opening.

3. Type, style, function, size, and finish of each hardware item.

4. Name and manufacturer of each item.

5. Fastenings and other pertinent information.

6. Location of each hardware set cross-referenced to indications on Drawings.

7. Explanation of all abbreviations, symbols, and codes contained in schedule.

8. Mounting locations for hardware.

9. Door and frame sizes and materials.

10. Name and phone number for the local manufacturer's representative for each product.

11. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and/or access control components). Operational description should include how the door will operate on egress, ingress, and/or fire/smoke alarm connection.

D. Key Schedule: After a keying meeting between representatives of the Owner, Architect, hardware supplier, and, if requested, the representative for the lock manufacturer, provide a keying schedule, listing the levels of keying, as well as an explanation of the key system's function, the key symbols used, and the door numbers controlled. Utilize ANSI A156.28 “Recommended Practices for Keying Systems” as a guideline for nomenclature, definitions, and approach for selecting the optimal keying system.

E. Samples: If requested by the Architect, submit production sample or sample installations as requested of each type of exposed hardware unit in the finish indicated, and tagged with a full description for coordination with the schedule.

1. Samples will be returned to the supplier in like-new condition. Units that are acceptable to the Architect may, after final check of operations, be incorporated into the Work, within limitations of key coordination requirements.

F. Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.

G. Riser and Wiring Diagrams: After final approval of the hardware schedule, submit riser and wiring diagrams as required for the proper installation of complete electrical, electromechanical, and electromagnetic products.

H. Operations and Maintenance Data: Provide in accordance with Division 01 and include the following:

1. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.

2. Catalog pages for each product.

3. Name, address, and phone number of local representative for each manufacturer.

4. Parts list for each product.

5. Copy of final approved hardware schedule, edited to reflect “As installed.”

6. Copy of final keying schedule.

7. ~~As installed "Wiring Diagrams" for each opening connected to power, both low voltage and 110 volts.~~

8. One (1) complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

9. Copy of warranties including appropriate reference numbers for manufacturers to identify the project.

I. Certificates of Compliance: Upon request of Architect or Authority Having Jurisdiction certificates of compliance for fire-rated hardware and installation instructions shall be made available.

1.05 QUALITY ASSURANCE

A. Substitutions: Products are to be those specified to ensure a uniform basis of acceptable materials. Requests for substitutions must be made in accordance with Division 1 requirements. If proposing a substitute product, submit product data for the proposed item with product data for the specified item and indicate basis for substitution and savings to be made. Provide sample if requested. Certain products have been selected for their unique characteristics and particular project suitability.

1. Items specified as "no substitute" shall be provided exactly as listed.

2. Items listed with no substitute manufacturers listed have been requested by the Owner or Architect to match existing for continuity and/or future performance and maintenance standards or because there is no known equal product.

3. If no other products are listed in a category, then "no substitute" is implied.

B. Supplier Qualifications: A recognized architectural hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides a certified Architectural Hardware Consultant (AHC) available to the Owner, Architect, and Contractor, at reasonable times during the course of the Work for consultation.

C. Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, exit devices, closers, etc.) from a single manufacturer.

D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwrites Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to the authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

E. Electronic Security Hardware: When electrified hardware is included in the hardware specification, the hardware supplier must employ an individual knowledgeable in electrified components and systems, who is capable of producing wiring diagrams and consulting as needed. Coordinate installation of the electronic security hardware with the Architect and electrical engineers and provide installation and technical data to the Architect and other related subcontractors. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Tag each item or package separately with identification related to the final hardware schedule and include installation instructions with each item or package.

B. Each article of hardware shall be individually packaged in manufacturer's original packaging.

C. Contractor will provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Items damaged in shipment shall be replaced promptly and with proper material and paid for by whomever did the damage or caused the damage to occur.

E. Hardware shall be handled in a manner to avoid damage, marring, or scratching. Irregularities that occur to the hardware after it has been delivered to the Project shall be corrected, replaced, or repaired by the Contractor. Hardware shall be protected against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. No direct shipments will be allowed unless approved by the Contractor.

1.07 WARRANTY

A. Provide manufacturer's warrantees as specified in Division 1 and as follows:

1. Closers: 10 years

2. Locksets: 3 years

3. Other hardware: 1 year.

B. No liability is to be assumed where damage or faulty operation is due to improper installation, improper use, or abuse.

C. Products judged to be defective during the warranty period shall be replaced or repaired in accordance with the manufacturer's warranty, at no additional cost to the Owner.

1.08 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Awarding Authority has determined that certain products should be selected for their unique characteristics and particular project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute” (NO OTHER PRODUCTS WILL BE CONSIDERED FOR THOSE LISTED IN PROJECTS DOCUMENTS.)

B. Approval of manufacturers other than those listed shall be in accordance with paragraph 1.05.A.

C. Note that even though an acceptable substitute manufacturer may be listed, the product must provide all the functions and features of the specified product, or it will not be approved.

Item	Scheduled Manufacturer	Acceptable Substitute
Hinges	Assa Abloy	NO SUBSTITUTE
Locksets	Assa Abloy	NO SUBSTITUTE
Stops & Holders	Assa Abloy	NO SUBSTITUTE
Cylinders & Keying	Assa Abloy	NO SUBSTITUTE

D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

E. Where the hardware specified is not adaptable to the finished shape or size of the members requiring hardware, furnish suitable types having the same operation and quality as the type specified, subject to the Architect's approval.

2.02 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.

2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

3. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent that no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Review door specification and advise Architect if thru-bolts are required.

4. Hardware shall be installed with the fasteners provided by the hardware manufacturer.

B. Hinges

1. Provide five-knuckle, ball bearing hinges of type, material, and height as outlined in the following guide for this specification:

a. 1-3/4-inch-thick doors, up to and including 36 inches wide:
Exterior: standard weight, bronze/stainless steel, 4-1/2 inches high
Interior: standard weight, steel, 4-1/2 inches high
b. 1-3/4-inch-thick doors over 36 inches wide:
Exterior: heavy weight, bronze/stainless steel, 5 inches high
Interior: heavy weight, steel, 5 inches high
c. 2 inches or thicker doors:
Exterior: heavy weight, bronze/stainless steel, 5 inches high
Interior: heavy weight, steel, 5 inches high

2. Provide three hinges per door leaf for doors 90 inches or less in height, and one additional hinge for each 30 inches of additional door height.

3. Where new hinges are specified for existing doors and/or existing frames, the new hinge size must be identical to hinge preparation present in the existing door and/or existing frame.

4. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

5. The width of hinges shall be 4-1/2 inches at 1-3/4-inch-thick doors, and 5 inches at 2 inches or thicker doors. Adjust hinge width as required for door, frame, and/or wall conditions to allow proper degree of opening.

6. Provide hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to the electrified locking component.

7. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame specification.

8. Acceptable manufacturers and/or products: Ives 5BB series, Hager BB series, Stanley FBB Series.

C. Cylindrical Locks - Grade 1

1. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to 2.04 KEYING.

2. Provide solid steel rotational stops to control excessive rotation of the lever.

3. Lockset to be completely refunctionable. Lockset design shall allow function of lock to be changed into over twenty other common functions by swapping easily accessible parts.

4. Provide locks with a standard 2-3/4 inches backset, unless noted otherwise, with a 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.

5. Provide locksets with a separate anti-rotation throughbolts and shall have no exposed screws. Levers shall operate independently and shall have two external return spring cassettes mounted under roses to prevent lever sag.

6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

7. Lever trim shall be solid cast levers without plastic inserts, and wrought roses on both sides. Locksets shall be thru-bolted to assure proper alignment.

   a. Lever design shall be Schlage Rhodes.
   b. Lever trim on the secure side of doors serving rooms considered by the authority having jurisdiction to be hazardous shall have a tactile warning.

8. Acceptable manufacturers and/or products: Schlage ND series, No Substitute.

D. Door Stops and Holders

1. Provide door stops for all doors in accordance with the following requirements:

    a. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
    b. Where wall stops cannot be used, provide dome type floor stops of the proper height.
    c. At any opening where a wall or floor stop cannot be used, a medium duty surface mounted overhead stop shall be used.

2. Acceptable manufacturers and/or products: Assa Abloy's Product Lines.

E. Silencers

1. Provide "Push-in" type silencers for each hollow metal or wood frame. Provide three for each single frame and two for each pair frame. Omit where gasketing is specified or required by code.

2. Acceptable manufacturers and/or products: Ives, Burns, Rockwood.

2.03 FINISHES

A. Finish of all hardware shall be US26D (BHMA 626/652) with the exceptions as follows:

2.04 KEYING

A. Provide cores and cylinders for the Owner's Existing Schlage Everest D Restricted Conventional Core, key system conforming to the following requirements:

1. Provide restricted patented conventional cylinders at al keyed devices, locksets, and exit device cylinder dogging. Restricted shall control the access to the products by requiring a signed letter of authorization and/or authorization form from the Owner or authorized agent of the Owner. Patent shall protect against the unauthorized manufacturing and duplication of the products. Restricted patented cylinders shall not be operable by non-patented key blanks. Restricted patented cylinders shall incorporate a mechanism to check for the patented features on the keys. Provide Split Key Construction Keys for use during construction. The hardware supplier, accompanied by the Owner or Owner's security agent, shall remove all Construction Inserts upon completion of the building.

2. Provide permanent cores and cylinders keyed by the manufacturer or authorized distributor into the existing key system as directed by the Owner. Provide owner with a copy of the bitting list, return receipt requested.

3. The hardware supplier, accompanied by a qualified factory representative for the manufacturer of the cores and cylinders, shall meet with Owner and Architect to review keying requirements and lock functions prior to ordering finish hardware. Submit a keying schedule to Architect for approval.

4. Provide keys as follows

    a. Ten grand master keys for each set.
    b. Ten master keys for each set.
    c. Three keys per core and/or cylinder.
    d. Six extractor tools.
    e. Six split key construction keys for each type (Contractor is to provide one set of split key construction keys to Architect).

5. Visual key control:

    a. Keys shall be stamped with their respective key set number and stamped “DO NOT DUPLICATE".
    b. All keys shall be stamped with their respective key set letters.
    c. Do not stamp any keys with the factory key change number.
    d. Do not stamp any cores with key set on face (front) of Core. Stamp on back or side of cores so not to be visible when core is in cylinder.

6. Deliver all keys and/or key blanks from the factory or authorized distributor directly to the Owner in sealed containers, return receipt requested. Failure to comply with these requirements may be cause to require replacement of all or any part of the keying system that was compromised at no additional cost to the Owner.

7. Approved products: Schlage Everest D Restricted, No Substitute.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of any hardware, examine all doors, frames, walls, and related items for conditions that would prevent proper installation of finish hardware. Correct all defects prior to proceeding with installation.

3.02 INSTALLATION

A. Coordination:

1. Prior to installation of hardware, schedule and hold a meeting for the purpose of instructing installers on proper installation and adjustment of finish hardware. Representatives of locks, exit devices, closers, automatic operators, and electrified hardware shall conduct training; provide at least 10 days notice to representatives. After training a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.

2. Prior to ordering electrified hardware, schedule and hold a meeting for the purpose of coordinating finish hardware with security, electrical, doors and frames, and other related suppliers. A representative of the supplier of finish hardware, and doors and frames, the electrical subcontractor, and the Owner’s security contractor shall meet with the Owner, Architect, and General Contractor prior to ordering finish hardware. After meeting a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.

B. Hardware will be installed by qualified tradesmen, skilled in the application of commercial grade hardware. For technical assistance, if necessary, installers may contact the manufacturer’s rep for the item in question, as listed in the hardware schedule.

C. Mount hardware units at heights indicated in “Recommended Locations for Builders Hardware for Standard Steel Doors and Frames” by the Door and Hardware Institute.

D. Install each hardware item in compliance with the manufacturer’s instructions and recommendations, using only the fasteners provided by the manufacturer.

E. Do not install surface mounted items until finishes have been completed on the substrate. Protect all installed hardware during painting.

F. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

G. Operating parts shall move freely and smoothly without binding, sticking, or excessive clearance.

H. Existing Doors and/or Frames: Remove existing hardware being replaced, tag, and store according to contract documents. Field modify and prepare existing door and/or frame for new hardware being installed. Provide necessary fillers, Dutchmen, reinforcements, and fasteners for mounting new hardware and to cover existing door/frame preps.

I. Wire (including low voltage), conduit, junction boxes, and pulling of wire is by Division 16, Electrical. Electrical Contractor shall connect wire to door position switches and run wire to central room or area as directed by the Architect. Wires shall be tested and labeled with the Architects opening number. Connections to/from power supplies to electrified hardware and any connection to fire/smoke alarm system, and/or smoke evacuation system where specified is by Division 16 Electrical.

3.03 ADJUSTING, CLEANING, AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door, to insure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.

B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make a final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Clean adjacent surfaces soiled by hardware installation.

D. Instruct Owner’s personnel in the proper adjustment, lubrication, and maintenance of door hardware and hardware finishes.

3.04 FIELD QUALITY CONTROL

A. Prior to Substantial Completion, the installer, accompanied by representatives of the manufacturers of locks, exit devices, closer, and any electrified hardware, shall perform the following work:

1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.

2. Consult with and instruct Owner’s personnel in recommended additions to the maintenance procedures.

3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.

4. Prepare a written report of current and predictable problems of substantial nature in the performance of the hardware.

5. At completion of project, a qualified factory representative for the manufacturers of locksets, closer, exit devices, and access control products shall arrange and hold a training session to instruct the Owner’s personnel on the proper maintenance, adjustment, and/or operation of their respective products. After training a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.

3.05 PROTECTION

A. Provide for the proper protection of complete items of hardware until the Owner accepts the project as complete. Damaged or disfigured hardware shall be replaced or repaired by the responsible party.

3.06 HARDWARE SCHEDULE

A. Provide hardware for each door to comply with requirements of Section “Finish Hardware,” hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.

B. It is intended that the following schedule includes complete items of finish hardware necessary to complete the work. If a discrepancy is found in the schedule, such as a missing item, improper hardware for a frame, door or fire codes, the preamble will be the deciding document.

C. Locksets, exit devices, and other hardware items are referenced in the Hardware Sets for series, type, and function. Refer to the preamble for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets: To be provided by the contractor for the Architect’s review.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal stud wall framing.

B. Gypsum wallboard.

C. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 07 9200 - Joint Sealants: Sealing gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.

D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.

E. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.

F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.

G. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

H. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.

I. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2015.

J. GA-216 - Application and Finishing of Gypsum Board; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.02 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. Clarkwestern Dietrich Building Systems LLC; www.clarkdietrich.com.
   2. Marino; www.marinoware.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Non-Loadbearing Framing System Components: ASTM C645; 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 (L/120 at 240 Pa).
   1. Studs: "C" shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company; www.americangypsum.com.
   2. Georgia-Pacific Gypsum; www.gpgypsum.com.
   3. National Gypsum Company; www.nationalgypsum.com.
   4. USG Corporation; www.usg.com.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Thickness:
      a. Vertical Surfaces: 5/8 inch (16 mm).
   3. Paper-Faced Products:
      a. American Gypsum Company; LightRoc Gypsum Wallboard.
      b. Georgia-Pacific Gypsum; ToughRock.

C. Impact Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
   5. Thickness: 5/8 inch (16 mm).
   6. Edges: Tapered.

2.04 ACCESSORIES

A. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel, or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile for tape embedment, for 90 degree outside corners and archways.
   2. J-Beads: for tape embedment, at all joints to dissimilar materials

B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
   2. Ready-mixed vinyl-based joint compound.

C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

D. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) 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 C754 and manufacturer's instructions.

B. Studs: Space studs at 16 inches on center (at 406 mm 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.

C. Blocking: Install wood blocking for support of:
   1. Wall mounted door hardware.
   2. Visual Display Monitors
   3. White boards

3.03 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. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim (J Bead): Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.

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 (0.8 mm).

END OF SECTION

SECTION 09 5100
SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 RELATED REQUIREMENTS

A. Section 23 3700 - Air Outlets and Inlets: Air diffusion devices in ceiling.

B. Section 26 5100 - Interior Lighting: Light fixtures in ceiling system

1.03 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on suspension system components.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed

1.05 QUALITY ASSURANCE

A. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
   2. Suspension System: Obtain each type through one source from a single manufacturer

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.08 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
   2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Basis-of-Design: Armstrong World Industries, Inc; www.armstrong.com.
   2. CertainTeed Corporation; www.certainteed.com.
   3. USG; www.usg.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Suspension Systems:
   1. Basis-of-Design: Armstrong World Industries, Inc; www.armstrong.com.
   2. CertainTeed Corporation; www.certainteed.com.
   3. USG; www.usg.com.

2.02 ACOUSTICAL UNITS

A. Basis of Design: Acoustical Panel Ceilings ULTIMA High NRC, as manufactured by Armstrong World Industries, Inc.
   1. Painted mineral fiber, ASTM E1264 Type: A, Form: A2.2, Pattern: E with the following characteristics:
   2. Surface Texture: Smooth Texture
   3. Composition: Mineral Fiber
   4. Color: White
   5. Size: 24 in x 24 in
   6. Edge Profile: Beveled Tegular
   7. Noise Reduction Coefficient (NRC) ASTM C 423 Classified w/ UL: 0.80
   8. Ceiling Attenuation Class (CAC): ASTM E1414/E1414M; Classified with UL: 35
   9. Articulation Class (AC): ASTM E 1111; Classified with UL: 170
   10. Flame Spread: ASTM E 1264; Class A
   11. Light Reflectance (LR) White Panel: ASTM E 1477; 0.87
   12. Dimensional Stability: Standard, HumiGuard Plus
   13. Recycle Content: Up to 89% total recycled content. (Total recycled content: pre-consumer, post-consumer and post-industrial)
   14. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
   15. Life Cycle Assessment: Third Party Certified Environmental Product Declaration (EPD)
   16. Indoor Air Quality Certified to SCS-105 v4.2-2023

17. USDA Certified Biobased Product

2.03 SUSPENSION SYSTEM

A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
   1. Structural Classification: ASTM C 635 Intermediate or Heavy Duty.
   2. Color: White or match the actual color of the selected ceiling tile, unless noted otherwise.
   3. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
   4. Basis of Design: Suprafine XL 9/16” Exposed Tee as manufactured by Armstrong World Industries, Inc.

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Edge Moldings and Trim as manufactured by Armstrong World Industries, Inc.

E. Accessories as manufactured by Armstrong World Industries, Inc.

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 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Locate system on room axis according to reflected plan.

C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

D. 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.

E. 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.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches (150 mm) of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

3.03 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. Install units after above-ceiling work is complete.

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.

END OF SECTION

SECTION 09 5610
FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:

1. Tiling Carpeting.
2. Accessories.

B. Preparation of existing wood and concrete floor slabs for installation of floor coverings, including floor leveler for existing defects and repaired areas.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Preparation of wood-based subfloors for installation of new floor coverings. Patching compound (floor leveler) application to new screw heads throughout the work area.

E. Removal of existing floor coverings, adhesives, loose or incompatible floor leveler, wall base, and transition strips within the work areas shown.

F. Treating of areas with exposed adhesive with floor sealer/primer as recommended by carpet tile manufacturer.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Additional requirements relating to testing agencies and testing.

B. Section 01 7320 - Waste Management: Handling of existing floor coverings removed.

1.03 REFERENCES

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Flooring; 2011.

B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

A. 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.

B. 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. Submit report to Architect.

7. Submit report not more than two business days after conclusion of testing.

C. Adhesive Bond and Compatibility Test Report.

D. Sealer Materials Product Data: Manufacturer's published data on each product to be used for remediation.

1. Manufacturer's installation instructions.

2. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.06 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. 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.

C. 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.

1.07 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.

1.08 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 (18 degrees C) or more than 85 degrees F (30 degrees C).

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. Patching Compound (floor leveler): Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:

1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.

2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.

3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Sealer: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. Consult carpet tile manufacturer for appropriate sealer to us over cut-back.

PART 3 EXECUTION

3.01 REMOVAL OF EXISTING FLOOR COVERINGS

A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings and carpet, as applicable to floor covering being removed.

B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.02 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:

1. Preliminary cleaning.
2. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
5. Specified remediation, if required.
6. Patching, smoothing, and leveling, as required.
7. Other preparation specified.
8. Adhesive bond and compatibility test.
9. Protection.

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 (1.4 kg per 93 square meters) 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. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.

C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.

D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

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 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

SECTION 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Resilient tile flooring.
B. Resilient base.
C. Installation accessories.

1.02 REFERENCE STANDARDS
A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
B. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2015.
C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
D. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, 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. Review Samples: Submit manufacturer's complete set of color samples for Architect's review and approval.

1.04 QUALITY ASSURANCE
A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.
B. Select an installer who is experienced and competent in the installation of Armstrong resilient solid vinyl tile flooring and the use of Armstrong Flooring subfloor preparation products.
    1. Engage installers certified as Armstrong Commercial Flooring Certified Installers
    2. Confirm installer's certification by requesting their credentials
C. Fire Performance Characteristics: Provide resilient tile flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
    1. ASTM E 648 (NFPA 253) Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
    2. ASTM E 662 (NFPA 258) (Smoke Generation) Maximum Specific Optical Density of 450 or less

1.05 DELIVERY, STORAGE, AND HANDLING
A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
B. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
C, Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer.

Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.06 PROJECT CONDITIONS

A. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65ºF (18ºC) and a maximum temperature of 85ºF (29ºC) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55ºF (13ºC) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances

1.07 LIMITED WARRANTY

A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
B. The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.
C. For the Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

1.08 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Quantity: Furnish quantity of flooring units equal to 5% of amount installed.
   2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage, and protection of extra material.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Basis of Design: Biome Luxury Flooring manufactured by Armstrong Flooring Inc.
   1. Description: A layered construction consisting of a tough, clear, rigid vinyl wear layer protecting a high-fidelity print layer on a solid vinyl backing. Protected by a diamond-infused UV-cured polyurethane finish, the wear surface is embossed with different textures to enhance each of the printed visuals. Colors are insoluble in water and resistant to cleaning agents and light.
   2. Reference specification - ASTM F 1700, “Standard Specification for Solid Vinyl Tile", Class III, Type B – Embossed Surface. Meets requirements for size, squareness, thickness, thickness of wear layer, residual indentation, resistance to chemicals, resistance to light and resistance to heat.
   3. Pattern and Color: As indicated in the finish specifications in drawings.
   4. Size: 6 in. x 48 in. (152 mm x 1219 mm).
   5. Wear layer thickness: 0.020 in. (0.5 mm).
   6. Thickness: 0.100 in. (2.5 mm).

2.02 RESILIENT BASE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Tarkett Traditional Thermoplastic Vinyl Wall Base.

B. Performance requirements meets ASTM F1861 Standard Specification for Resilient Vinyl Wall Base, Type TV, Group 1.
C. Thickness: [0.080" (2 mm)
D. Type: Coved
E. Height: 6" (15.24 cm)
F. Length:100' (30.48 m)
G, Colors and Patterns:As indicated in the finish specifications in drawings.
H. Test Data:
    1. Flexibility, ASTM F137: Passes 1/4 inch mandrel
    2. Resistance to light, ASTM F1515: Passes
    3. Resistance to chemicals, ASTM F925: Passes
    4. ASTM E 648, Standard Test Method for Critical Radiant Flux of 0.45 watts/cm^2 or greater, Class 1.

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer, including primer over asphaltic adhesive.
C. Moldings, Transition and Edge Strips: Color to be selected by Architect.

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. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
    1. Test in accordance with ASTM F710.
    2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

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 sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
D. Prohibit traffic until filler is fully cured.Perform subfloor moisture testing in accordance with ASTM F 2170, “Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes” and Bond Tests. Internal relative humidity of the concrete shall not exceed 99%. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.
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

A. Starting installation constitutes acceptance of sub-floor conditions.
B. Install in accordance with manufacturer's written instructions.
C. Spread only enough adhesive to permit installation of materials before initial set.
D. Fit joints and butt seams tightly.
E. Set flooring in place, press with heavy roller to attain full adhesion.
F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 TILE FLOORING

A. Install flooring in strict accordance with the latest edition ofManufacturer’s instructions. Failure to comply may result in voiding the manufacturer’s warranty listed in Section 1.08.
B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.

3.05 RESILIENT BASE

A. Do not stretch resilient base during installation.
B. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
C. Install base on solid backing. Bond tightly to wall and floor s
D. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrate surfaces.
E. 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. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.
B. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 6513
RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Provide resilient wall base and accessories.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

C. Submit extra stock equal to 2% of total used.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Performance: Fire performance meeting requirements of building code and local authorities.

PART 2 PRODUCTS

2.1 MATERIALS

A. Resilient Wall Base:
1. Type: TV (vinyl).
2. Group: I (solid, homogeneous)
3. Style: Cove.
4. Thickness: 0.125 inch
5. Height: 4 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions and recommendations. Install in proper relation to adjacent work.

B. Install base and accessories to minimize joints. Install base with joints as far from corners as practical.

C. Clean, polish, and protect.

END OF SECTION

SECTION 09 9100 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

PART 2 - Complete painting and finishing of new surfaces included in the Work.

1. Surfaces that are left unfinished by other sections of Specifications shall be painted or finished as a part of this section.
2. Copper, bronze, chromium plate, nickel, stainless steel, aluminum, Monel metal, lead, and lead coated copper shall not be painted or finished.
3. Other surfaces not to be painted include items with factory applied final finish; concealed ducts and pipes; and plenums above suspended ceilings, except as noted otherwise.

PART 3 - Painting or finishing existing surfaces where scheduled or required as a result of alterations work.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1.4 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to lusterless or matte finish with a gloss range below 15 when measure at an 85-degree meter.
2. Low-Sheen 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.
4. Full-Gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.5 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For each color and type of finish-coat material in gloss range indicated.

1.6 QUALITY ASSURANCE

A. Product Labels: Include manufacturer's name, type of paint, stock number, color and label analysis **on label of containers.**

1.7 PROJECT CONDITIONS

A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

B. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
D. Comply with applicable health and fire regulations.

1.8 **EXTRA MATERIALS**

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
1. Quantity: 5 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
1. Sherwin-Williams Co. (Sherwin-Williams).
2. Dunn Edwards Paints
3. Benjamin Moore & Co. (Benjamin Moore).
4. ICI Dulux Paint Centers (ICI Dulux Paints).

2.2 **PAINT MATERIALS, GENERAL**

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
C. Chemical Components of Interior Paints and Coatings: Unless otherwise indicated as specified herein, provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
1. Flat Paints and Coatings: VOC not more than 50 g/L.
2. Non-Flat Paints and Coatings: VOC not more than 150 g/L.
3. Anticorrosive Coatings: VOC not more than 250 g/L.
4. Varnishes and Sanding Sealers: VOC not more than 350 g/L.
5. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
6. Restricted Components: Paints and coatings shall not contain acrolein; acrylonitrile; antimony; benzene; butyl benzyl phthalate; cadmium; di (2-ethylhexyl) phthalate; di-n-butyl phthalate; di-n-octyl phthalate; 1,2-dichlorobenzene; diethyl phthalate; dimethyl phthalate; ethylbenzene; formaldehyde; hexavalent chromium; isophorone; lead; mercury; methyl ethyl ketone; methyl isobutyl ketone; methylene chloride; naphthalene; toluene (methylbenzene); 1,1,1-trichloroethane; or vinyl chloride.
D. Colors: Match colors as indicated in Finish Specifications on Drawings as P-1 through P-5.

2.3 **MATERIALS:**

A. Concrete Unit Masonry Block Filler: High-performance latex block filler of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.

B. Interior Galvanized Metal Primer: SW, Pro Industrial Pro-Cryl Primer, B66-310 Series, or approved equal.

C. Ornamental Metal Primer: SW, Pro Industrial Pro-Cryl Primer, B66-310 Series or approved equal.

D. Interior Painted Wood Primer: SW, ProBlock Premium All-Purpose Primer, Interior Water Based, B51W00 series, or approved equal.

E. Interior Drywall Primer: SW, ProMar 200 Zero VOC Latex Primer, B28W2600, or approved equal.

F. Alkyd Urethane Alkyd Satin Enamel: SW, Pro-Industrial Urethane Alkyd Semi-Gloss Enamel, Low or Zero VOC, B54-150 Series,or approved equal.

G. Latex Eggshell Enamel: SW, Pro-Mar 200 Latex Flat Wall Paint, Series B20, Zero VOC, or approved equal.

H Latex Semi-gloss Paint: SW, Pro-Industrial Zero VOC Acrylic Semi-Gloss, Series B66-650, Zero VOC, or approved equal.

I. Latex Flat Wall Paint - Fire retardant: SW, Pro-Mar 200 Latex Flat Wall Paint, Series B30W200. Low or Zero VOC.

J. Wood Doors: Hybrid Satin Polyurethane: Minwax Performance Series.or approved equal.

K. Texture Paint: USG Sheetrock Wall and Ceiling Spray Texture Finish

L. Wood Floor Finish: Water-based, self-crosslinking polyurethane and urethane resin formula: Minwax, Ultimate Floor Finish, clear satin or approved equal

M. Interior Concrete Floor Clear Satin Water-based Penetrating Lithium Silicate: Prosoco, Consolideck LS/CS

2.4 **MIXING AND TINTING:**

A. Accomplish job site tinting and mixing only when approved by Architect. Use tinting colors recommended by paint manufacturer for specific type of finish.

B. Thin paints only when specifically allowed by manufacturer; do not exceed thinning directions.

PART 3 - EXECUTION

3.1 **EXAMINATION:**

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of finish work, and which cannot be put into an acceptable condition through normal preparatory work.

B. Do not proceed with surface preparation or coating applications until conditions are suitable.

C. Application of paint or finish to surfaces shall constitute acceptance of that surface.

3.2 **GENERAL APPLICATION REQUIREMENTS:**

A. The intent of these Specifications is to produce highest quality appearance of paint and finish surfaces. Employ skilled mechanics only.

B. Finish tops, bottoms, and edges of doors same as balance of doors after they are fitted.

C. Clean surfaces free of foreign matter before applying paint or finishes.

D. Maintain ambient temperature in building of not less than 60°F. for 24 hours prior to and minimum of 24 hours after interior painting.

E. Provide a minimum of 20-foot candles illumination for surfaces to be painted or finished.

3.3 **PREPARATION OF SURFACES:**

A. Remove dirt, dust, oil, grease, and other contaminants from surfaces to be painted.
B. Sand woodwork smooth and clean surface before finishing.
C. Paste wood filler, applied on open grain wood, when set shall be wiped across grain of wood, then with grain to secure a clean surface.
D. Coat surfaces to be stained with a uniform coat of stain and wipe excess off.
E. Sand enamel and varnish finish on wood between coats using a fine sandpaper to produce an even, smooth finish. Thoroughly clean surfaces.
F. Wash metal surfaces with mineral spirits to remove dirt, oil, or grease before applying primer.
G. Remove rust or scale by wire brushing or sanding clean before painting. Clean marred shop coats and touch up with primer.
G. Pretreat galvanized metal surfaces as recommended by paint manufacturer.
I. Fill scratches, cracks, and abrasions in gypsum board with a spackling compound flush with adjoining surface. Remove ridges and other protrusions by scraping flush with surfaces. When dry, sand smooth and seal before application of priming coat.
J. Properly prepare existing surfaces required to be repainted. Remove loose, chipped or cracked existing paint. Thoroughly clean surfaces prior to painting. Fill and sand cracks and depressions. Lightly sand existing metal surfaces.
K. Provide full primer/sealer coat on existing painted surfaces unless specified finish coat material is compatible with existing paint.
L. Completely remove existing finish on existing wood doors scheduled to be refinished.
M. Fill and sand metal door frames to provide a smooth surface before finishing. Touch-up factory prime coat before applying first coat.
N. Touch-up shop coats on metal surfaces before applying
O. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

3.4 **APPLICATION**

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primer
C. Material Preparation:
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
D. Apply paint with suitable brushes, rollers, or spray equipment, as recommended by manufacturer.
E. Allow previous coats to thoroughly dry before applying succeeding coats.
F. Edges of paint adjoining other materials or colors shall be sharp and clean with no overlapping.
G. Slightly vary the color of successive coats.
H. Adjust transparent finishes to obtain matching appearance between new and existing doors.
I. Sand and dust between each coat to remove visual defects.
J. Apply each coat of paint uniformly to minimum wet film (MWF) thickness specified in schedule below, or as recommended by manufacturer.

K. Exposed Surfaces: Include areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
2. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
3. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
5. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

L. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Omit primer over metal surfaces that have been shop primed and touchup painted.
2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.

M. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

3.5 CLEANING AND PROTECTING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

B. Spot painting will be allowed to correct soiled or damaged paint surfaces only when touch-up spot will blend into surrounding finish and is invisible to normal viewing. Otherwise, re-coat entire section to corners or visible stopping point.

C. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

D. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

E. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINT SCHEDULE

A. Interior Hollow Metal Frames:
1. 1st coat - Alkyd Satin Enamel (MWF 2.9 mils)
2. 2nd coat - Same.

B. Interior Metals:
1. 1st coat - Ornamental Metal Primer (MWF 3.6 mils)
2. 2nd coat - Alkyd Satin Enamel (MWF 2.9 mils)

C. Interior Galvanized Metals:
1. 1st coat - Interior Galvanized Steel Primer (MWF 3.6 mils)
2. 2nd coat - Alkyd Satin Enamel (MWF 3.6 mils)

D. New and Existing Wood Floors and Doors: Transparent Finish
1. 1st coat - Water-based, self-crosslinking polyurethane and urethane resin formula
2. 2nd coat - Same

3. 3rd coat - Same

E. Gypsum Board Walls:
1. 1st coat - Texture Paint - apply with roller to match existing texture
2. 2nd coat - Latex Eggshell Enamel (MWF 3.6 mils)
3. 3rd coat - Same

F. Gypsum Board Ceilings:
1. 1st coat - Texture Paint - apply with roller to match existing texture
2. 2nd coat - Latex Interior Eggshell Wall Paint (MWF 4.0 mils)

G. Fire Retardant Plywood Wall Panels:
1. 1st coat - Latex Interior Flat Wall Paint - Fire Retardant (MWF 4.8 mils)
2. 2nd coat - Same

H. Concrete Floor Sealer:
1. 1st Coat: Clear sealer - spray applied

END OF SECTION

SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate cabinet physical dimensions.

C. Product Data: Provide extinguisher operational features.

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

E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Ansul, Inc; Red Line: www.ansul.com.
   2. Pyro-Chem: www.pyrochem.com.
   3. Strike First Corporation of America; Water Fire Extinguisher: www.strikefirstusa.com.

B. Fire Extinguisher Cabinets and Accessories:
   1. Ansul, Inc.: www.ansul.com.
   2. JL Industries, Inc: www.jlindustries.com.
   3. Larsen's Manufacturing Co.: www.larsensmfg.com.
   4. Potter-Roemer: www.potterroemer.com.
   5. Pyro-Chem: www.pyrochem.com.
   6. Strike First Corporation of America; EL-Elite Architectural Series Fire Extinguisher Cabinet, Non-Fire Rated: www.strikefirstusa.com.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
   1. Class: A:B:C.
   2. Size: 5 pound (2.27 kg).

2.03 FIRE EXTINGUISHER CABINETS

A. Product: Larsen's Manufacturing Co; Vertical Duo

B. Metal: Formed aluminum.

B. Cabinet Configuration: Recessed type, 5/16” Flat Trim.

C. Door: 1/2 inch thick, reinforced for flatness and rigidity; latch. Satin finish pull handle. Hinge doors for 180 degree opening with continuous piano hinge. Provide self adjusting roller catch.

D. Door Glazing: Tempered Safety Glass, clear.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

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.

C. Secure rigidly in place.

D. Place extinguishers and accessories in cabinets.

3.03 SCHEDULES

A. Dental Lab: 2 Fire Extinguishers hung on brackets located near egress doors.

B. Classroom: 1 Fire Extinguisher hung on bracket located near egress door.

END OF SECTION

SECTION 21 0500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes:
   1. Motors.
   2. Sleeves without waterstop.
   3. Sleeves with waterstop.
   4. Stack-sleeve fittings.
   5. Sleeve-seal systems.
   6. Grout.
   7. Silicone sealants.
   8. Escutcheons.

1.2 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. For each type of product, excluding motors which are included in Part 1 of the fire-suppression equipment Sections.
      a. Include construction details, material descriptions, and dimensions of components.
      b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:
   1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
   2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.

3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Advance Products & Systems, LLC.
   b. CALPICO, Inc.
   c. Metraflex Company (The).
2. Description: Manufactured PVC/HDPE or stainless steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Wade; a subsidiary of McWane Inc.
   c. Zurn Industries, LLC.
2. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Advance Products & Systems, LLC.
   b. CALPICO, Inc.
   c. Metraflex Company (The).
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   a. Hydrostatic Seal: 20 psig minimum.
   b. Sealing Elements: EPDM-rubber or High-temperature-silicone interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
   c. Pressure Plates: Stainless steel.
   d. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating or Stainless steel of length required to secure pressure plates to sealing elements.

E. Grout:
1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

F. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) GE Construction Sealants; Momentive Performance Materials Inc.
      2) Polymeric Systems, Inc.; PPG Industries, Inc.
      3) Sherwin-Williams Company (The).
      4) The Dow Chemical Company.
   b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
2. Silicone Sealant, S, P, T, NT: Single-component, pourable, movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Pecora Corporation.
      2) The Dow Chemical Company.
      3) Tremco Incorporated.
   b. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Smooth-On.
      2) Approved equal.

2.2 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. BrassCraft Manufacturing Co.; a Masco company.
   2. Keeney Manufacturing Company (The).
   3. ProFlo; a Ferguson Enterprises, Inc. brand.

B. Escutcheon Types:
   1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
   2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
   3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
   4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
   5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
   6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

C. Floor Plates:
   1. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

3.2 INSTALLATION OF SLEEVES, GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 8413 "Penetration Firestopping."

3.3 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width centered in concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeves.

3.4 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 6200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 07 8413 "Penetration Firestopping."

3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.6 INSTALLATION OF ESCUTCHEONS

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.7 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:
1. Perform the following tests and inspections:
a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
2. Prepare test and inspection reports.

B. Escutcheons:
1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.8 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above and below Grade:
a. Sleeves with waterstops.
1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
a. Sleeves with waterstops.
1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:
    a. Sleeves with waterstops or stack-sleeve fittings.
4. Interior Walls and Partitions:
    a. Sleeves without waterstops.

3.9 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping:
1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel polished, chrome-plated finish.
3. Insulated Piping:
    a. One piece, steel with polished, chrome-plated finish.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
    a. One piece, steel with polished, chrome-plated finish.
5. Bare Piping at Ceiling Penetrations in Finished Spaces:
    a. One piece, steel with polished, chrome-plated finish.
6. Bare Piping in Unfinished Service Spaces:
    a. One piece, steel with polished, chrome-plated finish.
7. Bare Piping in Equipment Rooms:
    a. One piece, steel with polished, chrome-plated finish.

B. Install floor plates for piping penetrations of equipment room floors.

C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping and Relocated Existing Piping: One piece, floor plate.

END OF SECTION

SECTION 21 0529

HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Equipment supports.

B. Related Requirements:
1. Section 05 5000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 21 0516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment.

C. NFPA Compliance: Comply with NFPA 13.

D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
   2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
   3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Cooper B-line; brand of Eaton, Electrical Sector.
      b. Haydon Corporation.
      c. Unistrut; Atkore International.
   2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
   3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
   4. Channels: Continuous slotted carbon-steel channel with inturned lips.
   5. Channel Width: Selected for applicable load criteria.
   6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
   8. Metallic Coating: Pregalvanized.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
   b. CADDY; brand of nVent Electrical plc.
   c. Carpenter & Paterson, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Select for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating: Pregalvanized.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cooper B-line; brand of Eaton, Electrical Sector.
      b. Hilti, Inc.
      c. MKT Fastening, LLC.
   2. Indoor Applications: Zinc-coated steel.
   3. Outdoor Applications: Stainless steel.

2.6 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.7 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.

D. Fastener System Installation:
   1. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup:
1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 9113 "Exterior Painting."

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

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

E. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

F. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
   3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
   5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
   6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
   7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
   9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Comply with NFPA requirements.

I. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. C-Clamps (MSS Type 23): For structural shapes.
   3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

J. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

K. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 21 0553

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Warning tape
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Craftmark Pipe Markers.
   b. Pipemarker.com; Brimar Industries, Inc.
   c. Seton Identification Products; a Brady Corporation company.
2. Material and Thickness: anodized aluminum, 0.032 inch thick, with predrilled or stamped holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Craftmark Pipe Markers.
2. Pipemarker.com; Brimar Industries, Inc.
3. Seton Identification Products; a Brady Corporation company.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Craftmark Pipe Markers.
2. Pipemarker.com; Brimar Industries, Inc.
3. Seton Identification Products; a Brady Corporation company.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
1. Pipe size.

2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Craftmark Pipe Markers.
   2. Pipemarker.com; Brimar Industries, Inc.
   3. Seton Identification Products; a Brady Corporation company.

B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
   1. Tag Material: anodized aluminum, 0.031 inch thick, with predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass beaded chain or S-hook.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Include valve-tag schedule in operation and maintenance data.

2.5 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Craftmark Pipe Markers.
   2. Pipemarker.com; Brimar Industries, Inc.
   3. Seton Identification Products; a Brady Corporation company.

B. Description: Preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Reinforced grommet and wire or string.
   3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of fire-suppression equipment.

B. Sign and Label Colors:
1. White letters on an ANSI Z535.1 safety-red background.

C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

A. Piping Color Coding: Painting of piping is specified in Section 09 9123 "Interior Painting."

B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit a view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft.in areas of congested piping and equipment.

D. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Fire-Suppression Pipe Label Color Schedule:
1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

3.5 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
1. Valve-Tag Size and Shape:
   a. Fire-Suppression Standpipe: 2 inches, round.
   b. Wet-Pipe Sprinkler System: 2 inches, round.
   c. Dry-Pipe Sprinkler System: 2 inches, round.
2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

3.6 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where scheduled.

END OF SECTION

SECTION 21 1313

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel pipe and fittings.
   2. Sprinkler piping specialties.
   3. Sprinklers.

B. Related Requirements:
   1. Section 23 0523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.2 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, or BIM model, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.

B. Qualification Data: For qualified Installer and professional engineer.

C. Design Data:
   1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Field Test Reports:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
2. Fire pump test report.

F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire pump test.
a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.8 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 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. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

D. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design wet-pipe sprinkler systems.
   1. Sprinkler system design shall be approved by authorities having jurisdiction.
      a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
      b. Sprinkler Occupancy Hazard Classifications:
         1) Building Service Areas: Ordinary Hazard, Group 1
         2) Mechanical Equipment Rooms: Ordinary Hazard, Group 1
   2. Minimum Density for Automatic-Sprinkler Piping Design:
      a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
      b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
      c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
      d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
   3. Maximum protection area per sprinkler according to UL listing.
   4. Maximum Protection Area per Sprinkler:
      a. Public Spaces: 225 sq. ft.
      b. Storage Areas: 130 sq. ft.
      c. Mechanical Equipment Rooms: 130 sq. ft.
      d. Electrical Equipment Rooms: 130 sq. ft.
      e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A53/A53M, Type E. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

D. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.

E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
   1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
      b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
      c. Victaulic Company.
   2. Pressure Rating: 175-psig minimum.
   3. Uncoated Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
   b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
   c. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aegis Technologies, Inc.
   b. CECA, LLC.
   c. Merit Manufacturing.
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.4 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
2. Victaulic Company.
3. Viking Group Inc.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

E. Sprinkler Finishes: Chrome plated and bronze.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: White concealed, two piece, with 1/2-inch vertical adjustment.
2. Sidewall Mounting: White, one piece, semi-recessed.

G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
b. Victaulic Company.
c. Viking Group Inc.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

A. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in URI Standards.

3.3 INSTALLATION OF PIPING

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

G. Fill sprinkler system piping with water.

H. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 0517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

I. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 0517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

J. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 0518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

G. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

K. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF SPRINKLERS

A. Install sprinklers in suspended ceilings as shown on contract drawings.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.6 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and URI Design Standards.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire-alarm tests. Operate as required.
   6. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Standard-pressure, wet-pipe sprinkler system, NPS 1 ¼” and smaller, shall be the following:
   1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 1 ½” to NPS 8, shall be the following:
   1. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.10 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms with Suspended Ceilings: Recessed, flush, and concealed sprinklers as indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   2. Pendent Sprinklers: Chrome plated in finished spaces exposed to view.

END OF SECTION

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Grooved-joint expansion joints, lead free.
2. Alignment guides and anchors.
3. Sleeves without waterstop.
4. Sleeves with waterstop.
5. Stack-sleeve fittings.
6. Sleeve-seal systems.
7. Grout.
8. Silicone sealants.
9. Escutcheons.
10. Thermometers, bimetallic actuated, lead free.
11. Thermometers, filled system, lead free.
12. Thermometers, liquid in glass, lead free.
13. Thermometers, light activated, lead free.
14. Thermowells, lead free.
15. Pressure gauges, dial type, lead free.
16. Gauge attachments, lead free.
17. Test plugs, lead free.
18. Test-plug kits, lead free.

B. Related Requirements:
1. Section 22 1119 "Domestic Water Piping Specialties" for water meters.
2. Section 33 1415 "Site Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.

1.2 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:
1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.
a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
b. Include operating characteristics and furnished accessories.

B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.

4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of expansion joint and gauge to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.7 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water expansion fittings and loops for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.

C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

A. Performance Requirements:
1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.

B. Grooved-Joint Expansion Joints, Lead Free:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ASC Engineered Solutions.
      b. Shurjoint; a part of Aalberts Integrated Piping Systems.
      c. Victaulic Company.
   2. Source Limitations: Obtain grooved-joint expansion joints from single manufacturer.
   3. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
   4. Standard: AWWA C606, for grooved joints.
   5. Material: ASTM A53/A53M, Schedule 40 stainless steel pipe with grooved ends.
   6. Couplings: ASTM A312/A312M ductile-iron flexible type for stainless steel pipe dimensions. Include ferrous housing sections, Grade E EPDM rubber gasket or Grade P fluoroelastomer blend gasket, and bolts and nuts.

C. Alignment Guides and Anchors:
   1. Alignment Guides:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Flex-Hose Co., Inc.
         2) Flexicraft Industries.
         3) Metraflex Company (The).
      b. Source Limitations: Obtain alignment guides from single manufacturer.
      c. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe. Provide dielectric spacer for use with copper tubing/piping.
   2. Anchor Materials:
      a. Steel Shapes and Plates: ASTM A36/A36M.
      b. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
      c. Washers: ASTM F844, steel, plain, flat washers.
      d. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
         1) Stud: Threaded, zinc-coated carbon or stainless steel.
         2) Expansion Plug: Zinc-coated carbon or stainless steel.
         3) Washer and Nut: Zinc-coated carbon or stainless steel.
      e. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
         1) Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
         2) Stud: ASTM A307, zinc-coated carbon or stainless steel with continuous thread on stud unless otherwise indicated.
         3) Washer and Nut: Zinc-coated carbon or stainless steel.

2.3 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:
   1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
   2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
   3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, LLC.
   b. CALPICO, Inc.
   c. Metraflex Company (The).
2. Description: Manufactured stainless steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Wade; a subsidiary of McWane Inc.
   c. Zurn Industries, LLC.
2. Description: Manufactured, Dura-coated, Duco-coated, or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, LLC.
   b. GPT; a division of EnPRO Industries.
   c. Metraflex Company (The).
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   a. Hydrostatic Seal: 20 psig minimum.
   b. Sealing Elements: EPDM-rubber or Nitrile (Buna-N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   c. Pressure Plates: Carbon steel or Stainless steel.
   d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 or Stainless steel of length required to secure pressure plates to sealing elements.

E. Grout:
1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

F. Silicone Sealants:
1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
   a. Manufacturers: Subject to compliance with requirements, provide products by the following:
      1) GE Construction Sealants; Momentive Performance Materials Inc.

2) Sherwin-Williams Company (The).
3) The Dow Chemical Company.

b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2. Silicone Sealant, S, P, T, NT: Single-component, 25, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Sika Corporation.
      2) The Dow Chemical Company.
      3) Tremco Incorporated.
   b. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Smooth-On.

2.4 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. BrassCraft Manufacturing Co.; a Masco company.
   2. Dearborn Brass.
   3. Keeney Manufacturing Company (The).
   4. ProFlo; a Ferguson Enterprises, Inc. brand.

B. Escutcheon Types:
   1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
   2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
   3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
   4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
   5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
   6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

C. Floor Plates:
   1. Split Floor Plates: Cast brass with concealed hinge.

2.5 METERS AND GAUGES FOR PLUMBING PIPING

A. Thermometers, Bimetallic Actuated, Lead Free:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ashcroft Inc.
      b. Trerice, H. O. Co.
      c. WATTS; A Watts Water Technologies Company.
   2. Source Limitations: Provide lead-free bimetallic-actuated thermometers from a single manufacturer.
   3. Standard: ASME B40.200.
   4. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.

5. Dial: Nonreflective aluminum with permanent scale markings and scales in deg F and deg C.
6. Connector Type(s): Union joint, adjustable angle; rigid, back; and rigid, bottom; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
7. Stem: 0.25 or 0.375 inch in diameter; stainless steel and lead-free brass.
8. Window: Plain glass or Safety glass.
9. Ring: Stainless steel.
10. Element: Bimetal coil.
11. Pointer: Dark-colored metal.
12. Accuracy: Plus or minus 1.5 percent of span.

B. Thermometers, Filled System, Lead Free - Direct Mounted, Metal Case, Vapor Actuated:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Weiss Instruments, Inc.
2. Source Limitations: Provide filled-system, lead-free, direct-mounted, metal-case, vapor-actuated thermometers from a single manufacturer.
3. Standard: ASME B40.200.
4. Case: Sealed type, cast aluminum or drawn steel; 5-inchnominal diameter.
5. Element: Lead-free.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanent scale markings graduated in deg F and deg C.
8. Pointer: Dark-colored metal.
9. Window: Glass or Safety glass.
10. Ring: Stainless steel.
11. Connector Type(s): Union joint, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
12. Thermal System: Liquid-filled, mercury-free bulb in copper-plated steel, aluminum, or lead-free brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
13. Accuracy: Plus or minus 1 percent of span.

C. Thermometers, Liquid in Glass, Lead Free - Metal Case, Compact Style:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Miljoco Corporation.
   b. Trerice, H. O. Co.
2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, compact-style thermometers by single manufacturer.
3. Standard: ASME B40.200.
4. Case: Cast aluminum; 6-inch nominal size.
5. Case Form: Back angle or Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid; mercury free.
7. Tube Background: Nonreflective aluminum with permanent scale markings graduated deg F and deg C.
8. Window: Glass or plastic.
9. Stem: Aluminum or lead-free brass and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
10. Connector: 3/4 inch, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
11. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

D. Thermowells, Lead Free:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Lead-free copper.
4. Material for Use with Steel Piping: Stainless steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
7. Internal Threads: Size and thread type as required to match thermometer mounting threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length to extend to match thermometer stem length.
10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond finished insulation surface.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

E. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Flo Fab Inc.
   c. Trerice, H. O. Co.
   d. WATTS; A Watts Water Technologies Company.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Case: Sealed type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free Bourdon tube.
6. Pressure Connection: Lead-free brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Glass or Safety glass.
11. Ring: Stainless steel
12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

F. Gauge Attachments, Lead Free:
1. Snubbers: ASME B40.100, lead-free brass; with ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
2. Valves: Lead-free brass or stainless steel needle, with ASME B1.20.1 pipe threads.

G. Test Plugs, Lead Free:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Miljoco Corporation.
   b. Trerice, H. O. Co.
   c. WATTS; A Watts Water Technologies Company.
2. Source Limitations: Provide lead-free test plugs from single manufacturer.
3. Description: Test-station fitting made for insertion into piping tee fitting.
4. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
5. Thread Size: ASME B1.20.1 pipe thread.

6. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
7. Core Inserts: EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS, GENERAL

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF PACKLESS EXPANSION JOINTS

A. Install metal-bellows expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

3.3 INSTALLATION OF GROOVED-JOINT EXPANSION JOINTS

A. Install grooved-joint expansion joints to grooved-end steel piping.

3.4 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:
1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.5 INSTALLATION OF PIPE LOOP AND SWING CONNECTIONS

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.6 INSTALLATION OF SLEEVES - GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   3. Using grout or silicone sealant, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 8413 "Penetration Firestopping."

3.7 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.8 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 6200 "Sheet Metal Flashing and Trim."

3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 8413 "Penetration Firestopping."

3.9 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.10 INSTALLATION OF ESCUTCHEONS

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.11 INSTALLATION OF METERS AND GAUGES

A. Install thermometer with thermowell at each required thermometer location.

B. Install thermowells in vertical position in piping tees.

C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

D. Install thermowells with extension on insulated piping.

E. Fill thermowells with heat-transfer medium.

F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

H. Install valve and snubber in piping for each pressure gauge for fluids.

I. Install test plugs in piping tees.

J. Install thermometers in the following locations:
1. Inlet and outlet of each water heater.
2. Inlet and outlet of each domestic hot-water storage tank.
3. Outlet side of hot-water-balancing valve.
4. Each main hot-water-recirculating line return pipe.

K. Install pressure gauges in the following locations:
1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.12 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.13 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.14 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:
1. Perform the following tests and inspections:
a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
2. Prepare test and inspection reports.

B. Escutcheons:
1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.15 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above and below Grade:
a. Sleeves with waterstops.
1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
a. Sleeves with waterstops.
1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
a. Sleeves with waterstops or stack-sleeve fittings.
4. Interior Wall and Partitions:
a. Sleeves without waterstops.

3.16 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:
1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel with polished, chrome-plated finish.
3. Insulated Piping:
a. One piece, steel with polished, chrome-plated finish.
b. One piece, stainless steel with polished stainless steel finish.
c. One piece, cast brass with polished, chrome-plated finish.
d. One piece, stamped steel with polished, chrome-plated finish.

4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
   a. One piece, steel with polished, chrome-plated finish.
   b. One piece, stainless steel with polished stainless steel finish.
   c. One piece, cast brass with polished, chrome-plated finish.
   d. One piece, stamped steel with polished, chrome-plated finish.
5. Bare Piping at Ceiling Penetrations in Finished Spaces:
   a. One piece, steel with polished, chrome-plated finish.
   b. One piece, stainless steel with polished stainless steel finish.
   c. One piece, cast brass with polished, chrome-plated finish.
   d. One piece, stamped steel with polished, chrome-plated finish.
6. Bare Piping in Unfinished Service Spaces:
   a. One piece, steel with polished, chrome-plated finish.
   b. One piece, cast brass with polished, chrome-plated finish.
   c. One piece, stamped steel with polished, chrome-plated finish.
7. Bare Piping in Equipment Rooms:
   a. One piece, steel with polished, chrome-plated finish.
   b. One piece, cast brass with polished, chrome-plated finish.
   c. One piece, stamped steel with polished, chrome-plated finish.

B. Install floor plates for piping penetrations of equipment-room floors.

C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping and Relocated Existing Piping: One piece, floor plate.

3.17 THERMOMETER, LEAD FREE, APPLICATION

A. Thermometers at inlet and outlet of each domestic water heater are to be the following:
   1. Liquid-filled or sealed, bimetallic-actuated type.
   2. Metal case, compact-style, liquid-in-glass type.
   3. Test plug with EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each domestic hot-water storage tank are to be the following:
   1. Liquid-filled or sealed, bimetallic-actuated type.
   2. Metal case, compact-style, liquid-in-glass type.
   3. Test plug with EPDM self-sealing rubber inserts.

C. Thermometer stems are to be of length to match thermowell insertion length.

3.18 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

A. Scale Range for Domestic Cold-Water Piping:
   1. 0 to 150 deg F.

B. Scale Range for Domestic Hot-Water Piping:
   1. 0 to 250 deg F.

3.19 PRESSURE-GAUGE APPLICATION

A. Pressure gauges at discharge of each water service into building are to be the following:
   1. Liquid filled or Sealed direct mounted, metal case.
   2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gauges at inlet and outlet of each water pressure-reducing valve are to be the following:
   1. Liquid filled or Sealed direct mounted, metal case.
   2. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gauges at suction and discharge of each domestic water pump are to be the following:
   1. Liquid filled or Sealed direct mounted, metal case.
   2. Test plug with EPDM self-sealing rubber inserts.

3.20 PRESSURE-GAUGE SCALE-RANGE APPLICATION

A. Scale Range for Water Service Piping:
   1. 0 to 200 psi.

B. Scale Range for Domestic Water Piping:
   1. 0 to 200 psi.

END OF SECTION

SECTION 22 0523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ball valves.
2. Check valves.
3. Gate valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer.

C. FKM: Fluoroelastomer.

D. NBR: Nitrile butadiene rubber (also known as Buna-N).

E. NRS: Nonrising stem.

F. OS&Y: Outside screw and yoke.

G. PTFE: Polytetrafluoroethylene.

H. RPTFE: Reinforced polytetrafluoroethylene.

I. RS: Rising stem.

1.3 ACTION SUBMITTALS

A. Product Data:
1. For each type of product.
a. Include material descriptions and dimensions of individual components.
b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.
6. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Standards:
1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast-copper solder-joint connections.
6. ASME B16.22 for wrought-copper solder-joint connections.
7. ASME B16.34 for flanged- and threaded-end connections.
8. ASME B16.51 for press joint connections.
9. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Valve Actuator Type:
1. Gear Actuator: For quarter-turn ball valves NPS 4 and larger.
2. Hand Lever: For quarter-turn ball valves smaller than NPS 4.

I. Valves in Insulated Piping:
1. Provide 2-inch extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.3 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Threaded Ends - Brass, One Piece:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bonomi North America, Inc.
      b. Apollo Valves
      c. WATTS; A Watts Water Technologies Company.
   2. Standards: MSS SP-110 and MSS SP-145.
   3. CWP Rating: 400 psig.
   4. Body Design: One piece.
   5. Body Material: Forged brass or bronze.
   6. Ends: Threaded.
   7. Seats: PTFE.
   8. Stem: Brass or stainless steel.
   9. Ball: Chrome-plated brass or stainless steel.
   10. Port: Reduced.

B. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Brass Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bonomi North America, Inc.
      b. American Valve, Inc.
      c. Apollo Valves; a part of Aalberts Integrated Piping Systems.
      d. Hammond Valve.
   2. Standards: MSS SP-110 and MSS SP-145.
   3. CWP Rating: 600 psig.
   4. Body Design: Two piece.
   5. Body Material: Forged brass.
   6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
   7. Seats: PTFE.
   8. Stem: Brass.
   9. Ball: Chrome-plated brass.
   10. Port: Full.

C. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Brass Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Bonomi North America, Inc.
      b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   2. Standards: MSS SP-110, MSS SP-145, IAPMO/ANSI Z1157.
   3. CWP Rating: Minimum 200 psig.
   4. Body Design: Two piece.
   5. Body Material: Forged brass.
   6. Ends: Press.
   7. Press-End Connections Rating: Minimum 200 psig.
   8. Seats: PTFE or RPTFE.
   9. Stem: Brass.
   10. Ball: Chrome-plated brass.
   11. Port: Full.
   12. O-Ring Seal: NBR or EPDM.

D. Ball Valves, Lead Free, Threaded Ends - Bronze, One Piece with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bonomi North America, Inc.
b. NIBCO INC.
c. WATTS; A Watts Water Technologies Company.
2. Standards: MSS SP-110 and MSS SP-145.
3. CWP Rating: 400 psig.
4. Body Design: One piece.
5. Body Material: Bronze.
6. Ends: Threaded.
7. Seats: PTFE.
8. Stem: Bronze.
9. Ball: Chrome-plated brass.
10. Port: Reduced.

E. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bonomi North America, Inc.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Hammond Valve.
2. Standards: MSS SP-110 and MSS SP-145.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
7. Seats: PTFE.
8. Stem: Bronze or brass.
9. Ball: Chrome-plated brass.
10. Port: Full.

F. Ball Valves, Lead Free, Press Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bonomi North America, Inc.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Hammond Valve.
2. Standards: MSS SP-110, MSS SP-145, and IAPMO/ANSI Z1157.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Seats: PTFE or RTPFE.
9. Stem: Bronze or brass.
10. Ball: Chrome-plated brass.
11. Port: Full.
12. O-Ring Seal: EPDM or NBR.

2.4 CHECK VALVES, LEAD FREE

A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

b. Bonomi North America, Inc.
c. NIBCO INC.
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
7. Disc: Bronze.

B. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Bonomi North America, Inc.
c. Hammond Valve.
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 300 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
7. Disc: Bronze.

C. Check Valves, Lead Free, Swing Type, Press Ends - Bronze:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Bonomi North America, Inc.
c. Hammond Valve.
2. Standards: MSS SP-80 and MSS SP-139.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B584, bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Disc: Brass or bronze.

2.5 GATE VALVES, LEAD FREE

A. Gate Valves, Lead Free, Threaded or Soldered Ends - Bronze, NRS, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Bonomi North America, Inc.
c. Milwaukee Valve Company.
2. Standard: MSS SP-80, Type 1.
3. CWP Rating: 200 psig.
4. Body Material: Bronze with integral seat and screw-in bonnet.
5. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
6. Stem: Bronze.
7. Disc: Solid wedge, bronze.
8. Packing: Asbestos free.
9. Handwheel: Malleable iron, bronze, or aluminum.

B. Gate Valves, Lead Free, Threaded Ends - Bronze, NRS, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Bonomi North America, Inc.
   c. Milwaukee Valve Company.
2. Standard: MSS SP-80, Type 1.
3. CWP Rating: 300 psig.
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.

C. Gate Valves, Lead Free, Press Ends - Bronze:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Bonomi North America, Inc.
   c. NIBCO INC.
2. Standards: MSS SP-80 and MSS SP-139.
3. CWP Rating: Minimum 200 psig.
4. Body Material: Bronze with integral seat and union-ring bonnet.
5. Ends: Press.
6. Press Ends Connection Rating: Minimum 200 psig.
7. Stem: Brass or bronze, RS or NRS. See Part 3 gate valve schedule articles.
8. Disc: Solid wedge, bronze.
9. Packing: Graphite.
10. Port: Full.
11. Handwheel: Malleable iron, bronze, or aluminum.

D. Gate Valves, Lead Free, Flanged Ends - Iron, NRS, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Bonomi North America, Inc.
   c. Kennedy Valve Company; a division of McWane, Inc.
2. Standard: MSS SP-70, Type I.
3. CWP Rating: 200 psig.
4. Body Material: Gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Examine press fittings to verify they have been properly pressed.

F. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

D. For valves in horizontal piping, install valves with stem at or above center of pipe.

E. Install valves in position that does not project into aisles or block access to other equipment.

F. Install valves in position to allow full stem and actuator or manual operator movement.

G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.

H. Install check valves for proper direction of flow and as follows:
   1. Check Valves, Swing Type: In horizontal position with hinge pin level.

I. Valve Tags: Comply with requirements in Section 22 0553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

J. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3. For Grooved-End Copper Tubing: Valve ends may be grooved.
4. For Grooved-End Steel Piping: Valve ends may be grooved.
5. Wafer-Type Valves: Flanged connections.

3.5 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Ball valves, lead free, threaded ends - brass, one piece.
2. Ball valves, lead free, threaded or soldered ends - brass, two piece with full port and brass trim.
3. Ball valves, lead free, threaded ends - bronze, one piece with bronze trim.
4. Ball valves, lead free, threaded or soldered ends - bronze, two piece with full port and bronze or brass trim ends.
5. Ball valves, lead free, threaded ends - bronze, two piece with regular port and bronze or brass trim.
6. Ball valves, lead free, press ends - brass, two piece with full port and brass trim.
7. Ball valves, lead free, press ends - bronze, two piece with full port and bronze or brass trim.

3.6 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125.
2. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150.
3. Check valves, lead free, swing type, press ends - bronze.

3.7 DOMESTIC HOT- AND COLD-WATER GATE VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:
1. Gate valves, lead free, threaded or soldered ends - bronze, NRS, Class 125.
2. Gate valves, lead free, threaded ends - bronze, NRS, Class 150.
3. Gate valves, lead free, press ends - bronze.

B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Gate valves, lead free, flanged ends - iron, NRS, Class 125.

END OF SECTION

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:
1. Section 05 5000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 22 0516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer.

B. Stainless-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer

C. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CADDY; brand of nVent Electrical plc.
2. Carpenter & Paterson, Inc.
3. National Pipe Hanger Corporation.

B. Insulation-Insert Material for Cold Piping: minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hilti, Inc.
      b. MKT Fastening, LLC.
      c. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hilti, Inc.
      b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
      c. MKT Fastening, LLC.
   2. Indoor Applications: steel.
   3. Outdoor Applications: Stainless steel.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:
   1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Hardware: Galvanized steel or polycarbonate.
   4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Vertical Members: Two -steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: Adjustable horizontal, -steel pipe support channels.
   5. Hardware: steel.
   6. Accessories: Protection pads.

D. High-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Single vulcanized rubber or molded polypropylene.
   3. Vertical Members: Two -steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: One adjustable-height, -steel, pipe-support slotted channel or plate.
   5. Hardware: steel.

6. Accessories: Protection pads.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.8 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Stand Installation:
   1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 7200 "Roof Accessories" for curbs.

F. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
   6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications as required.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-inch minimum.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and supports and attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
   11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
   12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
   13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
   16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
   17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Craftmark Pipe Markers.
   b. Pipemarker.com; Brimar Industries, Inc.
   c. Seton Identification Products; a Brady Corporation company.
2. Material and Thickness: minimum thickness, with predrilled or stamped holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Craftmark Pipe Markers.
   2. Pipemarker.com; Brimar Industries, Inc.
   3. Seton Identification Products; a Brady Corporation company.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, ¼" thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Craftmark Pipe Markers.
   2. Pipemarker.com; Brimar Industries, Inc.
   3. Seton Identification Products; a Brady Corporation company.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
   1. Pipe size.

2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Craftmark Pipe Markers.
   2. Pipemarker.com; Brimar Industries, Inc.
   3. Seton Identification Products; a Brady Corporation company.

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: minimum thickness, with predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Include valve-tag schedule in operation and maintenance data.

2.5 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Craftmark Pipe Markers.
   2. Pipemarker.com; Brimar Industries, Inc.
   3. Seton Identification Products; a Brady Corporation company.

B. Description: Preprinted accident-prevention tags of plasticized card stock.
   1. Size: 3 inches wide by 5 ¾ inches high
   2. Fasteners: Nylon self-locking ties
   3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of plumbing equipment.

B. Sign and Label Colors.

C. Locate equipment labels where accessible and visible.

D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E.

3.4 INSTALLATION OF PIPE LABELS

A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.

C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe-Label Color Schedule:
1. Domestic Cold-Water Piping: Green with white lettering.
2. Domestic Hot-Water Piping: Green with white lettering.
3. Domestic Hot-Water Return Piping: Green with white lettering.
4. Nonpotable Cold Water: Green with white lettering.
5. Storm piping: Green with white lettering.
6. Sanitary piping: Green with White lettering.
7. Vent piping: Green with white lettering.

3.5 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:
   a. Domestic Cold Water: 2-inch round.
   b. Domestic Hot Water: 2-inch round.
   c. Domestic Hot-Water Return: 2-inch round.
   d. Nonpotable Cold Water: 2-inch round.
2. Valve-Tag Colors:
   a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.6 INSTALLATION OF WARNING TAGS

A. Attach warning tags, with proper message, to equipment and other items that may require.

END OF SECTION

SECTION 22 0593

TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. TAB of domestic water system.
   2. TAB of plumbing equipment:
      a. Domestic hot-water in-line circulation pumps.
      b. Drain pumps.
   3. Pipe-leakage test verification

1.2 DEFINITIONS

A. NEBB: National Environmental Balancing Bureau.

B. TAB: Testing, adjusting, and balancing.

C. TABB: Testing, Adjusting, and Balancing Bureau.

D. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

E. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 14 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 14 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 14 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 14 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.

5. Dates of calibration.

1.4 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
   2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

D. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."

E. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine approved submittals for plumbing systems and equipment.

D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.

E. Examine equipment performance data, including pump curves.
   1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.

F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.

J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on plumbing equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:
1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
1. Domestic Water System:
a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
b. Water heaters are installed and functioning.
c. Piping is complete and all points of outlet are installed.
d. Water treatment is complete.
e. Systems are flushed, filled, and air purged.
f. Strainers are clean.
g. Control valves are functioning in accordance with the sequence of operation.
h. Shutoff and balance valves are 100 percent open.
i. Pumps are operational and proper rotation is verified.
j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
k. Variable-frequency controllers' startup is complete and safeties are verified.
l. Suitable access to balancing devices and equipment is provided.
2. Sanitary Sewage/Drainage System:

a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
b. Piping is complete.
c. Sanitary sewage pumps/drainage pumps are operational.
d. Control valves are functioning in accordance with the sequence of operation.
e. Shutoff valves are 100 percent open.
f. Suitable access to equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in this Section.

B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 22 0716 "Plumbing Equipment Insulation" and Section 22 0719 "Plumbing Piping Insulation."

C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
1. Motors.
2. Domestic water in-line pumps.
3. Domestic water heaters.

3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
1. Check expansion tank for proper setting.
2. Check water heater for proper discharge temperature setting.
3. Check remotest point of outlet for adequate pressure.
4. Check flow-control valves for proper position.
5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
6. Verify that motor controllers are equipped with properly sized thermal protection.
7. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

3.6 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.
   1. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gauge heights.
      d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
   2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
   3. Mark final settings and verify that all memory stops have been set.
   4. Verify final system conditions as follows:
      a. Re-measure and confirm that total flow is within design.
      b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
      c. Mark final settings.

3.7 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:
   1. Domestic Water Flow Rate: If design value is less than 10 gpm, within 10 percent.

3.8 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.9 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:
    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
1. Flow rates.
2. Pipe and valve sizes and locations.
3. Balancing stations.
4. Position of balancing devices.

E. Instrument Calibration Reports:
1. Report Data:
    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.10 ADDITIONAL TESTS

A. Within 5 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION

SECTION 22 0719

PLUMBING PIPING & EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Domestic recirculating hot-water piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.
   8. Detail removable insulation at equipment connections.
   9. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
   2. Jacket Materials for Pipe: 12 inches long by NPS 2.
   3. Sheet Jacket Materials: 12 inches square.
   4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Type A – Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. Knauf Insulation.
      c. Manson Insulation Inc.
      d. Owens Corning.
   2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ or ASJ-SSL.
   3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
   4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Type B – Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed; SAINT-GOBAIN.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Manson Insulation Inc.
      e. Owens Corning.
   2. Semirigid board material with factory-applied FSK jacket.
   3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Type C – Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. Rigid board shall have minimum density 6lb/cu.ft. Semi-rigid board shall have minimum density 2.5lb/cu.ft.
   1. For applications in concealed locations and mechanical rooms, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   2. For applications in exposed occupied space, provide insulation with factory-applied ASJ jacket for field painting. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. CertainTeed; SAINT-GOBAIN.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Manson Insulation Inc.
      e. Owens Corning.

2.3 INSULATING CEMENTS

A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.

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

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ramco Insulation, Inc.

C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Ramco Insulation, Inc.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller.
   c. Mon-Eco Industries, Inc.
   d. Vimasco Corporation.

C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller.
   c. Mon-Eco Industries, Inc.

D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller.
   c. Mon-Eco Industries, Inc.

E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. P.I.C. Plastics, Inc.
   c. Proto Corporation.
   d. Speedline Corporation.
   e. The Dow Chemical Company.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
      c. Knauf Insulation.
      d. Mon-Eco Industries, Inc.
      e. Vimasco Corporation.
   2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   3. Service Temperature Range: 0 to 180 deg F.
   4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
   5. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
      c. Mon-Eco Industries, Inc.
   2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   3. Service Temperature Range: 0 to 180 deg F.
   4. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
   2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   3. Service Temperature Range: Minus 50 to plus 220 deg F.
   4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
      c. Knauf Insulation.
      d. Mon-Eco Industries, Inc.
      e. Vimasco Corporation.
   2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
   3. Service Temperature Range: 0 to plus 180 deg F.
   4. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
      c. Vimasco Corporation.
   2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   3. Service Temperature Range: 20 to plus 180 deg F.
   4. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
      c. Mon-Eco Industries, Inc.
      d. Owens Corning.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 150 to plus 250 deg F.
   4. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
      c. Mon-Eco Industries, Inc.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Airex Manufacturing Inc.
   b. Johns Manville; a Berkshire Hathaway company.
   c. P.I.C. Plastics, Inc.
   d. Proto Corporation.
   e. Speedline Corporation.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. RPR Products, Inc.
2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   a. Finish and thickness are indicated in field-applied jacket schedules.
   a. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
   b. Moisture Barrier for Outdoor Applications: 53-mil-thick, heat-bonded polyethylene and kraft paper.
   c. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless Steel Jacket: ASTM A240/A240M.
   a. Material, finish, and thickness are indicated in field-applied jacket schedules.
   a. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
   b. Moisture Barrier for Outdoor Applications: 53-mil-thick, heat-bonded polyethylene and kraft paper.
   c. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with aluminum-foil facing.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. MFM Building Products Corp.
      b. Polyguard Products, Inc.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Childers Brand; H. B. Fuller Construction Products.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Childer's Brand.
      b. Foster Brand; H. B. Fuller.
      c. Vimasco Corporation.

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Alpha Associates, Inc.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. 3M Industrial Adhesives and Tapes Division.
      b. Avery Dennison Corporation, Specialty Tapes Division.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. 3M Industrial Adhesives and Tapes Division.
      b. Avery Dennison Corporation, Specialty Tapes Division.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. 3M Industrial Adhesives and Tapes Division.
      b. Ideal Tape Co., Inc., an American Biltrite Company.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   4. Adhesion: 64 ounces force/inch in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. 3M Industrial Adhesives and Tapes Division.
      b. Avery Dennison Corporation, Specialty Tapes Division.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
   2. Width: 2 inches.
   3. Thickness: 3.7 mils.
   4. Adhesion: 100 ounces force/inch in width.
   5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. RPR Products, Inc.
2. Stainless Steel: ASTM A240/A240M,; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. C & F Wire Products.
   b. Johns Manville; a Berkshire Hathaway company.
   c. RPR Products, Inc.

2.14 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Buckaroos, Inc.
   b. MVG Molded Products.
   c. McGuire Manufacturing.
   d. Plumberex Specialty Products, Inc.
   e. ProFlo; a Ferguson Enterprises, Inc. brand.
   f. Truebro; IPS Corporation.
   g. Zurn Industries, LLC.
   h. Oatey Co.
2. Description: Manufactured plastic wraps for covering plumbing fixture and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ProFlo; a Ferguson Enterprises, Inc. brand.
   b. Truebro; IPS Corporation.
   c. Zurn Industries, LLC.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and

jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF GLASS-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install prefabricated pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
   2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
   2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 "Exterior Painting" and "Interior Painting."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.11 PIPING INSULATION SCHEDULE

A. Provide piping insulation of minimum thickness, material, and required field applied jacketing as indicated in the system tables below.

Type	Material
A	Glass Fiber (Fiberglass)
B	Glass Fiber Pipe and Tank (large diameter Fiberglass)
C	Glass Fiber Board

Piping System	Insulation Type	Thickness by pipe size (inches)	Field Applied Jacket
Domestic Hot water, Tempered, and Protected Hot Water Supply & Return	A	<1.5NPS – 1.5 ≥1.5NPS – 2.5	-
Domestic Cold Water Supply, Up to Meter	A	All – 1.5	-
Domestic Cold Water, Protected Cold Water, and Non-Potable Cold Water	A	All – 1.5	-
Cold water supply, Hot water supply, and Hot water return piping below ceiling	A	See chart above	PVC Jacket
All exposed piping in mechanical room less than 10’-0” above finished floor	Per Chart above	Per chart above	PVC Jacket

END OF SECTION

SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Copper tube and fittings.
   2. Ductile-iron pipe and fittings.
   3. Transition fittings.
   4. Dielectric fittings.

B. Related Requirements:
   1. Section 33 1415 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Pipe and tube.
   2. Fittings.
   3. Joining materials.
   4. Transition fittings.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

1.4 WARRANTY

A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
   1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
   2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: Type K or L

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

F. Wrought Copper Unions: ASME B16.22.

G. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
   1. Description: Tee formed in copper tube in accordance with ASTM F2014.

H. Grooved, Mechanical-Joint, Copper Tube Appurtenances:
   1. Grooved-End, Copper Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.
   2. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting, EPDM-rubber gasket, UL classified per NSF 61 and NSF 372, and rated for minimum 150 deg F, for use with ferrous housing and steel bolts and nuts; 300 psig minimum CWP pressure rating.

I. Copper Tube, Pressure-Seal-Joint Fittings:
   1. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
   2. Minimum 200-psig working-pressure rating at 250 deg F.

J. Copper-Tube, Push-on-Joint Fittings:
   1. Description:
      a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
      b. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:
   1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:
   1. AWWA C110/A21.10, ductile or gray iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 TRANSITION FITTINGS

A. General Requirements:
1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Standard: ASSE 1079.
2. Pressure Rating: 200 psi
3. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 200 psi
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Nipples:
1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F1545.
3. Pressure Rating and Temperature: 200 psi
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, shall be the following:
1. Annealed-temper copper tube; wrought-copper, solder-joint fittings; and brazed joints.
2. Mechanical-joint, ductile-iron pipe; pattern, mechanical-joint fittings; and mechanical joints.
3. Push-on-joint, ductile-iron pipe; pattern, push-on-joint fittings; and gasketed joints.
4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

E. Under-building-slab, domestic water piping, shall be the following:
1. Copper tube, ASTM B88, Type L; joints.

F. Aboveground domestic water piping, shall be the following:
1. Drawn-temper copper tube; copper, solder-joint fittings; and joints.

3.2 EARTHWORK

A. Comply with requirements in Section 31 2000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install valves according to the following:
1. Section 22 0523 - General-Duty Valves for Plumbing Piping.

E. Install domestic water piping level and plumb.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 22 0500 - Common Work Results for Plumbing.

O. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 0500 - Common Work Results for Plumbing.

P. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 22 0500 - Common Work Results for Plumbing.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 0500 - Common Work Results for Plumbing.

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0500 - Common Work Results for Plumbing.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."

E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

F. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

G. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

H. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

I. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

J. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

K. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 24 inches of each fitting.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   2. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.10 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
      a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
      b. Adjust calibrated balancing valves to flows indicated.
   5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
   6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
   8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   2. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
g. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:
1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION

SECTION 22 1119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Vacuum breakers.
2. Backflow preventers.
3. Water Pressure reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers for domestic water piping.
7. Outlet boxes.
8. Drain valves.
9. Water-hammer arresters.
10. Flexible connectors.

B. Related Requirements:
1. Section 22 0500 “Common Work Results for Plumbing" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Section 22 1116 "Domestic Water Piping" for water meters.
3. Section 33 1415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

A. AMI: Advanced Metering Infrastructure.

B. AMR: Automatic Meter Reading.

C. FKM: A family of fluroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.
1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 200 psi unless otherwise indicated.

2.3 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
   1. Standard: ASSE 1013.
   2. Operation: Continuous-pressure applications.
   3. Pressure Loss: **12 psig** maximum, through middle third of flow range.

2.4 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
   1. Standard: ASSE 1003.
   2. Pressure Rating: Initial working pressure of 150 psig.
   3. Design Outlet Pressure Setting: 65 psig.
   4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; bronze for NPS 2-1/2 and NPS 3.
   5. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

2.5 BALANCING VALVES

A. Memory-Stop Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hammond Valve.
      b. Milwaukee Valve Company.
      c. NIBCO INC.
   2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
   3. Pressure Rating: 400-psig minimum CWP.
   4. Size: NPS 2 or smaller.
   5. Body: Copper alloy.
   6. Port: Standard or full port.
   7. Ball: Chrome-plated brass or stainless steel.
   8. Seats and Seals: Replaceable.
   9. End Connections: Solder joint or threaded.
   10. Handle: Vinyl-covered steel with memory-setting device.

B. Automatic Flow Control Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Circuit Solver.

b. IMI Hydronic Engineering Inc.
c. ThermOmegaTech.
2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless steel or antiscale polymer.
7. End Connections: Threaded or solder joint.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Leonard Valve Company.
b. POWERS; A WATTS Brand.
c. WATTS.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 120 deg. F.
9. Tempered-Water Design Flow Rate: 30 gpm
10. Pressure Drop at Design Flow Rate: 5 psig
11. Valve Finish: Chrome
12. Cabinet: Factory fabricated, stainless steel, for wall mounting and with hinged, stainless steel door.

B. Primary, Electronic, Water Mixing Valve Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Engineering Company; a Division of Morris Group International.
b. Leonard Valve Company.
c. POWERS; A WATTS Brand.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed, electronically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or solder joint inlets and outlet.
7. Accessories: Manual temperature override control, check stops on hot- and cold-water supplies, and automatic hot- and cold-water shutoff upon inlet supply failure.
8. Tempered-Water Setting: 120 deg. F
9. Tempered-Water Design Flow Rate: 30 gpm
10. Pressure Drop at Design Flow Rate: 5 psig
11. Valve Finish: Bronze.
12. Digital temperature control and monitoring module.
a. Controls temperature within plus or minus 2 deg F.
b. User programmable at module or through BAS.
c. ASHRAE 188 compliance.
d. Local and remote monitoring.
e. protocol language(s).
f. V ac, 60 Hz.
g. Battery backup.

C. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Lawler Manufacturing Company, Inc.
b. Leonard Valve Company.
c. POWERS; A WATTS Brand.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.
8. Tempered-Water Setting: 110 deg. F
9. Tempered-Water Design Flow Rate: 5 gpm

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Titan Flow Control, Inc.
b. WATTS.
c. Zurn Industries, LLC.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.

2.8 HOSE BIBBS

A. Hose Bibbs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. WATTS.
c. Woodford Manufacturing Company.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough Bronze
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Include operating key with each operating-key hose bibb.
14. Include wall flange with each chrome- or nickel-plated hose bibb.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.

3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:
1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flex-Hose Co., Inc.
2. Mason Industries, Inc.
3. Metraflex Company (The).

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psi.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psi
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe

diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.

3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

C. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

D. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

E. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

H. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

I. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 26 0526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

A. Connect control wiring in accordance with Section 26 0523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Backflow preventers.
   2. Water pressure-reducing valves.
   3. Balancing valves.
   4. Temperature-actuated, water mixing valves.
   5. Hose bibbs.
   6. Trap-seal primer device.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

D. Adjust each backflow-prevention assembly in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections.
   1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 22 1316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. PVC pipe and fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.
   2. Waste, Force-Main Piping: 50 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

2.2 PIPING MATERIALS

A. Piping materials to bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 PVC PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Charlotte Pipe and Foundry Company.
   2. National Pipe and Plastic, Inc.
   3. North America Pipe Corporation.

B. Comply with NSF 14 for plastic piping components. Include "NSF-DWV" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.

C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

D. Cellular-Core PVC Pipe: Not acceptable for installation.

E. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

F. Adhesive Primer: ASTM F656.

G. Solvent Cement: ASTM D2564.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 2000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
   1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
   2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
      a. Straight tees, elbows, and crosses may be used on vent lines.
   3. Do not change direction of flow more than 90 degrees.
   4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; One percent downward in direction of flow for piping NPS 4 and larger.
   2. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.

M. Install aboveground PVC piping in accordance with ASTM D2665.

N. Install underground PVC piping in accordance with ASTM D2321.

O. Install force mains at elevations indicated.

P. Plumbing Specialties:
   1. Install backwater valves in sanitary waste gravity-flow piping.
      a. Comply with requirements for backwater valves specified in Section 22 1319 "Sanitary Waste Piping Specialties."
   2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
      a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
      b. Comply with requirements for cleanouts specified in Section 22 1319 "Sanitary Waste Piping Specialties."
   3. Install drains in sanitary waste gravity-flow piping.
      a. Comply with requirements for drains specified in Section 22 1319 "Sanitary Waste Piping Specialties."

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.4 VALVE INSTALLATION

A. General valve installation requirements for general-duty valve installation are specified in the following Sections:
1. Section 22 0523 - General-Duty Valves for Plumbing Piping.

B. Shutoff Valves:
1. Install shutoff valve on each sewage/drainage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in .
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42 clamps.
6. Install individual, straight, horizontal piping runs:
   a. 100 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Ft. if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52 spring hangers.

C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. All horizontal piping 5-inches and larger branch openings, or changes in direction shall be suitably restrained to prevent movement of joints and possible separation. Restraints can be field fabricated, or pre-engineered and manufactured.

F. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Equipment: Connect waste piping as indicated.
    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections in accordance with the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
      a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
      a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
      b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
      c. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
      a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
      b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
      c. Air pressure must remain constant without introducing additional air throughout period of inspection.
      d. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
      a. Isolate test source and allow to stand for four hours.
      b. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   4. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PREVENTIVE MAINTENANCE

A. All piping connected to “low flow” fixtures shall be flushed with clean water by filling and releasing a utility wash basin sink from the furthest point possible not less than once every 7 days.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping are to be the following:
   1. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, vent piping is to be the following:
   1. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, soil, waste, and vent piping are to be the following:
   1. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Cellular (foam) core PVC pipe shall not be installed.

END OF SECTION

SECTION 22 1319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backwater valves.
2. Cleanouts.
3. Air-admittance valves.
4. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:
1. Section 07 6200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 07 7200 "Roof Accessories" for preformed flashings.
3. Section 07 8413 "Penetration Firestopping" for through-penetration firestop assemblies.

1.2 DEFINITIONS

A. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Show fabrication and installation details for frost-resistant vent terminals.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. MIFAB, Inc.
d. Sioux Chief Manufacturing Company, Inc.
e. WATTS; A Watts Water Technologies Company.
f. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Riser: ASTM A74, Class, cast-iron drainage pipe fitting and riser to cleanout.

B. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS; A Watts Water Technologies Company.
e. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: as required to match connected piping.
5. Closure Plug: Nickel bronze.
a. Drilled and threaded for cover attachment screw.
b. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access, Cover Plate: Round, cover plate with screw.

C. Plastic Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. IPS Corporation.
b. Sioux Chief Manufacturing Company, Inc.
c. Zurn Industries, LLC.
2. Size: Same as connected branch.
3. Body: PVC.
4. Closure Plug: PVC.
5. Cleanout Cover: Nickel bronze.
6. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:
1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
a. NPS 2: 4-inch-minimum water seal.
b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Inline Trap Seal:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Green Drain, Inc.
   b. Jay R. Smith Mfg Co; a division of Morris Group International.
   c. MIFAB, Inc.
   d. RectorSeal Plumbing; A CSW Industrials Company.
2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: listed.
6. Size: Same as floor drain outlet or strainer throat.

D. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Frost-Resistant Vent Terminals:
1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

H. Expansion Joints:
1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Assemble open drain fittings and install with top of hub above floor.

E. Install deep-seal traps on floor drains and other waste outlets, if indicated.

F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

G. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

H. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

I. Install wood-blocking reinforcement for wall-mounting-type specialties.

J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 22 1316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
   1. Nameplates and signs are specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 1319.13

SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Floor drains.

1.2 DEFINITIONS

A. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg Co; a division of Morris Group International.
      b. Josam Company.
      c. MIFAB, Inc.
      d. Sioux Chief Manufacturing Company, Inc.
      e. WATTS; A Watts Water Technologies Company.
      f. Zurn Industries, LLC.
   2. Standard: ASME A112.6.3.
   3. Characteristics: Refer to contract drawings.

B. Plastic Floor Drain:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg Co; a division of Morris Group International.
      b. Josam Company.
      c. Oatey Co.
      d. Sioux Chief Manufacturing Company, Inc.
      e. Zurn Industries, LLC.
   2. Standard: ASME A112.6.3.
   3. Material: PVC.
   4. Characteristics: Refer to contract drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
      a. Maintain integrity of waterproof membranes where penetrated.
   5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

B. Install open drain fittings with top of hub above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 1316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 22 1319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 6113

COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Dental compressed-air piping, designated "dental air."
2. Laboratory compressed-air piping, designated "laboratory air."
3. Pressure-seal fittings.
4. Flexible pipe connectors.
5. Ball valves.
6. Check valves.
7. Compressed-air safety valves.
8. Compressed-air service connections.

B. Related Requirements:
1. Section 12 3570 "Healthcare Casework" for compressed-air outlets in healthcare casework.
2. Section 22 1513 "General-Service Compressed-Air Piping" for general-service compressed-air piping and specialties.
3. Section 22 6119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities" for air compressors and specialties.

1.2 DEFINITIONS

A. Compressed-Air Piping Systems: Include medical air, dental air, instrument air, and laboratory air.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: Signed by Installer, certifying that medical compressed-air piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.

B. Brazing certificates.

C. Field Quality-Control Reports: Brazing certificates.

D. Source Quality Control Reports:
1. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code, Section VIII.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical compressed-air pressure outlets.
      a. Medical Air: Equal to 10 percent of amount installed, but no fewer than **1** units.
      b. Instrument Air: Equal to 10 percent of amount installed, but no fewer than 1 units.
   2. D.I.S.S. Service Connections: Furnish complete medical compressed-air-pressure outlets complying with CGA V-5.
      a. Medical Air D.I.S.S. No. 1160: Equal to 10 percent of amount installed, but no fewer than 1 units.
      b. Instrument Air D.I.S.S. No. 1160: Equal to 10 percent of amount installed, but no fewer than 1 units.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Medical Air Piping Systems for Healthcare Facilities: In accordance with ASSE Standard #6010 for medical-gas-system installers.
   2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer in accordance with ASSE Standard #6040 .

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.
   1. Qualify testing personnel in accordance with ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications," or AWS B2.2/B2.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. All positive-pressure compressed-air products including piping, tubing, fittings, valves, zone valve boxes, manifolds, and service connections are required to be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.
   1. All are to be delivered plugged or capped by the manufacturer and are to be kept sealed until prepared for installation.

B. Comply with NFPA 99.

2.2 PIPES, TUBES, AND FITTINGS

A. Comply with ASME B31.1 for laboratory air piping operating at more than 150 psig.

B. Comply with ASME B31.9 for laboratory air piping operating at 150 psig or less.

C. Copper Medical Gas Tube: ASTM B819, , seamless, drawn temper. Include standard color marking "MED" or "OXY/MED" in green for Type K tube and in blue for Type L tube.

D. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.

E. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

F. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, full-face type.
2. Flange Bolts and Nuts: ASME B18.2.1 carbon steel.

G. Copper Pressure-Seal Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
b. FNW; Ferguson Enterprises, Inc.
c. Viega LLC.
2. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
3. NPS 2-1/2 to NPS 4: Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end.

H. Flexible Pipe Connectors:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Flex-Hose Co., Inc.
b. Flexicraft Industries.
c. Metraflex Company (The).
2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
a. Working-Pressure Rating: minimum.
b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

2.4 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged in accordance with CGA G-4.1 for oxygen service.

B. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
b. Bonomi North America, Inc.
c. NIBCO INC.
2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever.
8. Stem: Blowout proof with PTFE or TFE seal.

C. Check Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
b. Bonomi North America, Inc.
c. NIBCO INC.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed, ASTM B819, copper-tube extensions.

D. Compressed-Air Safety Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Amico Corporation.
b. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
c. Bonomi North America, Inc.
2. Bronze body.
3. ASME-construction, poppet, pressure-relief type.
4. Settings to match system requirements.

E. Pressure Regulators:
1. Bronze body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for <**Insert value**> minimum inlet pressure.
5. Capable of controlling delivered air pressure within 0.5 psig for each 10-psig inlet pressure.

2.5 MEDICAL COMPRESSED-AIR SERVICE CONNECTIONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Amico Corporation.
2. Ohio Medical Corporation.
3. Oxequip Health Industries; a division of Allied Healthcare Products Inc.
4. Tri-Tech Medical.

B. General Requirements for Medical Compressed-Air Service Connections:
1. Suitable for specific medical air pressure and service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Recessed-type units made for concealed piping unless otherwise indicated.

C. Roughing-in Assembly:
1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
3. Double seals that will prevent air leakage.
4. ASTM B819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

D. Finishing Assembly:
1. Brass housing with primary check valve.

2. Double seals that will prevent air leakage.
3. Cover plate with gas-service label.

E. Quick-Coupler Pressure Service Connections:
1. Outlets with noninterchangeable keyed indexing to prevent interchange between services.
2. Constructed to permit one-handed connection and removal of equipment.
3. With positive-locking ring that retains equipment stem in valve during use.

F. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
1. Medical Air: D.I.S.S. No. 1160.
2. Instrument Air: D.I.S.S. No. 1160.

G. Cover Plates:
1. One piece.
2. Permanent, color-coded, identifying label matching corresponding service.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Air Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
1. Clean medical air tube and fittings, valves, gauges, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service in accordance with CGA G-4.1.
2. Wash medical air tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
a. Scrub to ensure complete cleaning.
b. Rinse with clean, hot water to remove cleaning solution.

3.2 INSTALLATION OF PIPING

A. General Location and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Comply with NFPA 99 for installation of compressed-air piping.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

G. Install piping adjacent to equipment and specialties to allow service and maintenance.

H. Install piping with 1 percent slope downward in direction of flow.

I. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

J. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

K. Install branch connections to mains from top of main. Provide drain leg at end of each main and branch at low points.

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and for branch connections.

O. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 22 6313 "Gas Piping for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical air service.

P. Piping Restraint Installation: Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

Q. Install service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

R. Connect piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.

S. Install unions in copper tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

3.3 INSTALLATION OF VALVES

A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.

B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gauges in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install pressure regulators on compressed-air piping where reduced pressure is required.

F. Install flexible pipe connectors in discharge piping of each air compressor.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of cleaned tubing and fittings before assembly.

C. Threaded Joints: Apply appropriate tape to external pipe threads.

D. Brazed Joints: Join copper tube and fittings in accordance with CDA's "Copper Tube Handbook," Ch. "Brazed Joints." Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.

E. Soldered Joints: Apply ASTM B813, water-flushable flux to tube end. Join copper tube and fittings in accordance with ASTM B828.

F. Extruded-Tee Outlets: Form branches in copper tube in accordance with ASTM F2014, with tools recommended by tube manufacturer.

G. Flanged Joints:
1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.

H. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.5 INSTALLATION OF COMPRESSED-AIR SERVICE COMPONENTS

A. Install compressed-air pressure-control panel in walls. Attach to substrate.

B. Install compressed-air manifolds anchored to substrate.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Vertical Piping: MSS Type 8 or Type 42 clamps.

C. Individual, Straight, Horizontal Piping Runs:
1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

E. Base of Vertical Piping: MSS Type 52 spring hangers.

F. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support horizontal piping within 4 feet of each fitting and coupling.

H. Support vertical runs of copper tubing to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 IDENTIFICATION

A. Install identifying labels and devices for laboratory compressed-air piping, valves, and specialties. Comply with requirements in Section 22 0553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for medical compressed-air piping systems in accordance with NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
1. Medical Air: Black letters on yellow background.
2. Dental Air: Black letters on yellow background.
3. Instrument Air: White letters on red background.
4. Laboratory Air: Black letters on yellow-and-white checkerboard background.

3.8 FIELD QUALITY CONTROL FOR MEDICAL COMPRESSED-AIR PIPING IN HEALTHCARE FACILITIES

A. Testing Agency:
1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Tests and Inspections:
1. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of systems.
2. Preparation: Perform the following Installer tests in accordance with requirements in NFPA 99 and ASSE Standard #6010:
   a. Initial blowdown.
   b. Initial pressure test.
   c. Cross-connection test.
   d. Piping purge test.
   e. Standing pressure test for positive-pressure medical compressed-air piping.
   f. Repair leaks and retest until no leaks exist.
3. System Verification: Perform the following tests and inspections in accordance with NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:

a. Standing pressure test.
b. Cross-connection test.
c. Valve test.
d. Master and area alarm tests.
e. Piping purge test.
f. Piping particulate test.
g. Piping purity test.
h. Final tie-in test.
i. Operational pressure test.
j. Medical air-purity test.
k. Verify correct labeling of equipment and components.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed, and certify report results. Include the following:
   a. Inspections performed.
   b. Procedures, materials, and gases used.
   c. Test methods used.
   d. Results of tests.

E. Piping will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.9 FIELD QUALITY CONTROL FOR COMPRESSED-AIR PIPING IN LABORATORY FACILITIES

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill compressed-air piping with oil-free dry nitrogen to pressure of 50 psig above system operating pressure. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.

D. Piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, in accordance with "Preparation" Article.

3.11 PIPING SCHEDULE

A. Flanges may be used where connection to flanged equipment is required.

B. Type L Copper Tubing for NPS 3 and Smaller, Operating between 15 psig and 50 psig: Type L copper tubing, wrought copper fittings, and brazed joints.

C. Type K Copper Tubing for NPS 3 and Smaller, Operating between 15 psig and 50 psig: Type K copper tubing, wrought copper fittings, and brazed joints.

D. Type L Copper Tubing for Laboratory Air Piping, NPS 3 and Smaller, Operating between 15 psig and 50 psig: Type L copper tubing, wrought copper fittings, and brazed joints.

3.12 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B819, copper-tube extensions.

END OF SECTION

SECTION 22 6213

VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Dental vacuum piping, designated "dental vacuum."
2. Laboratory vacuum piping, designated "laboratory vacuum."

B. Related Requirements:
1. Section 12 3570 "Healthcare Casework" for vacuum inlets in healthcare casework.
2. Section 22 6219 "Vacuum Equipment for Laboratory and Healthcare Facilities" for vacuum producers and accessories.

1.3 DEFINITIONS

A. Vacuum Piping Systems: Include medical vacuum, dental vacuum, HVE, and laboratory vacuum piping systems.

B. Laboratory Vacuum Piping Systems: Include laboratory low-vacuum and laboratory high-vacuum piping systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: Signed by Installer, certifying that medical vacuum piping materials comply with requirements in NFPA 99 for medical vacuum systems.

B. Brazing certificates.

C. Field quality-control reports.

D. Source quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical vacuum suction inlets.
   a. Medical Vacuum: Equal to 10 percent of amount installed, but no fewer than 1 units.
   b. WAGD: Equal to 10 percent of amount installed, but no fewer than 1 units.
2. D.I.S.S. Service Connections: Furnish complete medical vacuum suction inlets complying with CGA V-5.
   a. Medical Vacuum D.I.S.S. No. 1220: Equal to 10 percent of amount installed, but no fewer than 1 units.
   b. WAGD D.I.S.S. No. 2220: Equal to 10 percent of amount installed, but no fewer than 1 units.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Medical Vacuum Piping Systems for Healthcare Facilities: In accordance with ASSE Standard #6010 for medical-gas-system installers.
   2. Pressure-Seal Joining Procedure for Copper Tubing: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.
   1. Qualify testing personnel in accordance with ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications," or AWS B2.2/B2.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 99.

2.2 PIPES, TUBES, AND FITTINGS

A. Comply with NFPA 99 for medical vacuum piping materials.

B. Copper Medical Gas Tube: ASTM B819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or in accordance with CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.

C. Copper Water Tube: ASTM B88/ASTM B88M, Type M, seamless, drawn temper.

D. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or in accordance with CGA G-4.1 for oxygen service.

E. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

F. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
   1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.

2. Flange Bolts and Nuts: ASME B18.2.1 carbon steel.

G. Pressure-Seal Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. FNW; Ferguson Enterprises, Inc.
   b. NIBCO INC.
   c. Viega LLC.
2. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
3. NPS 2-1/2 to NPS 4: Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end.

H. Flexible Pipe Connectors:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Metraflex Company (The).
2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   a. Working-Pressure Rating: minimum.
   b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux in accordance with ASTM B813.

B. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys.

C. Threaded-Joint Tape: PTFE.

2.4 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged in accordance with CGA G-4.1 for oxygen service.
1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.

B. Copper-Alloy Ball Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Allied Healthcare Products Inc.
   b. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
   c. NIBCO INC.
2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever.
8. Stem: Blowout proof with PTFE or TFE seal.

C. Check Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Allied Healthcare Products Inc.
b. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
c. NIBCO INC.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B819, copper-tube extensions.

2.5 MEDICAL VACUUM SERVICE CONNECTIONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Allied Healthcare Products Inc.
2. Amico Corporation.
3. Tri-Tech Medical.

B. General Requirements for Medical Vacuum Service Connections:
1. Suitable for specific medical vacuum service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple units or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

C. Roughing-in Assembly:
1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body inlet block.
3. Seals that will prevent vacuum leakage.
4. ASTM B819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

D. Finishing Assembly:
1. Brass housing with primary check valve.
2. Seals that will prevent vacuum leakage.
3. Cover plate with gas-service label.

E. Quick-Coupler Suction Service Connections:
1. Inlets with noninterchangeable keyed indexing to prevent interchange between services.
2. Constructed to permit one-handed connection and removal of equipment.
3. With positive-locking ring that retains equipment stem in valve during use.

F. D.I.S.S. Suction Service Connections:
1. Inlets complying with CGA V-5.
2. Threaded indexing to prevent interchange between services.
3. Constructed to permit one-handed connection and removal of equipment.
4. Medical Vacuum: CGA V-5, D.I.S.S. No. 1220.

G. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.

H. Cover Plates:
1. One piece.

2. Permanent, color-coded, identifying label matching corresponding service.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Vacuum Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
   1. Clean medical vacuum tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service in accordance with CGA G-4.1.
   2. Wash medical vacuum tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
      a. Scrub to ensure complete cleaning.
      b. Rinse with clean, hot water to remove cleaning solution.

3.2 INSTALLATION OF PIPING

A. General Location and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of vacuum piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install piping to permit valve servicing.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.

N. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 22 6219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.

O. Install vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

P. Install vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.

Q. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.

R. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

3.3 INSTALLATION OF VALVES

A. Install shutoff valve at each connection to and from vacuum equipment and specialties.

B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Apply appropriate tape to external pipe threads.

D. Brazed Joints: Join copper tube and fittings in accordance with CDA's "Copper Tube Handbook," Ch. "Brazed Joints." Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.

E. Soldered Joints: Apply ASTM B813, water-flushable flux to tube end. Join copper tube and fittings in accordance with ASTM B828.

F. Flanged Joints:
1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.

G. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices specified in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Vertical Piping: MSS Type 8 or Type 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:
1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52 spring hangers.

G. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

H. Support horizontal piping within 4 feet of each fitting and coupling.

I. Support vertical runs of copper tubing to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 IDENTIFICATION

A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Section 22 0553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for medical vacuum piping systems in accordance with NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
1. Dental Vacuum: Black letters on white background.
2. Laboratory Vacuum: Black boxed letters on white-and-black checkerboard background.

3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

A. Testing Agency:
1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Tests and Inspections:
1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of systems.
2. Preparation: Perform the following Installer tests in accordance with requirements in NFPA 99 and ASSE Standard #6010:
   a. Initial blowdown.
   b. Initial pressure test.
   c. Cross-connection test.
   d. Piping purge test.
   e. Standing pressure test for vacuum systems.
   f. Repair leaks and retest until no leaks exist.
3. System Verification: Perform the following tests and inspections in accordance with NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
   a. Standing pressure test.
   b. cross-connection test.
   c. Valve test.
   d. Master and area alarm tests.
   e. Piping purge test.
   f. Final tie-in test.
   g. Operational vacuum test.
   h. Verify correct labeling of equipment and components.
4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed, and certify report results. Include the following:
   a. Inspections performed.
   b. Procedures, materials, and gases used.
   c. Test methods used.
   d. Results of tests.

E. Piping will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 FIELD QUALITY CONTROL FOR LABORATORY FACILITY VACUUM PIPING

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Piping Leak Tests for Vacuum Piping: Test new piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
   a. Test Pressure for Copper Tubing: 60 psi.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters for proper operation.

D. Piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, in accordance with "Preparation" Article.

3.10 PIPING SCHEDULE

A. Connect new copper tubing to existing copper tubing with memory-metal couplings.

B. Flanges may be used where connection to flanged equipment is required.

C. Dental Vacuum Piping: Use copper water tube, wrought-copper fittings, and joints.

D. Medical Vacuum Piping: Use the following piping materials for each size range:
1. NPS 3 and Smaller, Wrought-Copper Fittings: Copper tube, wrought-copper fittings, and joints.
2. NPS 3 and Smaller, Press-Type Fittings: Copper tube, press-type fittings, and pressure-sealed joints.

E. Laboratory Vacuum Piping: Use the following piping materials for each size range:
1. NPS 3 and Smaller, Wrought-Copper Fittings: Copper tube, wrought-copper fittings, and joints.
2. NPS 3 and Smaller, Press-Type Fittings: Copper tube, press-type fittings, and pressure-sealed joints.

3.11 VALVE SCHEDULE

A. Shutoff Valves:
1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B819, copper-tube extensions.

END OF SECTION

SECTION 23 3113

AIR DISTRIBUTION SYSTEMS – METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Backdraft and pressure relief dampers.
8. Manual volume dampers.
9. Flexible connectors.
10. Duct accessory hardware.
11. Non-insulated flexible ducts.
12. Insulated flexible ducts.
13. Diffuser, registers & grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.
3. Flexible ducts.

B. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated Design Submittals:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades. Plans shall show ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved. Refer to Division 20 for requirements.

B. Field quality-control reports.

C. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports are to withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation, duct lining, or duct wall thickness.

G. Comply with NFPA 90A and NFPA 90B.

H. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

I. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

J. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B209Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

D. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.3 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
3. Welded sections of ductwork shall be minimum 16 gage sheet metal, provide SMACNA thickness where pressure class requires heavier gage.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
3. Where specified for specific applications, all joints are to be welded.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams are to be Pittsburgh lock seams unless otherwise specified for specific application.
1. Where specified for specific applications, all joints are to be welded.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. The following elbows in Table 4-2 shall not be used:
      a. Type RE-2, Square throat with vanes (acceptable for low pressure only where H & W is less than 18, otherwise default to Type RE-3)
      b. Type RE-4, Square throat without vanes
      c. Type RE-7, 45degree throat, 45degree heel
   2. The following divided flow branch fittings in Table 4-5 shall not be used:
      a. Type 2
   3. The following branch connections in Table 4-6 shall not be used:
      a. Straight tap
      b. Cinch lock
      c. Flanged or spin-in connections without conical or bell mouth transition
   4. The following obstruction methods in Table 4-8 shall not be used:
      a. Figure D, use Figure B instead.

2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
   1. Construct ducts of galvanized sheet steel unless otherwise indicated.
   2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
   3. All round ductwork exposed to view shall be spiral type construction.
   4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Linx Industries; a DMI company (formerly Lindab).
      b. McGill AirFlow LLC.
      c. Nordfab Ducting.
      d. SEMCO, LLC; part of FlaktGroup.
      e. Sheet Metal Connectors, Inc.

B. Source Limitations: Obtain single-wall round ducts and fittings from single manufacturer.

C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and

Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. The following fittings in Table 3-5 shall not be used:
    a. 90 degree tee fitting
    b. 90 degree tap
    c. 90 degree saddle fitting
    d. Rectangular straight tap

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Certainteed; SAINT-GOBAIN.
    b. Johns Manville; a Berkshire Hathaway company.
    c. Knauf Insulation.
    d. Owens Corning.
    e. Sekisui Voltek, LLC.
2. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.
3. Maximum Thermal Conductivity:
    a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
    a. Verify adhesive has a VOC content of 80 g/L or less.Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Aeroflex USA.
    b. Armacell LLC.
    c. K-Flex USA.
    d. Sekisui Voltek, LLC.
2. Source Limitations: Obtain flexible elastomeric duct liner from single manufacturer.
3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
    a. Verify adhesive has a VOC content of 80 g/L or less.Fibrous-Glass-Free, Natural-Fiber Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with antimicrobial coating.

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

b. Ductmate Industries, Inc; a DMI company.

2. Source Limitations: Obtain fibrous-glass-free, natural-fiber duct liner from single manufacturer.
3. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.
5. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

a. Verify adhesive has a VOC content of 80 g/L or less.Polyolefin Duct Liner: Cross-linked, partially open-cell polyolefin foam sheet or roll materials, with reinforced aluminum foil facing and adhesive backing, complying with NFPA 90A or NFPA 90B; sheet (Type II) complying with ASTM C1427.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Sekisui Voltek, LLC.
2. Source Limitations: Obtain polyolefin duct liner from single manufacturer.
3. Foam Core Density: 1.5 pcf.
4. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
5. Minimum Noise Reduction Coefficient (NRC): 0.50 for3/8-inch thickness, 0.45 for 5/8-inch thickness, 0.55 for 1-inch thickness, 0.55 for 2-1/8-inch thickness.
6. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
7. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

a. Verify adhesive has a VOC content of 80 g/L or less.Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

F. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. Verify sealant has a VOC content of 420 g/L or less.Water-Based Joint and Seam Sealant (Duct Air Temperatures above 0 degrees F):
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant (Duct Air Temperatures below 0 degrees F, cold climate outside air ducts):
1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.

7. Mold and mildew resistant.
8. Verify sealant has a VOC content of 420 g/L or less.Maximum Static-Pressure Class: 10-inch wg, positive or negative.
10. Service: Indoor or outdoor.
11. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Verify sealant has a VOC content of 420 g/L or less.Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:
1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.8 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
2. NCA Manufacturing, Inc.; Metal Industries, Inc.

3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
6. Vent Products Co., Inc

B. Description: Gravity balanced.

C. Performance:
1. Low Pressure Ductwork (2" pressure class and under)
   a. Minimum Air Velocity Rating: 1500fpm
   b. Maximum System Pressure: 2 inches wg.
   c. AMCA Certification: Test and rate in accordance with AMCA 511.
   d. Leakage shall not exceed 20 cfm/sq. ft. against 1-inch wg differential static pressure.

D. Construction:
1. Frame shall be hat shaped, material shall match ductwork construction, with welded or mechanically attached corners and mounting flange.
2. Blades: Multiple single-piece blades. End pivoted, maximum 6-inch width, aluminum sheet with sealed edges.
3. Blade Action: Parallel.

E. Blade Seals: Extruded vinyl, mechanically locked.

F. Blade Axles: Nonmetallic material.

G. Tie Bars and Brackets: Aluminum.

H. Return Spring: Adjustable tension.

I. Bearings: Brass sleeve or synthetic pivot bushings.

J. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. 90-degree stops.

2.9 MANUAL VOLUME DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
2. McGill AirFlow LLC.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
6. Vent Products Co., Inc.

B. Low Pressure (2" pressure class and under), Manual Volume Dampers:
1. Performance:
   a. Leakage Rating Class III: Leakage not exceeding 20 cfm/sq. ft. against 1-inch wg differential static pressure.
2. General Requirements:
   a. Minimum Air Velocity Rating: 2000 fpm.
   b. Maximum System Pressure: 2 inches wg.

3. Construction:
   a. Linkage out of airstream.
   b. Suitable for horizontal or vertical airflow applications.
4. Frames:
   a. Hat-shaped, material shall match ductwork construction.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Material shall match connected ductwork.
6. Blade Axles: Material shall match connected ductwork.
7. Bearings:
   a. Molded synthetic when installed in galvanized ductwork, Oil-impregnated stainless steel sleeve when installed in stainless steel ductwork.
   b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
8. Tie Bars and Brackets: Material shall match ductwork construction.
9. Locking device to hold damper blades in a fixed position without vibration.

C. Medium Pressure (2" and above pressure class) Manual Volume Dampers:
1. Performance:
   a. AMCA Certification: Test and rate in accordance with AMCA 511.
   b. Leakage: Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
2. Construction: Linkage: Out of airstream. Suitable for horizontal or vertical airflow applications.
3. Frames: Hat, U, or angle shaped. Material shall match connected ductwork. Mitered and welded corners. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades: Multiple or single blade. Parallel- or opposed-blade design. Stiffen damper blades for stability. Roll-formed material shall match connected ductwork.
5. Blade Edging Seals: PVC.
6. Blade Jamb Seals: Vinyl.
7. Blade Axles: Material shall match connected ductwork.
8. Bearings:
   a. Molded synthetic for galvanized ductwork, or Oil-impregnated stainless steel sleeve for stainless steel ductwork.
   b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
9. Tie Bars and Brackets: Material shall match connected ductwork.
10. Locking device to hold damper blades in a fixed position without vibration.

D. Jackshaft:
1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. CL WARD & Family Inc.
   2. Ductmate Industries, Inc; a DMI company.
   3. Duro Dyne Inc.
   4. DynAir; a Carlisle Company.
   5. Elgen Manufacturing.
   6. Ventfabrics, Inc.
   7. Ward Industries; a brand of Hart & Cooley, LLC.

B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Materials: Flame-retardant or noncombustible fabrics.

E. Coatings and Adhesives: Comply with UL 181, Class 1.

F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

H. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

I. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
   1. Minimum Weight: 16 oz./sq. yd.
   2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
   3. Service Temperature: Minus 67 to plus 500 deg F.

J. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
   1. Minimum Weight: 14 oz./sq. yd.
   2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
   3. Service Temperature: Minus 67 to plus 500 deg F.

K. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 DUCT ACCESSORY HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CL WARD & Family Inc.
2. Ductmate Industries, Inc; a DMI company.
3. Duro Dyne Inc.
4. DynAir; a Carlisle Company.
5. Elgen Manufacturing.
6. Ward Industries; a brand of Hart & Cooley, LLC.

B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.12 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Buckley Associates
2. Flexmaster U.S.A., Inc.
3. JP Lamborn Co.
4. McGill AirFlow LLC.
5. Thermaflex; a Flex-Tek Group company.
6. Ward Industries; a brand of Hart & Cooley, LLC.

B. Non-Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire.
1. Pressure Rating: 10-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 175 deg F.

C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

D. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.13 DIFFUSERS, REGISTERS & GRILLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
   2. METALAIRE, Inc.
   3. Nailor Industries Inc.
   4. Price Industries Limited.
   5. Titus; brand of Johnson Controls International plc, Global Products.
   6. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.

B. Provide diffusers, registers, and grilles for supply, return and exhaust outlets of size, type and, material of construction matching the basis of design devices scheduled on the drawings.

C. Equipment shall be tested and rated according to ASHRAE Standard 70-2006 (RA 2011), “Method of Testing for Rating the Performance of Air Outlets and Inlets”.

D. Room air velocities shall be determined in accordance with ASHRAE Standard 113-2013.

E. Coordinate diffusers, registers and grilles with ceiling and wall construction. Refer to Architectural Drawings for exact lengths and for framing and mitering arrangements that may differ from those shown on Division 23 Drawings.

F. General Construction and Performance Requirements
   1. Supply diffusers shall be specifically designed for variable-air-volume flows.
   2. Material: Steel, aluminum or stainless steel consistent with basis of design scheduled diffuser, register or grille.
   3. Finish: Steel and aluminum diffusers, registers and grilles shall have a baked enamel finish with color selected by Architect. Stainless steel diffusers and grilles shall have a brushed finish.
   4. Mounting: Coordinate selections with ceiling grid indicated on the architectural drawings.
   5. Pattern: Provide fully adjustable or fixed pattern consistent with scheduled basis of design diffuser, register or grille.
   6. Dampers: Opposed blade or butterfly as indicated.
   7. Accessories:
      a. Equalizing grid where run out branch to the device is less than 18 inches long.
      b. Aluminum plaster ring for devices mounted in dry wall, masonry, or tile construction.
      c. Safety chain for devices with a face area equal to or larger than 3 square feet.

G. RECTANGULAR AND SQUARE CEILING DIFFUSERS
   1. Devices shall be specifically designed for variable-air-volume flows.
   2. Material: Steel or Aluminum as indicated on plan.
   3. Finish: Baked enamel, white.

H. LOUVER FACE DIFFUSERS
   1. Devices shall be specifically designed for variable-air-volume flows.
   2. Material: Aluminum.
   3. Finish: Baked enamel, white.
   4. Pattern: Two-way Adjustable core style.
   5. Dampers: Radial opposed blade.
   6. Accessories:
      a. Square to round neck adaptor.
      b. Adjustable pattern vanes.
      c. Throw reducing vanes.
      d. Sectorizing baffles.

e. Operating rod extension.

2.14 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and No. 3 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B221 Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inchminimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

L. Elbows: Use long-radius elbows where coordination allows.
1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

M. Branch Connections: Use lateral or conical branch connections.

N. Provide 1/2” x 1/2” aluminum wire mesh on all open ended ducts, concealed or exposed. Requirement does not apply to transfer ducts.

O. Plenums and Connections to Louvers:
1. Shall be 18 ga. minimum cross-broken and properly reinforced with galvanized angle irons to SMACNA requirements.
2. Shall have bottom and corner seams soldered watertight at least 12” up from bottom.
3. Shall have neoprene gaskets or other non-corrodible material to make connections to louvers watertight.
4. Shall pitch connection back towards the louver. Provide half-coupling drain connection at bottom of plenum unless noted otherwise. Pipe drain to nearest floor drain.
5. Shall have unused portions of louvers blocked-off with insulated louver blank off panels; sealed air and watertight.
6. Provide and install bird or insect screen.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

F. All round ductwork exposed to view shall be spiral construction.

3.3 AIR DUCT ACCESSORY INSTALLATION

A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel. Volume dampers shall match connected duct material.

F. Manual volume dampers are not shown on plan for drawing clarity. Provide manual volume dampers at all low-pressure supply, return, and exhaust branches; and also at all register, grille, and diffuser takeoff. Volume dampers shall be installed in branch takeoff.

G. Set dampers to fully open position before testing, adjusting, and balancing.

H. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.

I. Install flexible connectors to connect ducts to equipment.

J. Install duct test holes where required for testing and balancing purposes.

3.4 FLEXIBLE DUCT INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect terminal units without fans to supply and return ducts directly. Connect terminal units with fans to supply and return ducts with flexible connectors.

D. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with nylon draw bands or reusable stainless steel draw bands. Nylon draw bands shall be installed with manufacturer clamping tool.

F. Install duct test holes where required for testing and balancing purposes.

G. Installation:
   1. Install ducts fully extended.
   2. Do not bend ducts across sharp corners.
   3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
   4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
   5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:
1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

3.5 DIFFUSER, REGISTER AND GRILLE INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing. Perimeter linear slot diffusers shall be deflected towards perimeter. Opposing diffusers shall be adjusted to prevent downdraft into occupied zone.

3.6 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.8 DUCTWORK CONNECTIONS

A. Make connections to motorized equipment with flexible connectors.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.9 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.

C. Air Duct Accessory Tests and Inspections

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 23 0130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.
1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 3300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

E. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.12 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT

A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
   1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in "Temporary Facilities and Controls," install MERV 8 filter media in accordance with ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
   2. Replace air filters immediately prior to occupancy with new filters specified in "Particulate Air Filtration."

3.13 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
   1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
   2. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.

B. Supply Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and downstream of Terminal Units:
      a. Pressure Class: Minimum Positive 2-inch wg or 125% of scheduled fan external static pressure.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 8.
      d. SMACNA Leakage Class for Round and Flat Oval: 4.
   2. Ducts Connected to Constant-Volume Air-Handling Units:
      a. Pressure Class: Minimum Positive 2-inch wg or 125% of scheduled fan external static pressure.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 8.
      d. SMACNA Leakage Class for Round and Flat Oval: 4.
   3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
      a. Pressure Class: Minimum Positive 4-inch wg or 125% of scheduled fan external static pressure.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.

C. Return Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and upstream of return terminal Units:
      a. Pressure Class: Positive or negative 2-inch wg or 125% of scheduled fan external static pressure.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 8.
      d. SMACNA Leakage Class for Round and Flat Oval: 4.
   2. Ducts Connected to Constant-Volume Air-Handling Units:
      a. Pressure Class: Minimum Negative 2-inch wg or 125% of scheduled fan external static pressure.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 8.
      d. SMACNA Leakage Class for Round and Flat Oval: 4.
   3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
      a. Pressure Class: Minimum Negative 2-inch wg or 125% of scheduled fan external static pressure.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Minimum negative 2-inch wg or 125% of scheduled fan external static pressure.
      b. Minimum SMACNA Seal Class: A if negative or positive pressure.
      c. SMACNA Leakage Class for Rectangular: 4.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.

E. Ducts and Systems not listed
   1. Ducts Connected to Equipment or Systems Not Listed Above:
      a. Pressure Class: Negative or Positive 4-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 2.
      d. SMACNA Leakage Class for Round and Flat Oval: 2.

F. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel.
   2. Aluminum Ducts: Aluminum.

G. Liner:
   1. Supply-Air Ducts: Fibrous glass, Type I, 1 inch thick.
   2. Return-Air Ducts: Fibrous glass, Type I, 1 inch thick.
   3. Exhaust-Air Ducts: Fibrous glass, Type I, 1 inch thick.

H. Elbow Configuration: Comply with the referenced figures in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Rectangular Duct -Use only the following fittings from Figure 4-2, "Rectangular Elbows" from SMACNA “Duct Construction Manual.” Priority shall be given to full radius type elbows. Square throat elbows with turning vanes (Type RE-2) are only allowed when shown on design documents. Refer to “Turning Vanes” under Part 2 – Products for additional information.
      a. Type RE 1: Radius elbow, where the inside elbow radius is equal to the width of the duct in plane of the elbow.
      b. Type RE 3: Radius elbow with full length turning vanes. R is equal to inside elbow radius. W is equal to width of the duct in plane of the elbow.

1) 1 > R/W >= 0.5: One splitter vane
2) 0.5 > R/W >= 0.25: Two splitter vanes
3) 0.25 > R/W > 0.05: Three splitter vanes
4) Where two elbows are less than 2 equivalent duct diameters away, increase quantity of splitter vanes up to maximum of three.

c. Type RE 5: Dual radius elbow
d. Type RE 6: Mitered elbow. Only to be used where angle is 15 degrees or less.

2. Round Duct: Comply with Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam for non-welded ductwork. Provide welded elbows in welded ductwork.

I. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Conical, bellmouth, and 45 degree lead in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 0 to 1250 fpm: Conical tap.
   b. Velocity 1250 fpm or Higher: 45-degree lateral.

J. Divided Flow Branches
1. Comply with the following types identified in Figure 4-5 of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Type 1
   b. Type 3
   c. Type 4A (without square throat elbow)
   d. Type 4B (without square throat elbow)

K. Offsets and Transitions
1. All types shown in Figure 4-7 of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." are acceptable.

L. Obstructions
1. Comply with the following types identified in Figure 4-8 of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Figure A, B, C, and E

END OF SECTION

SECTION 23 3400

HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ventilators, centrifugal - ceiling mounted.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. For each type of product.
      a. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
      b. Rated capacities, furnished specialties, and accessories for each fan.
      c. Fans:
         1) Certified fan performance curves with system operating conditions indicated.
         2) Certified fan sound-power ratings.
         3) Fan construction and accessories.
         4) Motor ratings and electrical characteristics, plus motor and electrical accessories.
         5) Fan speed controllers.
      d. Material thickness and finishes, including color charts.
      e. Dampers, including housings, linkages, and operators.

B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Design Calculations: Calculate requirements for selecting vibration isolators.

C. Delegated Design Submittal: For vibration isolation indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for selecting vibration isolators.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans showing fan rooms and fan system layouts, reflected ceiling plans, and other drawings required to illustrate relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

B. Startup service reports.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fans and ventilators, include the following:
   1. Operation in normal modes.
   2. Operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective coverage for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 "Quality Requirements," to design vibration isolation, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 VENTILATORS, CENTRIFUGAL - CEILING MOUNTED

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Acme Engineering & Manufacturing Corp.
   3. Broan.; a Broan-NuTone LLC brand; a Nortek company.
   4. Delta Breez.
   5. Loren Cook Company.

B. Source Limitations: Obtain ceiling-mounted centrifugal ventilators from single manufacturer.

C. Standards: Comply with UL 705.

D. Housing: Steel, lined with acoustical insulation.

E. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel are removable for service.

F. Back-draft damper: Integral.

G. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.

H. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

I. Accessories:
1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Cooling thermostat.
3. Isolation: Rubber-in-shear vibration isolators.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 "Common Work Results for HVAC."

2.4 SOURCE QUALITY CONTROL

A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.

B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.

C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

D. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, in accordance with manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:
1. Support duct-mounted and other hanging fans directly from the building structure, using suitable hanging systems as specified in Division 23 "Hangers and Supports for HVAC Piping and Equipment."

E. Install units with adequate clearances for service and maintenance.

F. Plastic Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Brady Corporation.
b. Carlton Industries, LP.
c. Champion America.
d. Craftmark Pipe Markers.
e. Kolbi Pipe Marker Co.
f. LEM Products Inc.

g. Marking Services Inc.
h. Pipemarker.com; Brimar Industries, Inc.
i. Seton Identification Products; a Brady Corporation company.
j. emedco.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Label Content: Include equipment's Drawing designation or unique equipment number.

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 "Air Duct Accessories."

B. Where installing ducts adjacent to fans, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Division 26 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Division 26 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
1. Nameplate is to be laminated acrylic or melamine plastic signs, as specified in "Identification for Electrical Systems."
2. Nameplate is to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect wiring in accordance with Division 26 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE:

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Lubricate bearings.

C. Comply with requirements for testing, adjusting, and balancing for HVAC, per one of the following acceptable qualification:
   1. AABC: Associated Air Balance Council
   2. NEBB: National Environmental Balancing Buteau
   3. TABB: Testing, Adjusting, and Balancing Bureau

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safeties.
   3. Fans and components will be considered defective if they do not pass tests and inspections.
   4. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans.

END OF SECTION

SECTION 26 0010

SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.
34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.
37. EVPE: Electric vehicle power export equipment.

38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
56. IR: Infrared.
57. IS: Intrinsically safe.
58. IT&R: Inspecting, testing, and repair.
59. ITE: Information technology equipment.
60. kAIC: Kiloampere interrupting capacity.
61. kcmil or MCM: One thousand circular mils.
62. kV: Kilovolt.
63. kVA: Kilovolt-ampere.
64. kVAr or kVAR: Kilovolt-ampere reactive.
65. kW: Kilowatt.
66. kWh: Kilowatt-hour.
67. LAN: Local area network.
68. lb: Pound (weight).
69. lbf: Pound (force).
70. LCD: Liquid-crystal display.
71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.
79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.
81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.

87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.
120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.
131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VOM: Volt-ohm-multimeter.
134. VPN: Virtual private network.
135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
136. W: Watt, unit of real electrical power.
137. Wh: Watt-hour, unit of electrical energy usage.
138. WPT: Wireless power transfer.
139. WPTE: Wireless power transfer equipment.
140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:
   1. EMT: Electrical metallic tubing.
   2. EMT-A: Aluminum electrical metallic tubing.
   3. EMT-S: Steel electrical metallic tubing.
   4. EMT-SS: Stainless steel electrical metallic tubing.
   5. ENT: Electrical nonmetallic tubing.
   6. EPEC: Electrical HDPE underground conduit.
   7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
   8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
   9. EPEC-A: Type A electrical HDPE underground conduit.
   10. EPEC-B: Type B electrical HDPE underground conduit.
   11. ERMC: Electrical rigid metal conduit.
   12. ERMC-A: Aluminum electrical rigid metal conduit.
   13. ERMC-S: Steel electrical rigid metal conduit.
   14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
   15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
   16. ERMC-SS: Stainless steel electrical rigid metal conduit.
   17. FMC: Flexible metal conduit.
   18. FMC-A: Aluminum flexible metal conduit.
   19. FMC-S: Steel flexible metal conduit.
   20. FMT: Steel flexible metallic tubing.
   21. FNMC: Flexible nonmetallic conduit. See "LFNC."
   22. HDPE: See EPEC.
   23. IMC: Steel electrical intermediate metal conduit.
   24. LFMC: Liquidtight flexible metal conduit.
   25. LFMC-A: Aluminum liquidtight flexible metal conduit.
   26. LFMC-S: Steel liquidtight flexible metal conduit.
   27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
   28. LFNC: Liquidtight flexible nonmetallic conduit.
   29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
   30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
   31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
   32. PVC: Rigid PVC conduit.
   33. PVC-40: Schedule 40 rigid PVC conduit.
   34. PVC-80: Schedule 80 rigid PVC Conduit.
   35. PVC-A: Type A rigid PVC concrete-encased conduit.
   36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
   37. RGS: See ERMC-S-G.
   38. RMC: See ERMC.
   39. RTRC: Reinforced thermosetting resin conduit.
   40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
   41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
   42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
   43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
   44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:
   1. AC: Armored cable.
   2. CATV: Coaxial general-purpose cable.
   3. CATVP: Coaxial plenum cable.
   4. CATVR: Coaxial riser cable.
   5. CI: Circuit integrity cable.

6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.

61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:
1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
4. SEOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.

18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:
1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
    a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
    a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
    b. Concrete Box: A box intended for use in poured concrete.
    c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal

point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
f. Device Box: A box with provisions for mounting a wiring device directly to the box.
g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
o. Raised-Floor Box: A floor box intended for use in raised floors.
p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility

during disruption of normal power sources, and also to minimize disruption within the internal wiring system.

12. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
    a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
13. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
14. Jacket: A continuous nonmetallic outer covering for conductors or cables.
15. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
16. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
17. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
18. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
19. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
20. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
21. Sheath: A continuous metallic covering for conductors or cables.
22. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
23. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
    d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
   1. Notify Architect, Construction Manager, and Owner no fewer than seven days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Owner's written permission.
   3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
      a. Telecommunications.

B. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

1.4 PREINSTALLATION MEETINGS

A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:
   1. Electrical installation schedule.
   2. Value analysis proposals and requests for substitution of electrical equipment.
   3. Sustainability activities, including Measurement and Verification Plan.

1.5 SCHEDULING

A. Provide Electrical Project Schedule.

1.6 ACTION SUBMITTALS

A. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.

B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 01 3100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which equipment and suspension systems will be attached.
   3. Size and location of access panels on ceilings.
   4. Elevation, size, and route of sprinkler piping.
   5. Elevation, size, and route of plumbing piping.
   6. Elevation, size, and route of ductwork.
   7. Elevation, size, and route of conduit.
   8. Elevation and size of wall-mounted and ceiling-mounted equipment.
   9. Access panels.
   10. Sprinklers.
   11. Air inlets and outlets.
   12. Control modules.
   13. Fire-alarm devices.
   14. Indicate clear dimensions for maintenance access in front of equipment.
   15. Indicate dimensions of fully-open access doors.

C. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
   1. Structural members in paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

D. Coordination Drawings for Large Equipment Indoor Installations:
   1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
   2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
      a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
      b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
      c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.
   3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:
      a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
      b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
      c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.

E. Coordination Drawings for Large Equipment Outdoor Installations:
   1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
      a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
      b. Indicate clear dimensions for fence gates and wall openings.
      c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
      d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
      e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
      f. Dimensioned working clearances and dedicated areas around electrical equipment.

F. Coordination Drawings for Duct Banks:
   1. Show duct profiles and coordination with other utilities and underground structures.
   2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.7 CLOSEOUT SUBMITTALS

A. Facility EPM Program Binders:

1. Complete Set: On approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
2. Volumes 2 and 8: Reproducible hardcopy on archival quality, 28 lb, acid-free, bond paper.

B. Operation and Maintenance Data:
1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:
2. Include the following information:
   a. Manufacturer's operating specifications.
   b. User's guides for software and hardware.
   c. Schedule of maintenance material items recommended to be stored at Project site.
   d. Detailed instructions covering operation under both normal and abnormal conditions.
   e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
   f. List of load-current and overload-relay heaters with related motor nameplate data.
   g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
   h. Manufacturer's instructions for setting field-adjustable components.
   i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
   j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
   k. Exterior pole inspection and repair procedures.

C. Software and Firmware Operational Documentation: Provide software and firmware operational documentation in Facility EPM Program Binders, including the following:
1. Software operating and upgrade manuals.
2. Names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.
5. Testing and adjusting of panic and emergency power features.
6. For lighting controls, include the following:
   a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
   b. Operation of adjustable zone controls.

D. Software:
1. Program Software Backup: Provide username and password for approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
2. Provide to Owner upgrades and unrestricted licenses for installed and backup software, including operating systems and programming tools required for operation and maintenance.

1.8 QUALIFICATIONS

A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 01 4000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.

B. Structural Professional Engineer: Professional engineer possessing active qualifications specified in Section 01 4000 "Quality Requirements," with expertise in structural engineering, including seismic- and wind-load modeling and analysis.

C. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 01 4000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.

D. Lighting Professional Engineer: Professional engineer possessing active qualifications in accordance with Section 01 4000 "Quality Requirements" and the following:
1. Expertise in electrical engineering, lighting design, and structural requirements for exterior poles and standards.
2. Lighting Certified (LC) Professional by the National Council on Qualifications for the Lighting Professions (NCQLP).

E. EPM Specialist: Recognized experts possessing the following qualifications in accordance with Section 01 4000 "Quality Requirements" and NFPA 70B:
1. Technical Competence: Person should, by education, training, and experience, be well-rounded in all aspects of electrical maintenance.
2. Administrative and Supervisory Skills: Person should be skilled in planning and development of long-range objectives to achieve specific results and should be able to command respect and solicit cooperation of persons involved in EPM Program development.

F. EVSE Installers: Installer possessing active qualifications specified in Section 01 4000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by EVSE manufacturer prior to starting installation.

G. Medium-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

H. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

I. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 01 4000 "Quality Requirements" with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:
1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that

substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.

2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

2.2 FACILITY ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM BINDERS

A. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.

B. Applicable Standards:
   1. Regulatory Requirements: Comply with recommendations in NFPA 70B.
   2. General Characteristics:
      a. Volume 1 - Introduction:
         1) Summarize how Facility EPM Program Analysis was performed, how data were collected, and how volumes are organized.
         2) Describe Facility EPM Program and provide recommended policies and procedures for implementing the program and keeping it current.
         3) Provide place for Owner to identify contact information for employees responsible for implementing and maintaining Facility EPM Program.
      b. Volume 2 - Facility Safety, Hazards Awareness, and Emergency Procedures:
         1) Include training requirements for employees and contractors.
         2) Include list of known facility hazards impacting IT&R activities.
         3) Include approval and permitting procedures for IT&R activities.
         4) Include incident emergency response procedures.
         5) Include emergency shutdown procedures.
         6) Include electrical disaster recovery procedures.
      c. Volume 4 - Facility Diagrams and Schedules:
         1) Include single-line diagrams.
         2) Include grounding and bonding diagrams.
         3) Include essential wiring diagrams.
         4) Include records of switchgear, switchboard, and panelboard schedules.
         5) Include time-current curves for overcurrent protective devices.
         6) Include list of load-current and overload-relay heaters with related motor nameplate data.
      d. Volume 5 - Inventory of Facility Equipment Using Electrical Power:
         1) Include simplified floor plans showing equipment locations.
         2) Identify critical equipment (electrical or otherwise).
         3) Include identifying designations and nameplate data.
         4) Include warranty and maintenance contract information.
      e. Volume 6 - Inventory of Facility Tools, Supplies, and Personnel Protective Equipment:
         1) Include schedules of maintenance material items recommended to be stored at facility.
         2) Include list of lamp types and photoelectric relays used in facility with ANSI and manufacturers' codes.
         3) Include calibration and servicing data for each item.
      f. Volume 7 - Inspection, Testing, and Repair (IT&R) Plan:
         1) Include tables showing frequency of activities for each item.

2) Include annual schedule with activities mapped to specific days of the year.
3) Include exterior pole inspection and repair procedures.

g. Volume 11 - Construction Project Closeout Record Documentation:
1) Include records of power system studies and photometric studies.
2) Include records of risk assessment studies.
3) Include records of electrical system startup and commissioning activities.
4) Include records of baseline inspections and tests.
5) Include records of baseline infrared photographs with normal light photographs showing the location, direction, angle, and conditions necessary for reproducing each infrared photograph.
6) Include records of baseline settings for adjustable equipment and devices.

PART 3 - EXECUTION

3.1 DEVELOPMENT OF FACILITY EPM PROGRAM

A. Facility EPM Program must be developed by qualified EPM specialist.

B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.
1. Renovation Projects:
a. Facility diagrams must include connected existing equipment for entire facility where known. Areas of uncertainty should be clearly indicated.
b. Obtain copies of existing operation and maintenance data and existing Facility EPM Program information from Owner.
c. Facility EPM Program analysis should identify existing equipment that does not have available operation and maintenance data, and should explain the Owner's risks because this equipment is not included in Facility EPM Program.
d. Data for existing equipment outside scope of Project may be inserted in Facility EPM Program Binders without analysis.
e. Data for existing equipment impacted by scope of Project should be analyzed and documented similar to Project's new equipment data as much as possible.

C. Compile operation and maintenance data from Facility EPM Program analysis and submit updated Facility EPM Program Binders.

3.2 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.3 FIELD QUALITY CONTROL

A. Administrant for Low-Voltage Electrical Tests and Inspections:
1. Owner will engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
2. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
4. Administer and perform tests and inspections with assistance of factory-authorized service representative.

B. Administrant for Power-Limited Electrical Tests and Inspections:
1. Owner will engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.
2. Engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.
3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
4. Administer and perform tests and inspections with assistance of factory-authorized service representative.

C. Administrant for Field Tests and Inspections of Lighting Installations:
1. Owner will engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.
2. Engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.
3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
4. Administer and perform tests and inspections with assistance of factory-authorized service representative.

3.4 CLOSEOUT ACTIVITIES

A. Demonstration:
1. Demonstrate to Owner's maintenance and clerical personnel and building occupants how to operate the following systems and equipment:
a. Lighting control devices specified in Section 26 0923 "Lighting Control Devices."
b. Lighting control systems specified in Section 26 0943.23 "Relay-Based Lighting Controls."
2. Provide video recordings of demonstrations to Owner or allow Owner to record demonstrations.

B. Training:
1. Train Owner's maintenance personnel on the following topics:
a. How to implement updated Facility EPM Program.
b. How to operate normal and emergency electrical systems, including justifications for, and limitations of, protective device settings recommended in study report specified in Section 26 0573.16 "Coordination Studies."
c. Electrical power safety fundamentals refresher including arc-flash hazard safety features of electrical power distribution equipment in facility, interpreting arc-flash warning labels, selecting appropriate personal protective equipment, and understanding significance of findings documented in study report specified in Section 26 0573.19 "Arc-Flash Hazard Analysis."
d. How to adjust, operate, and maintain devices specified in Section 26 0923 "Lighting Control Devices."
e. How to adjust, operate, and maintain hardware and software specified in Section 26 0943.23 "Relay-Based Lighting Controls."
f. How to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units specified in Section 26 2413 "Switchboards."
g. How to adjust, operate, and maintain equipment specified in Section 26 2743 "Electric-Vehicle Service Equipment - AC Level 1 and Level 2."

h. How to adjust, operate, and maintain equipment specified in Section 26 2913.03 "Manual and Magnetic Motor Controllers."
i. How to adjust, operate, and maintain transfer switches and related equipment, including ground-fault protection system, specified in Section 26 3600 "Transfer Switches."
j. How to adjust, operate, and maintain devices specified in Section 26 4313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits."
k. How to adjust, operate, and maintain luminaires and photoelectric controls specified in Section 26 5619 "LED Exterior Lighting."

2. Provide video recordings of training sessions to Owner or allow Owner to record training sessions.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.

B. Related Requirements:
1. Section 26 0010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For each type of product indicated.

B. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control" Article, including the following:
1. Test wells.
2. Rod electrodes.
3. Grounding arrangements and connections for separately derived systems.

C. Field Quality-Control Submittals:
1. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
1. In addition to items specified in Section 26 0010 "Supplemental Requirements for Electrical," include the following:
a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:
1) Test wells.
2) Rod electrodes.
3) Grounding arrangements and connections for separately derived systems.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2 **or** XHHW-2, copper wire or cable, green color, in accordance with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

B. Isolated Equipment Grounding Conductor:
1. General Characteristics: 600 V, THHN/THWN-2 **or** XHHW-2, copper wire or cable, green color with one or more yellow stripes, in accordance with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. ASTM - Bare Copper Grounding and Bonding Conductor:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ERICO; brand of nVent Electrical plc.
   b. Harger Lightning & Grounding; business of Harger, Inc.
2. Referenced Standards: Complying with one or more of the following:
   a. Soft or Annealed Copper Wire: ASTM B3
   b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
   c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
   d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
1. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
   a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Bonding Bushing:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ABB, Electrification Business.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ABB, Electrification Business.

b. Crouse-Hinds; brand of Eaton, Electrical Sector.
c. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
d. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.3 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

2.4 GROUNDING AND BONDING CONNECTORS

A. Source Limitations: Obtain products from single manufacturer.

B. Performance Criteria:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. ABB, Electrification Business.
b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. ABB, Electrification Business.
b. Chatsworth Products, Inc.
c. Greaves Corp.; Essex Products Group, Inc.
d. ILSCO.
2. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.

E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ABB, Electrification Business.
      b. Harger Lightning & Grounding; business of Harger, Inc.
      c. ILSCO.
   2. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 inch centers for two-bolt connection to busbar.

F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Panduit Corp.
   2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.

G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ABB, Electrification Business.
      b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      c. ILSCO.
   2. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
      a. Copper, C and H shaped.

H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ABB, Electrification Business.
      b. ERICO; brand of nVent Electrical plc.
      c. Greaves Corp.; Essex Products Group, Inc.
   2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.
      a. Copper.

I. UL KDER - Signal Reference Grid Grounding and Bonding Connector:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ABB, Electrification Business.
      b. Cooper B-line; brand of Eaton, Electrical Sector.
      c. ERICO; brand of nVent Electrical plc.
      d. Harger Lightning & Grounding; business of Harger, Inc.
   2. General Characteristics: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

2.5 GROUNDING AND BONDING BUSBARS

A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Listing Criteria:
      a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Equipment Room Grounding and Bonding Busbar:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
      b. Cooper B-line; brand of Eaton, Electrical Sector.
      c. ERICO; brand of nVent Electrical plc.
      d. Harger Lightning & Grounding; business of Harger, Inc.
      e. Hoffman; brand of nVent Electrical plc.
      f. ILSCO.
   2. General Characteristics:
      a. Bus: Rectangular bar of annealed copper.
      b. Mounting Stand-Off Insulators: Lexan or PVC.
         1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.
   3. Options:
      a. Dimensions: 1/4 by 4 inch in cross section; length as indicated on Drawings.
      b. Predrilled Hole Pattern: 9/32 inch holes spaced 1-1/8 inch apart.
      c. Mounting Hardware: Stand-off brackets that provide **2 inch** clearance to access rear of bus. Brackets and bolts must be stainless steel.

E. UL KDER - Rack and Cabinet Bonding Busbar:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Cooper B-line; brand of Eaton, Electrical Sector.
      b. Harger Lightning & Grounding; business of Harger, Inc.
      c. Hoffman; brand of nVent Electrical plc.
   2. General Characteristics:
      a. Bus: Rectangular bar of hard-drawn solid copper.
      b. Horizontal Mounting Dimensions: Designed for mounting in 19 inchwide equipment racks or cabinets.
      c. Vertical Mounting Dimensions: Designed for mounting in 72 inch high equipment racks or cabinets.
      d. Predrilled Hole Pattern: Accepts connectors for grounding and bonding conductor sizes 14 AWG to 2/0 AWG.
      e. Mounting Hardware: Stainless steel or copper-plated, for attachment to rack.

2.6 GROUNDING (EARTHING) ELECTRODES

A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Rod Electrode:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. ABB, Electrification Business.
b. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
c. ERICO; brand of nVent Electrical plc.
d. Galvan Industries, Inc.; Electrical Products Division, LLC.
e. Harger Lightning & Grounding; business of Harger, Inc.
2. General Characteristics: Copper-clad; 3/4 inch by 10 ft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 10 AWG and smaller, and stranded conductors for 8 AWG and larger unless otherwise indicated.

B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.

C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.

D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inchwide and 1/16 inch thick.

F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inchwide and 1/16 inch thick.

G. Underground Grounding Conductors: Install bare copper conductor, 4/0 AWG minimum.
1. Bury at least 30 inch below grade.

3.3 SELECTION OF CONNECTORS

A. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.4 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:
1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:
1. Conductors:
a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
b. Make connections with clean, bare metal at points of contact.
c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

g. Grounding and Bonding for Piping:
   1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
   3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

i. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft apart.

3. Electrodes:

a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.
   1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2) Use exothermic welds for below-grade connections.

b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.

c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 26 0543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch deep, with cover.
   1) Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

d. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around perimeter of building.
   1) Install tinned-copper conductor not less than 4/0 AWG for ring electrode and for taps to building steel.
   2) Bury ring electrode not less than 24 inches from building's foundation.

e. Concrete-Encased Electrode (Ufer Ground):
   1) Fabricate in accordance with NFPA 70; use minimum of 20 ft of bare copper conductor not smaller than 4 AWG.
      a) Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
   2) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 ft long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.

4. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.

5. Grounding Separately Derived Systems:
   a. Generator: Install grounding electrode(s) at generator location. Electrode must be connected to equipment grounding conductor and to frame of generator.
6. Grounding Underground Distribution System Components:
   a. Comply with IEEE C2 grounding requirements.
   b. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
   c. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields in accordance with manufacturer's published instructions with splicing and termination kits.
   d. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than 6 inches from foundation.
7. Equipment Grounding:
   a. Install insulated equipment grounding conductors with feeders and branch circuits.
   b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
      1) Feeders and branch circuits.
      2) Lighting circuits.
      3) Receptacle circuits.
      4) Single-phase motor and appliance branch circuits.
      5) Three-phase motor and appliance branch circuits.
      6) Flexible raceway runs.
      7) Metal-clad cable runs.
   c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
   d. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
   e. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
   f. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit

raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

g. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

h. Metallic Fences: Comply with requirements of IEEE C2.
   1) Grounding Conductor: Bare copper, not less than 8 AWG.
   2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
   3) Barbed Wire: Strands must be bonded to grounding conductor.

8. Fence Grounding: Install at maximum intervals of 1500 ft except as follows:
   a. Fences within 100 ft of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 ft.
      1) Gates and Other Fence Openings: Ground fence on each side of opening.
         a) Bond metal gates to gate posts.
         b) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use 2 AWG wire and bury it at least 18 inches below finished grade.
   b. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at maximum distance of 150 ft on each side of crossing.
   c. Grounding Method: At each grounding location, drive grounding rod vertically until top is 6 inches below finished grade. Connect rod to fence with 6 AWG conductor. Connect conductor to each fence component at grounding location.
   d. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
   e. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground fence and bond fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
   3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at ground test wells and at individual ground rods. Make tests at ground rods before conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
      c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Nonconforming Work:
1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.
1. Report measured ground resistances that exceed the following values:
a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω.
b. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 Ω.
c. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 Ω.
d. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 Ω.
e. Pad-Mounted Equipment: 5 Ω.
f. Manhole Grounds: 10 Ω.

3.6 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Support, anchorage, and attachment components.
   2. Fabricated metal equipment support assemblies.

B. Related Requirements:
   1. Section 26 0010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Slotted support systems, hardware, and accessories.
      b. Clamps.
      c. Hangers.
      d. Sockets.
      e. Eye nuts.
      f. Fasteners.
      g. Anchors.
      h. Saddles.
      i. Brackets.
   2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
   1. Hangers. Include product data for components.
   2. Slotted support systems.
   3. Equipment supports.
   4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated Design Submittal: For hangers and supports for electrical systems.
   1. Include design calculations and details of hangers.
   2. Include design calculations for seismic restraints.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame Rating: Class 1.
   2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inchdiameter holes at a maximum of 8 incheson center in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ABB, Electrification Business.
      b. Allied Tube & Conduit; Atkore International.
      c. CADDY; brand of nVent Electrical plc.
      d. Cooper B-line; brand of Eaton, Electrical Sector.
      e. Unistrut; Atkore International.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Material for Channel, Fittings, and Accessories: Galvanized steel.
   4. Channel Width: Selected for applicable load criteria.
   5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32 inchdiameter holes at a maximum of 8 incheson center in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ABB, Electrification Business.
      b. Eaton.
      c. Unistrut; Atkore International.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Channel Material: 6063-T5 aluminum alloy.
   4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
   5. Channel Width: Selected for applicable load criteria.
   6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) Cooper B-line; brand of Eaton, Electrical Sector.
         2) Empire Industries, Inc.
         3) Hilti, Inc.
         4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
   6. Toggle Bolts: All steel springhead type.
   7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA NEIS 101
   2. NECA NEIS 102.
   3. NECA NEIS 105.
   4. NECA NEIS 111.

B. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 26 0533 "Raceway and Boxes for Electrical Systems."

D. Provide vibration and seismic controls with hangers and supports in accordance with requirements specified in "Section 26 0548 "Vibration and Seismic Controls for Electrical Systems."

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inchin diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inchand smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT, IMC and ERMC may be supported by openings through structure members, in accordance with NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inchthick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inchthick.
   6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27).
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Do not attach any equipment or component supports from metal roof deck.

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

G. Supports shall be installed

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 5000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

END OF SECTION

SECTION 26 0533.16

BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:
1. See Section 26 0553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:
1. Section 26 0010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

B. Shop Drawings:
1. Shop drawings for floor boxes.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:
1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT - Metallic Outlet Boxes and Covers:
1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Appleton; Emerson Electric Co., Automation Solutions.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.
   d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Pass & Seymour; Legrand North America, LLC.
   g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. Wiremold; Legrand North America, LLC.
3. Options:
   a. Material: Sheet steel or Cast metal.
   b. Sheet Metal Depth: Minimum 1.5 inch.
   c. Cast-Metal Depth: Minimum 1.8 inch
   d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
   e. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

D. UL QCIT - Metallic Conduit Bodies:
1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Appleton; Emerson Electric Co., Automation Solutions.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Pass & Seymour; Legrand North America, LLC.
   f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

E. UL QCIT - Metallic Device Boxes:
1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Appleton; Emerson Electric Co., Automation Solutions.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.

d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

3. Options:
a. Material: Sheet steel or Cast metal.
b. Sheet Metal Depth: minimum 1.5 inch.
c. Cast-Metal Depth: minimum 1.8 inch.

F. UL QCIT - Metallic Extension Rings:
1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Appleton; Emerson Electric Co., Automation Solutions.
b. Cooper B-line; brand of Eaton, Electrical Sector.
c. Crouse-Hinds; brand of Eaton, Electrical Sector.
d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

G. UL QCIT - Metallic Floor Boxes and Floor Box Covers:
1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. AFC Cable Systems; Atkore International.
b. Arlington Industries, Inc.
c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
e. Leviton Manufacturing Co., Inc.
f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2.2 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Appleton; Emerson Electric Co., Automation Solutions.
   b. Cooper B-line; brand of Eaton, Electrical Sector.
   c. Hoffman; brand of nVent Electrical plc.
   d. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   g. Square D; Schneider Electric USA.
3. Options:
   a. Degree of Protection: Type 1.

D. UL BGUZ - Indoor Cast-Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Appleton; Emerson Electric Co., Automation Solutions.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
3. Options:
   a. Degree of Protection: Type 1.

2.3 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Appleton; Emerson Electric Co., Automation Solutions.
   b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.
   d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. Leviton Manufacturing Co., Inc.
   f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. Wiremold; Legrand North America, LLC.

2. Options:
    a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
    b. Wallplate Material: As indicated on architectural Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:
    1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness at location where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

3.2 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:
    1. Outdoors:
        a. Type 3R unless otherwise indicated.
        b. Locations Exposed to Hosedown: [Type 4.
        c. Locations Subject to Potential Flooding: Type 6P.
        d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
        e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
        f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
    2. Indoors:
        a. Type 1 unless otherwise indicated.
        b. Damp or Dusty Locations: Type 12.
        c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
    1. Boxes with knockouts or unprotected openings are prohibited.
    2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
    1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
    2. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:
    1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
    a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    b. Provide gaskets for wallplates and covers.
14. Identification: Provide labels for boxes and associated electrical equipment.
    a. Identify field-installed conductors, interconnecting wiring, and components.
    b. Provide warning signs.
    c. Label each box with engraved metal or laminated-plastic nameplate.

3.4 CLEANING

A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.5 PROTECTION

A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 0544

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Pourable sealants.
7. Foam sealants.

B. Related Requirements:
1. Section 26 0010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Advance Products & Systems, LLC.
b. CCI Piping Systems.
c. Flexicraft Industries.
d. GPT; an EnPro Industries company.
2. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Round, Galvanized-Steel, Sheet Metal Sleeves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Benefast.
b. Specified Technologies, Inc.
2. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Holdrite; a division of Reliance Worldwide Corporation.

B. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.3 GROUT

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

B. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
   1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
   2. Design Mix: 5000 psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.4 FOAM SEALANTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Innovative Chemical Products (Building Solutions Group).
   2. The Dow Chemical Company.

B. Performance Criteria:
   1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
      b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 9200 "Joint Sealants."
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed or seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

B. Related Requirements:
1. Section 26 0010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
1. Fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.

C. Signs, labels, and tags required for personnel safety must comply with the following standards:
1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.

5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

D. Comply with NFPA 70E and Section 26 0573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 1000 V or Less:
1. Black letters on orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
2. Colors for 208Y/120 V Circuits:
a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
3. Color for Neutral: .
4. Color for Equipment Grounds: Bare copper Green.

C. Raceways and Cables Carrying Circuits at More Than 1000 V:
1. Black letters on orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:
1. Identify system voltage with black letters on orange background.

E. Warning labels and signs must include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

F. Equipment Identification Labels:
1. Black letters on white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.

b. Champion America.
c. Panduit Corp.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.
b. HellermannTyton.
c. Marking Services Inc.
d. Panduit Corp.

C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.
b. Ideal Industries, Inc.
c. Panduit Corp.
2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
3. Marker for Labels:
a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.
b. HellermannTyton.
c. Panduit Corp.
2. Minimum Nominal Size:
a. 1-1/2 by 6 inch for raceway and conductors.
b. 3-1/2 by 5 inch for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.
1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.

b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. Ideal Industries, Inc.
      c. Marking Services Inc.
      d. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inchwide; compounded for outdoor use.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. Carlton Industries, LP.
      c. Marking Services Inc.

C. Tape and Stencil: 4 inchwide black stripes on 10 inch centers placed diagonally over orange background and are 12 inchwide. Stop stripes at legends.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. HellermannTyton.
      b. Marking Services Inc.
      c. Seton Identification Products; a Brady Corporation company.

D. Floor Marking Tape: 2 inchwide, 5 mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. Carlton Industries, LP.
      c. Seton Identification Products; a Brady Corporation company.

E. Underground-Line Warning Tape:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. Ideal Industries, Inc.
      c. Marking Services Inc.
      d. Seton Identification Products; a Brady Corporation company.
   2. Tape:
      a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
      b. Printing on tape must be permanent and may not be damaged by burial operations.

c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:
   a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
   b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
   c. Inscriptions for Orange Tapes: "CAUTION BURIED CATV LINE BELOW" "CAUTION BURIED TELEPHONE LINE BELOW" "CAUTION BURIED FIBER OPTIC LINE BELOW" "CAUTION BURIED COMMUNICATION LINE BELOW".

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. Marking Services Inc.
   d. Seton Identification Products; a Brady Corporation company.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened or printed permanent designations; punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. Marking Services Inc.
   d. Panduit Corp.

C. Write-on Tags:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brady Corporation.
   b. LEM Products Inc.
   c. Seton Identification Products; a Brady Corporation company.
2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags:
   a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
   b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

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

a. Brady Corporation.
b. Champion America.
c. Marking Services Inc.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4 inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inch.

B. Laminated Acrylic or Melamine Plastic Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.
b. Carlton Industries, LP.
c. Marking Services Inc.
2. Engraved legend.
3. Thickness:
a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
b. For signs larger than 20 sq. inch, 1/8 inch thick.
c. Engraved legend with black letters on white face.
d. Punched or drilled for mechanical fasteners with 1/4 inch grommets in corners for mounting or Self-adhesive.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8 inch high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

L. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
   1. "POWER."

M. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

N. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

P. Self-Adhesive Labels:
   1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.

Q. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.

W. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
   2. Limit use of underground-line warning tape to direct-buried cables.
   3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Write-on Tags:
   1. Place in location with high visibility and accessibility.
   2. Secure using general-purpose cable ties.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:
   1. "POWER."

E. Concealed Raceways and Duct Banks, More Than 1000 V, within Buildings: Apply floor marking tape to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inch of floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in building, or concealed above suspended ceilings.

F. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with

NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

G. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels, Baked-enamel warning signs or Metal-backed, butyrate warning signs.
   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
      a. Power-transfer switches.
      b. Controls with external control power connections.

I. Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Metal-backed, butyrate warning signs, Laminated acrylic, or melamine plastic signs.

J. Equipment Identification Labels:
   1. Indoor Equipment: Self-adhesive label Baked-enamel signs, Metal-backed butyrate signs or Laminated acrylic or melamine plastic sign.
   2. Outdoor Equipment: Laminated acrylic or melamine sign or Stenciled legend 4 inch high.
   3. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Enclosed switches.
      e. Enclosed circuit breakers.
      f. Enclosed controllers.
      g. Push-button stations.
      h. Contactors.
      i. Monitoring and control equipment.

END OF SECTION

SECTION 26 0923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Electronic time switches.
2. Electromechanical dial-time switches.
3. Outdoor photoelectric switches, solid state, flexible mounting.
4. Outdoor photoelectric switches, solid state, luminaire-mounted.
5. Outdoor photoelectric switches, low voltage.
6. Indoor occupancy and vacancy sensors.
7. Switchbox-mounted occupancy sensors.
8. Lighting contactors.
9. Conductors and cables.

B. Related Requirements:
1. Section 26 0010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 26 2726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For each type of product.

B. Shop Drawings:
1. Show installation details for the following:
a. Occupancy sensors.
b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

1.3 WARRANTY

A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.
1. Failures include, but are not limited to, the following:
a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.
2. Extended Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, LUMINAIRE-MOUNTED

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Eaton.
   2. Intermatic, Inc.
   3. Leviton Manufacturing Co., Inc.
   4. nLight; Acuity Brands Lighting, Inc.

B. Description: Solid state, with SPST dry contacts rated for 1000 W incandescent or 1800 VA inductive, to operate connected load, complying with UL 773, and compatible with CFL and LED lamps.
   1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
   3. Time Delay: Thirty-second minimum, to prevent false operation.
   4. Lightning Arrester: Air-gap type.
   5. Mounting: Twist lock complying with ANSI C136.10, with base from same source and manufacturer as switch.
   6. Failure Mode: Luminaire stays ON.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. WattStopper; Legrand North America, LLC. or approved equivalent.

B. General Requirements for Sensors:
   1. Wall Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
   2. Dual technology.
   3. Separate power pack.
   4. Hardwired connection to switch; and BAS and lighting control system.
   5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   6. Operation:
      a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
      b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
      c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
   8. Power Pack: Dry contacts rated for 20 A ballast or LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
   9. Mounting:

a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

10. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
11. Bypass Switch: Override the "on" function in case of sensor failure.
12. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
4. Detection Coverage Room, Wall Mounted: Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 sq. ft. when mounted 48 inch above finished floor.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. WattStopper; Legrand North America, LLC. or approved equivalent.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, with provisions for connection to BAS using hardwired connection.
1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 800 VA ballast or LED load at 120 V, 1200 VA ballast or LED load at 277 V, and 800 W incandescent.

C. Wall-Switch Sensor Tag WS1:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Dual voltage - 120 and 277 V.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: By Architect.
11. Faceplate: Color matched to switch.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

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

3.2 INSTALLATION OF SENSORS

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF CONTACTORS

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.

C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 26 0553 "Identification for Electrical Systems.
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Nonconforming Work:
   1. Lighting control devices will be considered defective if they do not pass tests and inspections.
   2. Remove and replace defective units and retest.

C. Prepare test and inspection reports.

D. Manufacturer Services:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
   1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
   2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
   3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.
4. Hospital-grade straight-blade receptacles.
5. Receptacles with arc-fault and ground-fault protective devices.
6. Locking receptacles.
7. Pin-and-sleeve receptacles.
8. Special-purpose power outlet assemblies.
9. Connectors, cords, and plugs.

B. Related Requirements:
1. Section 26 0010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 26 0011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 26 0923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.
4. Section 26 0936 "Modular Dimming Controls" for multiscene and multipreset dimming controls.
5. Section 26 0943.16 "Addressable Luminaire Lighting Controls" for network lighting control solid-state devices.
6. Section 26 0943.23 "Relay-Based Lighting Controls" for network lighting control relay devices.
7. Section 26 2726.11 "General-Use Switches, Dimmer Switches, and Fan-Speed Controller Switches" for additional wiring device products.
8. Section 26 2726.31 "General-Grade Single Straight-Blade Receptacles" for additional wiring device products.
9. Section 26 2726.33 "General-Grade Duplex Straight-Blade Receptacles" for additional wiring device products.
10. Section 26 2726.35 "Hospital-Grade Straight-Blade Receptacles" for additional wiring device products.
11. Section 26 2726.37 "Receptacles with Arc-Fault and Ground-Fault Protective Devices" for additional wiring device products.
12. Section 26 2726.39 "Locking Receptacles" for additional wiring device products.
13. Section 26 2726.41 "Pin-and-Sleeve Receptacles" for additional wiring device products.
14. Section 26 2726.43 "Special-Purpose Power Outlet Assemblies" for additional wiring device products.
15. Section 26 2726.51 "Connectors, Cords, and Plugs" for additional wiring device products.

1.2 DEFINITIONS

A. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.

B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. General-use switches, dimmer switches, and fan-speed controller switches.
   2. General-grade single straight-blade receptacles.
   3. General-grade duplex straight-blade receptacles.
   4. Receptacles with arc-fault and ground-fault protective devices.
   5. Locking receptacles.
   6. Pin-and-sleeve receptacles.
   7. Special-purpose power outlet assemblies.
   8. Connectors, cords, and plugs.

B. Shop Drawings:
   1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.

C. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
   1. Dimmers.
   2. Fan-speed controllers.
   3. Single straight-blade receptacles.
   4. Duplex straight-blade receptacles.
   5. Duplex straight-blade receptacles with integral switching means.
   6. Hospital-grade straight-blade receptacles.
   7. Receptacles with AFCI device.
   8. Receptacles with AFCI and GFCI devices.
   9. Receptacles with GFCI device.
   10. Locking receptacles.
   11. Pin-and-sleeve receptacles.
   12. Spring-driven commercial/industrial-use cord reels.
   13. Cord reels for use in hazardous locations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Special Tools:
   1. Proprietary equipment and software required to maintain, repair, adjust, or implement future changes to controlled receptacles.
   2. Proprietary equipment required to maintain, repair, adjust, or implement future changes to cord connectors.

1.6 WARRANTY FOR DEVICES

A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.
   1. Initial Extended Warranty Period: one year from date of Substantial Completion; coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. Toggle Switch:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
      b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour; Legrand North America, LLC.
   2. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   3. General Characteristics:
      a. Reference Standards: UL CCN WMUZ and UL 20.
   4. Options:
      a. Device Color: As indicated on architectural Drawings.
      b. Configuration:
         1) General-duty, 120-277 V, 20 A, single pole
   5. Accessories:
      a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
      b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
   6. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   7. General Characteristics:
      a. Reference Standards: UL CCN WMUZ and UL 20.
      b. Device Color: As indicated on architectural Drawings.
      c. Configuration:
         1) 120-277 V, 20 A, single pole.

2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

A. Single Straight-Blade Receptacle:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.

b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
   a. Device Color: As indicated on architectural Drawings.
   b. Configuration:
      1) General-duty, NEMA 5-20R
5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
   a. Device Color: As indicated on architectural Drawings.
   b. Configuration:
      1) General-duty, NEMA 5-15R.
5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
   c. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   d. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.4 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with AFCI Device:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
      b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour; Legrand North America, LLC.
   2. General Characteristics:
      a. Reference Standards: UL CCN AWBZ, UL 498, UL 1699, and UL Subject 1699A.
   3. Options:
      a. Device Color: As indicated on architectural Drawings.
      b. Configuration: Heavy-duty, NEMA 5-20R.
   4. Accessories:
      a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
      b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with AFCI and GFCI Device :
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
      b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour; Legrand North America, LLC.
   2. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   3. General Characteristics:
      a. Reference Standards: UL CCN KCXX, UL 498, UL 943, UL 1699, and UL Subject 1699A.
   4. Options:
      a. Device Color: As indicated on architectural Drawings.
      b. Configuration: Heavy-duty, NEMA 5-20R.
   5. Accessories:
      a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
      b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

C. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.
4. Options:
   a. Device Color: As indicated on architectural Drawings.
   b. Configuration: Heavy-duty, NEMA 5-20R.
5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
   c. In use cover for outdoor locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:
   1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:
   1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
   2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
   3. Consult Architect for resolution of conflicting requirements.

C. Identification:
   1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 26 0553 "Identification for Electrical Systems."
      a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
      b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:
   1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
   2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
   3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
      a. Hospital-Grade Receptacle Orientation: Orient receptacle with ground pin or neutral pin at top.
   4. Consult Architect for resolution of conflicting requirements.

C. Identification:
   1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 26 0553 "Identification for Electrical Systems."
      a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
      b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

END OF SECTION

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GENERAL NOTES

1. ALL DIMENSIONS AND FIELD CONDITIONS WILL BE VERIFIED BY THE GENERAL CONTRACTOR. THE ACCURACY OF THE FIELD MEASUREMENTS IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR.
2. THE GENERAL CONTRACTOR AND ALL SUBCONTRACTORS WILL COMPLY WITH ALL FEDERAL, STATE, AND LOCAL LAWS AND ORDINANCES PERTAINING TO THE CONSTRUCTION OF THIS DENTAL OFFICE.
3. MILLWORK SHALL BE DESIGNED BY THE MILLWORK SUPPLIER AND/OR DENTAL CABINETRY SUPPLIER EXCEPT AS NOTED.
4. BENCO SUGGESTS COMPLIANCE WITH CDC/OSHA RECOMMENDATIONS AGAINST INSTALLING CARPETING IN TREATMENT ROOMS.
5. ALL HAZARDS, TEMPORARY OR OTHERWISE SHALL BE PROTECTED TO PRESERVE PUBLIC SAFETY.
6. BENCO WILL SUPPLY ALL DETAILED TEMPLATES AND/OR DETAIL MANUFACTURER'S INSTRUCTIONS. SUCH TEMPLATES AND INSTRUCTIONS WILL DEFINE THE LOCATIONS, CONNECTIONS, AND SERVICES REQUIRED BY THE DENTAL EQUIPMENT. ERRORS RESULTING FROM THE FAILURE OF THE GENERAL CONTRACTOR TO FOLLOW THE INSTRUCTIONS AND/OR TEMPLATES WILL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR.
7. DIMENSIONS FOR ALL DENTAL EQUIPMENT ARE CRITICAL AND MUST COMPLY WITH THE MANUFACTURER'S SPECIFICATIONS, AS SUPPLIED BY BENCO. BENCO WILL NOT ASSUME RESPONSIBILITY FOR UNAUTHORIZED VARIATIONS TO THE PLANS AND/OR THE MANUFACTURER'S SPECIFICATIONS.
8. WHERE NEW MATERIALS ARE TO BE APPLIED IN EXISTING AREAS, THE GENERAL CONTRACTOR WILL REMOVE EXISTING MATERIALS, AS REQUIRED, AND PROPERLY PREPARE AREA TO RECEIVE THE NEW WORK.
9. THE GENERAL CONTRACTOR WILL INSPECT ALL AREAS OF CONSTRUCTION AFTER COMPLETION OF THE WORK AND PROVIDE "REPAIR" AND "TOUCH-UP" PAINTING, IN ORDER TO RETURN AREA TO ORIGINAL CONDITION.
10. ALL WORK FOR ALL TRADES WILL BE GUARANTEED FOR A PERIOD OF ONE YEAR MINIMUM FROM THE DATE OF ITS ACCEPTANCE.
11. ALL MATERIALS INCORPORATED INTO THE WORK WILL BE NEW, UNLESS OTHERWISE NOTED. INSPECTIONS BY A BENCO REPRESENTATIVE ARE AN INTEGRAL PART OF OFFICE CONSTRUCTION.
12. IT IS RESPONSIBILITY OF THE CUSTOMER OR HIS GENERAL CONTRACTOR TO ARRANGE FOR ALL MEETINGS, INCLUDING THE INITIAL REVIEW OF THE PLANS, SPECIFICATIONS, AND TEMPLATES AND ALL SUBSEQUENT INSPECTIONS.

BENCO DENTAL INSPECTIONS

- INITIAL REVIEW OF THE PLANS, SPECIFICATIONS, AND FIELD CONDITIONS WITH THE GENERAL CONTRACTOR, CARPENTER, PLUMBER, AND ELECTRICIAN BEFORE RENOVATIONS BEGIN.
- INSPECTION AFTER FRAMING AND BLOCKING ARE COMPLETE, PLUMBING AND ELECTRICAL LINES ARE INSTALLED, AND BEFORE WALLS AND/OR FLOORS ARE CLOSED.
- FINAL INSPECTION AFTER FINISH WORK IS COMPLETE, TWO (2) DAYS PRIOR TO THE INSTALLATION OF DENTAL EQUIPMENT.

13. BENCO WILL BE PROVIDED FIVE (5) DAYS ADVANCE NOTICE OF ALL MEETINGS. TO ARRANGE THE ABOVE, PLEASE CALL THE EQUIPMENT SPECIALIST LISTED UNDER THE PROJECT TEAM SECTION OF THE COVER SHEET.
14. CONTRACTOR SHALL CONSULT DOCTOR AND/OR BUILDING OWNER AND, WHERE APPLICABLE, BE RESPONSIBLE FOR THE SUPPLY AND INSTALLATION OF THE FOLLOWING:
    a. UPGRADING AND INSTALLATION OF ELECTRICAL SERVICE TO DENTAL OFFICE
    b. COMPLETE HVAC SYSTEM
    c. HOT WATER SYSTEM
    d. FIRE SAFETY DEVICES INCLUDING: ALARMS, DETECTORS, EXTINGUISHERS, ETC.
    e. ILLUMINATED EXIT SIGNS
    f. GENERAL AND EMERGENCY LIGHTING
    g. TELEPHONE SYSTEM AND WIRING
    h. SOUND SYSTEM
    i. COMPUTER SYSTEM WIRING

SYMBOLS LEGEND

##/##	DETAIL/SHEET TAG	S#	SINK TAG
#	EQUIPMENT TAG	#	NOTE TAG

PROJECT NAME & LOCATION

JUANITA SANCHEZ HIGH SCHOOL

PROVIDENCE, RI

PROJECT TEAM

Benco® | Practice Design

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PROJECT MANAGER : JEFF RIDZON JRIDZON@BENCO.COM (203) 231-1327

PROJECT DESIGNER : EMILY PIESHEFSKI

DRAWING LIST

SHEET	DRAWING TITLE	ISSUED	DATE
Q0.1	COVER SHEET	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026
Q1.1	DENTAL EQUIPMENT PLAN	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026
Q2.1	DENTAL CARPENTRY PLAN	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026
Q2.2	DENTAL CARPENTRY DETAILS	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026
Q2.3	DENTAL CABINET DRAWINGS	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026
Q3.1	DENTAL ELECTRICAL PLAN	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026
Q3.2	DENTAL ELECTRICAL DETAILS	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026
Q4.1	DENTAL PLUMBING PLAN	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026
Q4.2	DENTAL PLUMBING DETAILS	DENTAL CONST. DOCUMENTS – REVISION #2	10/15/2026

GENERAL CONDITIONS

1. SUMMARY OF WORK

DIVISION OF RESPONSIBILITIES TERMINOLOGY:

- "CONTRACTOR": WHERE REFERENCED ON THE DRAWINGS, THE TERM "CONTRACTOR" REFERS TO THE PERSON OR ENTITY RESPONSIBLE FOR PROVIDING ALL CONSTRUCTION WORK.

CONSTRUCTION DRAWINGS:

- CONSTRUCTION DRAWINGS SHALL NOT BE SCALED IN ORDER TO DETERMINE LOCATIONS OF ITEMS OF CONSTRUCTION. LARGER SCALE DETAILS TAKE PRECEDENCE OVER SMALLER SCALE DETAILS. DIMENSIONED DETAILS TAKE PRECEDENCE OVER NON-DIMENSIONED DETAILS.
- THE WORD "FURNISH" IS USED TO MEAN "SUPPLY" COMPLETE WITH ALL ESSENTIAL ACCESSORIES SO THAT THE WORK WHEN INSTALLED FUNCTIONS FOR ITS INTENDED USE, AND DELIVERY TO THE PROJECT SITE, READY FOR UNLOADING, UNPACKING, ASSEMBLY, INSTALLATION, AND SIMILAR OPERATIONS.
- THE WORD "INSTALL" IS USED TO DESCRIBE OPERATIONS AT THE PROJECT SITE INCLUDING THE UNLOADING, UNPACKING, ASSEMBLY, ERECTION, PLACING, ANCHORING, APPLYING, WORKING TO DIMENSION, FINISHING, CURING, CONNECTING, PROTECTING, CLEANING, AND SIMILAR OPERATIONS NECESSARY FOR THE WORK TO FUNCTION FOR ITS INTENDED USE.
- THE WORD "PROVIDE" MEANS "FURNISH AND INSTALL", AS DEFINED ABOVE, COMPLETE IN-PLACE AND READY FOR INTENDED USE. THE WORD "PROVIDE" THUS REQUIRES INCLUSION OF ALL ACCESSORIES, ATTACHMENTS, SUPPORTS AND SERVICES NECESSARY TO COMPLY WITH THIS DEFINITION, WHETHER OR NOT SPECIFICALLY IDENTIFIED OR DESCRIBED IN THE CONSTRUCTION DOCUMENTS.

ENVIRONMENTAL ASSESSMENT:

- REMOVAL OF HAZARDOUS MATERIALS, IF IDENTIFIED BY ANY ENVIRONMENTAL ASSESSMENT PERFORMED BY AN ENVIRONMENTAL ENGINEER CONTRACTED BY THE OWNER, SHALL BE COMPLETED BY WAY OF A HAZARDOUS MATERIALS REMOVAL CONTRACT EXECUTED BY THE OWNER INDEPENDENT FROM AND PRIOR TO THE DATE OF COMMENCEMENT.

2. PERMIT SUBMISSION, REVIEWS, APPROVALS & FEES

PERMIT SUBMISSION BY CONTRACTOR:

- THE CONTRACTOR SHALL SUBMIT THE APPLICATION FOR THE BUILDING PERMIT SUBMISSION, AND SHALL INCLUDE ALL REQUIRED DESIGN AND ENGINEERING DRAWINGS AND OTHER REQUIRED DOCUMENTS.
- THE CONTRACTOR SHALL COORDINATE WITH THE ARCHITECT TO PROVIDE FOLLOW-UP COORDINATION WITH THE LOCAL JURISDICTION, AS REQUIRED, WITH RESPECT TO BUILDING-RELATED ISSUES THAT IMPACT THE APPROVAL AND RELEASE OF THE BUILDING PERMIT.
- THE COST OF ARCHITECT/ENGINEER SIGNED/SEALED CONSTRUCTION DRAWINGS AND OTHER REQUIRED DOCUMENTS, AND TRANSMITTAL TO THE CONTRACTOR WILL BE THE OWNER'S RESPONSIBILITY.
- TIME AND MATERIAL COSTS FOR THE CONTRACTOR'S DELIVERY TO AND PICKUP FROM THE LOCAL JURISDICTION, AS APPLICABLE, WILL BE THE CONTRACTOR'S RESPONSIBILITY.

BUILDING PERMIT FEES:

- ALL BUILDING PERMIT FEES SHALL BE THE_CONTRACTOR'S RESPONSIBILITY, SHALL BE DUE AND PAYABLE TO THE LOCAL JURISDICTION ACCORDING TO THE LOCAL JURISDICTION'S REQUIREMENTS, AND SHALL BE INCLUDED BY THE CONTRACTOR IN THE BASE BID.

CONTRACTOR LICENSE OR LOCAL SUBCONTRACTOR PERMITS:

- IF THE CONTRACTOR OR ANY SUBCONTRACTOR IS REQUIRED BY THE STATE OR LOCAL JURISDICTION TO OBTAIN AN APPLICABLE CONTRACTOR LICENSE, OR ANY OTHER LOCAL SUBCONTRACTOR PERMITS, SO AS TO PERMIT LEGAL WORK TO BE PROVIDED FOR THIS PROJECT, THEN THE CONTRACTOR IS RESPONSIBLE FOR ALL COSTS INCURRED TO SATISFY THESE JURISDICTIONAL REQUIREMENTS.
- THE COST OF ANY AND ALL CONTRACTOR LICENSE(S), SUBCONTRACTOR TRADE PERMITS, SERVICES AND INSPECTIONS SHALL BE THE CONTRACTOR'S RESPONSIBILITY AND SHALL BE INCLUDED IN THE BASE BID.
- THE PRINTING COST FOR DRAWINGS AND OTHER CONSTRUCTION DOCUMENTS REQUIRED FOR ANY CONTRACTOR LICENSE(S) OR SUBCONTRACTOR TRADE PERMITS SHALL BE THE CONTRACTOR'S RESPONSIBILITY, AND SHALL BE INCLUDED IN THE BASE BID.

FINAL CERTIFICATE OF OCCUPANCY:

- THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING THE LOCAL JURISDICTION FINAL CERTIFICATE OF OCCUPANCY, OR ITS EQUIVALENT PERMIT, SO TO ALLOW THE OWNER TO COMMENCE FULL OPERATIONS, ON OR BEFORE THE DATE OF FINAL COMPLETION.

3. SITE UTILITIES

- APPLICATIONS FOR SITE UTILITY SERVICE TO THE TENANT SPACE SHALL BE COORDINATED BY THE CONTRACTOR WITH THE OWNER. LOCAL SITE UTILITY PROVIDERS' POINTS OF CONTACT MAY BE INCLUDED IN THE DRAWINGS FOR REFERENCE PURPOSES.
- THE CONTRACTOR SHALL COORDINATE THE ISSUANCE OF ALL LETTERS OF REQUEST FOR SITE UTILITY SERVICES WITH THE OWNER WITHOUT DELAY FOLLOWING THE AWARD OF THE CONTRACT FOR GENERAL CONSTRUCTION, SO AS TO CONFIRM SITE UTILITY SERVICES AND SCHEDULE CONNECTIONS AT THE EARLIEST POSSIBLE CALENDAR DATE.
- ALL COORDINATION OF PROVISIONS FOR THE SITE UTILITY SERVICES BY THE CONTRACTOR SHALL BE INCLUDED IN THE BASE BID. FEES DUE AND PAYABLE TO THE LOCAL UTILITY SO AS TO FACILITATE PROVISIONS FOR SITE UTILITY SERVICES WILL BE EITHER THE OWNERS RESPONSIBILITY, OR THE OWNER MAY COORDINATE WITH THE CONTRACTOR FOR PAYMENT BY THE CONTRACTOR, WITH REIMBURSEMENT BY THE OWNER TO THE CONTRACTOR AT DIRECT COST.

Clarion SOLUTIONS

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DESIGN SCHEMATIC	05/18/2026
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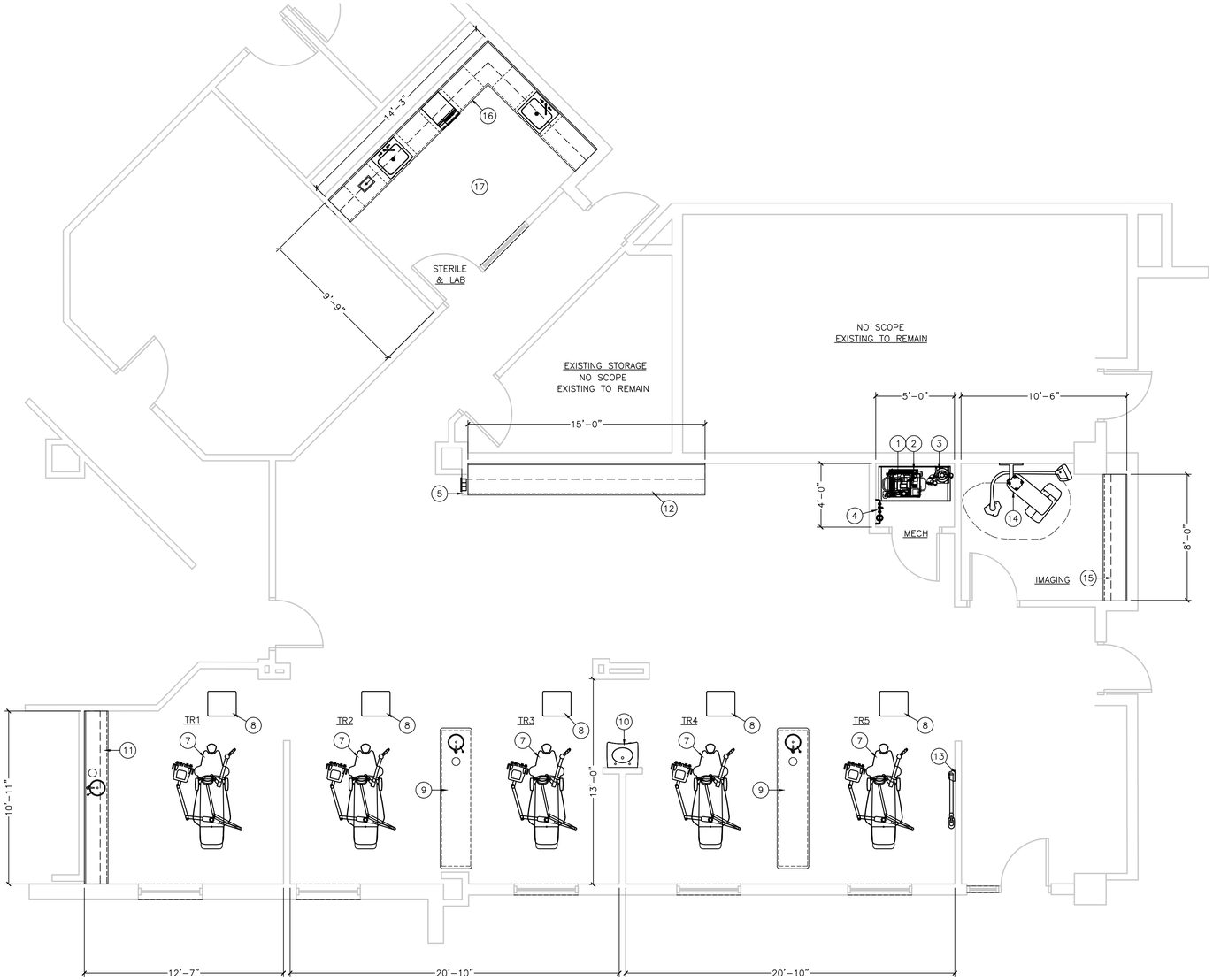
PROJECT # : 25-HU29052-EP -

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DRAWING TITLE : COVER SHEET

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1 DENTAL EQUIPMENT PLAN
SCALE: 1/4" = 1'-0"

DENTAL EQUIPMENT LEGEND

ITEM	DESCRIPTION	STATUS	LOCATION
1	AIR TECH AIRSTAR 40 AIR COMPRESSOR	NEW	MECH. ROOM
2	AIR TECH MOJAVE LT5M VACUUM PUMP	NEW	MECH. ROOM
3	AIR TECH ACADIA AMALGAM SEPARATOR	NEW	MECH. ROOM
4	AIR TECH REMOTE WATER CONTROL VALVE	NEW	MECH. ROOM
5	AIR TECH. 3-BUTTON REMOTE CONTROL PANEL (A/W/V)	NEW	CORRIDOR (VERIFY LOCATION)
6	NOT USED	--	--
7	DCI S5 CHAIR WITH DELIVERY, LIGHT & ASSISTANT'S INSTRUMENTS	NEW	TRs 2-5
8	MODULAR ASSISTANT'S ALABAMA CART	NEW	TRs 2-5
9	DCI CUSTOM CENTER ISLAND CABINET WITH SINK	NEW	BETWEEN TRs 2&3 AND 4&5
10	DCI T-WALL SINK CABINET	NEW	BETWEEN TRs 3&4
11	DCI CUSTOM SIDE SINK CABINET WITH UPPERS	NEW	TR 1
12	DCI CUSTOM 178" STORAGE CBAINET WITH UPPERS	NEW	CORRIDOR
13	MIDMARK PREVA INTRAORAL X-RAY WITH 76" REACH	NEW	TR 5
14	DEXIS OP3D PAN/CEPH X-RAY	NEW	IMAGING
15	DCI CUSTOM 96" STORAGE CABINET WITH UPPERS	NEW	IMAGING
16	DCI CUSTOM STERILIZATION CENTER	NEW	STERILE & LAB
17	MISCELLANEOUS STERILIZATION EQUIPMENT: MIDMARK M11 STEAM STERILIZER, STATIM G4 AUTOCLAVE & MIDMARK QUICKCLEAN ULTRASONIC CLEANER	NEW	STERILE (VERIFY LOCATIONS)
-	REMAINING MISCELLANEOUS CABINETRY & MILLWORK BY OTHERS	NEW	AS SHOWN ON EQUIPMENT PLAN

Clarion SOLUTIONS

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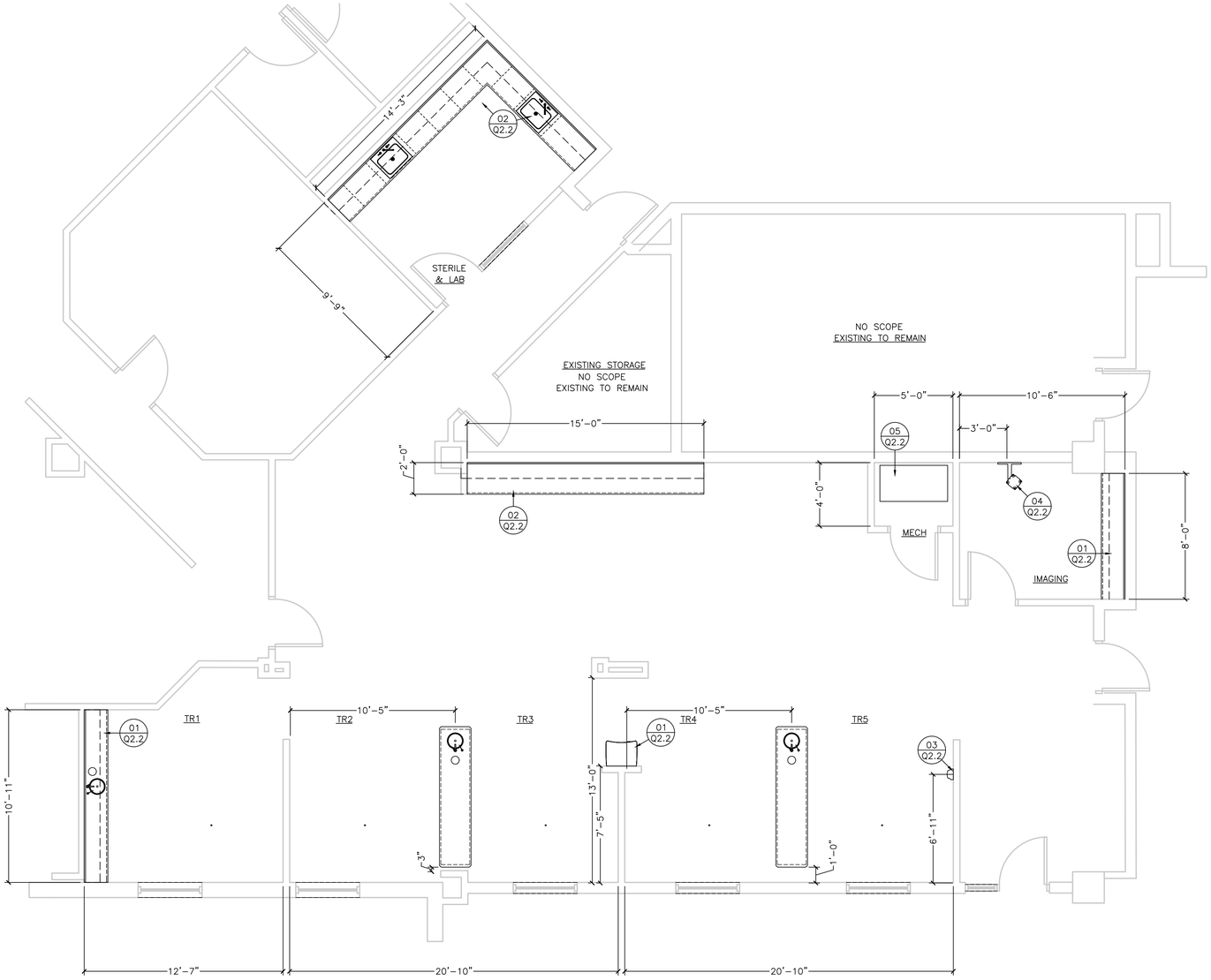
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EP	ALH

DRAWING TITLE :
DENTAL EQUIPMENT PLAN

SHEET :
Q1.1

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1 DENTAL CARPENTRY PLAN

SCALE: 1/4"=1'-0"

CARPENTRY NOTES

1. THE DRAWING IS DIMENSIONED FROM THE FACE OF A FINISH WALL TO THE FACE OF A FINISH WALL, UNLESS OTHERWISE NOTED. THE DENTAL EQUIPMENT WILL BE DIMENSIONED FROM THE FACE OF A FINISH WALL TO THE CENTERLINE OF THE EQUIPMENT, UNLESS OTHERWISE NOTED.
2. PARTITIONS SHOWN ARE 5" NOMINAL.
3. ALL BLOCKING WILL BE INSTALLED FLUSH WITH THE FACE OF THE STUDS.
4. THE GENERAL CONTRACTOR WILL BE RESPONSIBLE TO BRACE AND PROTECT ALL WORK DURING CONSTRUCTION AGAINST DAMAGE, BREAKAGES, COLLAPSE, DISTORTIONS, AND OFF-ALIGNMENT ACCORDING TO APPLICABLE CODES, STANDARDS, AND GOOD PRACTICE.
5. THE CARPENTER WILL BE RESPONSIBLE FOR BOTH THE STRUCTURAL INTEGRITY AND THE STABILITY OF ALL BLOCKING AND WALL SUPPORT.
6. THE CARPENTER WILL COMPLY WITH ALL BENCO INSPECTIONS, AS NOTED IN THE GENERAL NOTES IN THE FIRST SECTION OF THESE DOCUMENTS.
7. VERIFY LOCAL & STATE X-RAY SHIELDING REQUIREMENTS WITH ARCHITECT, CONTRACTOR OR CLIENT
8. MECHANICAL ROOM ACOUSTIC CONTROL MEASURES

   A. WALL AND CEILING INSULATION FOR SOUND TRANSMISSION – PROVIDE AND INSTALL ACOUSTIC BATT INSULATION WITHIN ALL DESIGNATED WALLS AND CEILINGS TO REDUCE AIRBORNE SOUND TRANSMISSION. INSULATION SHALL BE CONTINUOUS, FULLY CONTACTING STUDS AND JOISTS WITHOUT VOIDS, GAPS, OR COMPRESSION. ENSURE INSULATION IS INSTALLED TO MANUFACTURER RECOMMENDATIONS TO MAINTAIN ITS ACOUSTIC PERFORMANCE.

   B. DOOR UNDERCUT SOUND CONTROL – PROVIDE AND INSTALL A DOOR SWEEP OR APPROVED ACOUSTIC BOTTOM SEAL ON ALL DOORS IDENTIFIED FOR SOUND CONTROL. DOOR SWEEP SHALL MAINTAIN CONTINUOUS CONTACT WITH THE FINISHED FLOOR OR THRESHOLD TO MINIMIZE SOUND TRANSMISSION UNDER THE DOOR.

   C. VIBRATION ISOLATION FROM DENTAL EQUIPMENT – WHEN APPLICABLE, DO NOT MOUNT DENTAL EQUIPMENT STACK RACKS OR SIMILAR VIBRATION PRODUCING DEVICES ON ANY COMMON (SHARED) WALL. INSTALL SUCH EQUIPMENT ON ISOLATED FRAMING OR NON SHARED WALLS TO PREVENT VIBRATION TRANSFER TO ADJACENT TENANTS OR ROOMS.

Clarion SOLUTIONS

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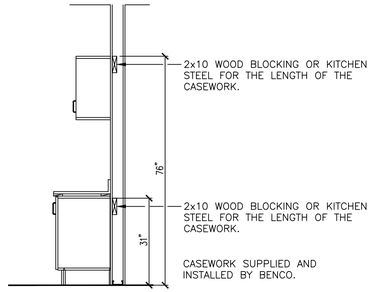
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DENTAL CARPENTRY PLAN

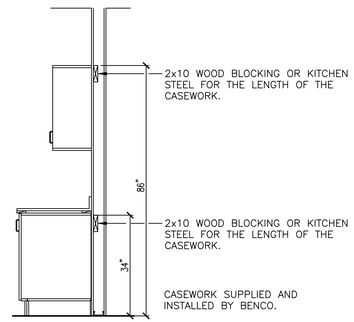
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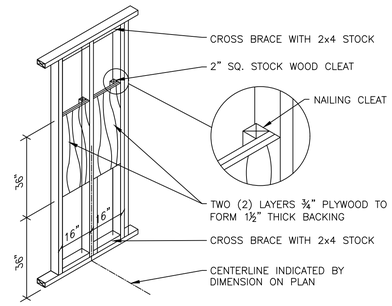
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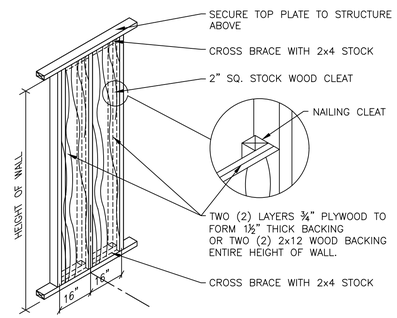
DETAIL - TYPICAL CASEWORK BLOCKING IN TR'S | 01
REF.: SOURCE: | N.T.S.



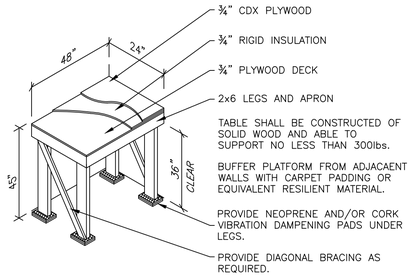
DETAIL - TYPICAL CASEWORK BLOCKING | 02
REF.: SOURCE: | N.T.S.



DETAIL - TYP. X-RAY BACKING | 03
REF.: SOURCE: | N.T.S.



DETAIL - TYPICAL PAN X-RAY BACKING | 04
REF.: SOURCE: | N.T.S.



DETAIL - EQUIPMENT PLATFORM | 05
REF.: SOURCE: | N.T.S.

DETAIL | 06
REF.: SOURCE: | N.T.S.

DETAIL | 07
REF.: SOURCE: | N.T.S.

DETAIL | 08
REF.: SOURCE: | N.T.S.

DETAIL | 09
REF.: SOURCE: | N.T.S.

DETAIL | 10
REF.: SOURCE: | N.T.S.

DETAIL | 11
REF.: SOURCE: | N.T.S.

DETAIL | 12
REF.: SOURCE: | N.T.S.

DETAIL | 13
REF.: SOURCE: | N.T.S.

DETAIL | 14
REF.: SOURCE: | N.T.S.

DETAIL | 15
REF.: SOURCE: | N.T.S.

DETAIL | 16
REF.: SOURCE: | N.T.S.

Clarion SOLUTIONS

BencoDental

JUANITA SANCHEZ HIGH SCHOOL
PROVIDENCE, RI

ISSUED :	DATE :
DESIGN SCHEMATIC	05/18/2026
DCD (FOR REVIEW)	06/09/2026
DCD	06/11/2026
DCD REVISION 1	10/05/2026
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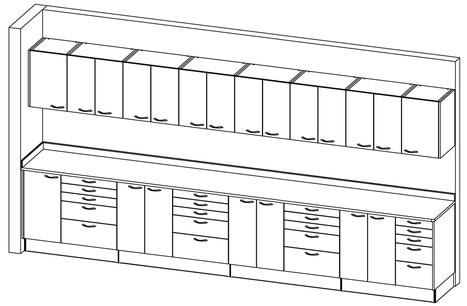
PROJECT # :
25-HU29052-EP -

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EP	ALH

DRAWING TITLE :
DENTAL CARPENTRY DETAILS

SHEET :
Q2.2

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QUOTE: QE261587

NOTES: *PLEASE VERIFY WALL DIMENSIONS

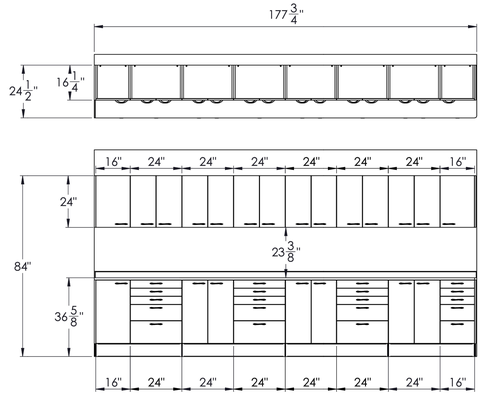
2026 Pricing

DRAWN	DATE
MR	5/19/2026
DR NAME	DEALER

Laminate:
Solid Surface:

DR. SIGNATURE (REQUIRED) DATE

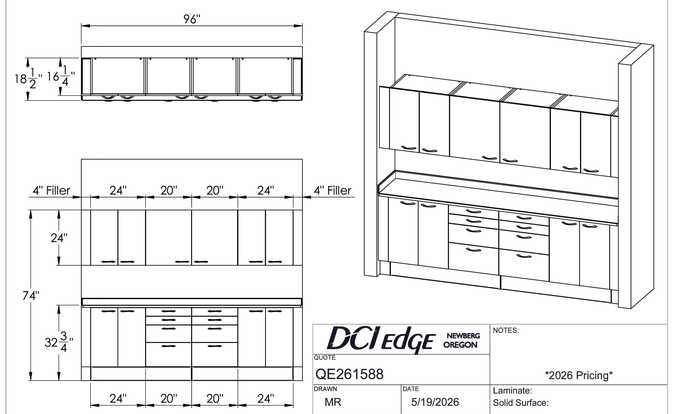
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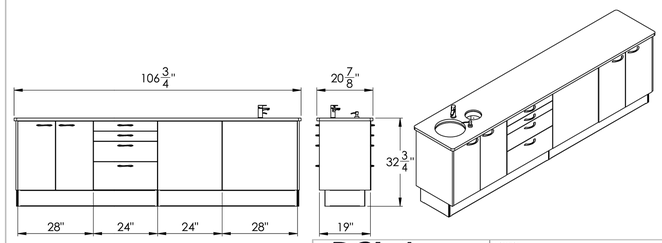
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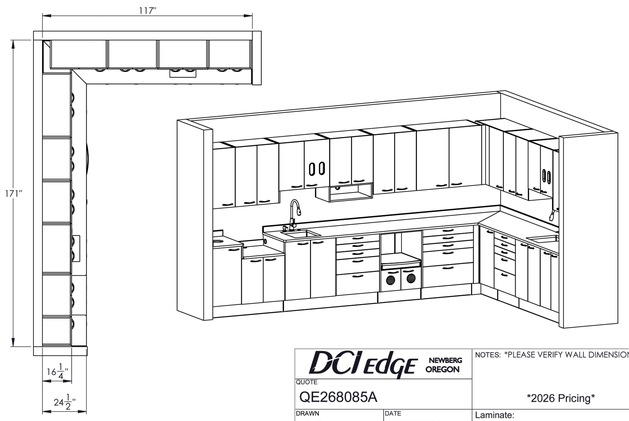
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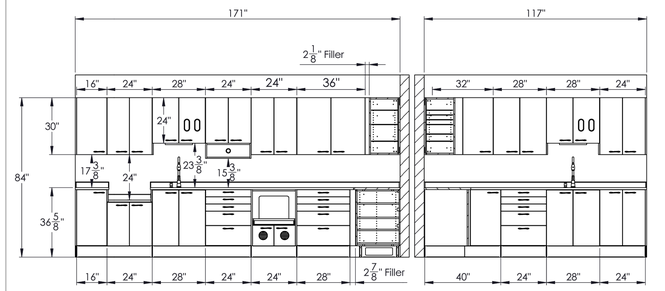
2026 Pricing

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DR NAME	DEALER

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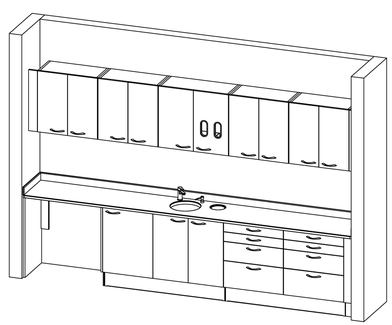
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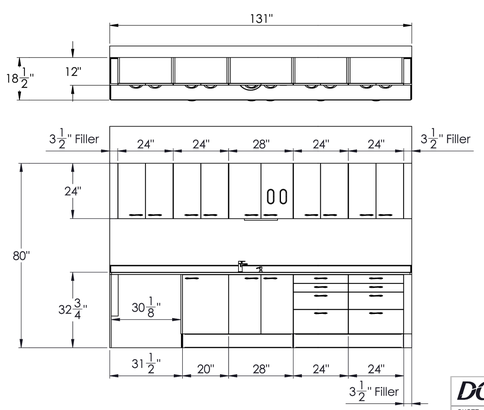
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PROVIDENCE, RI

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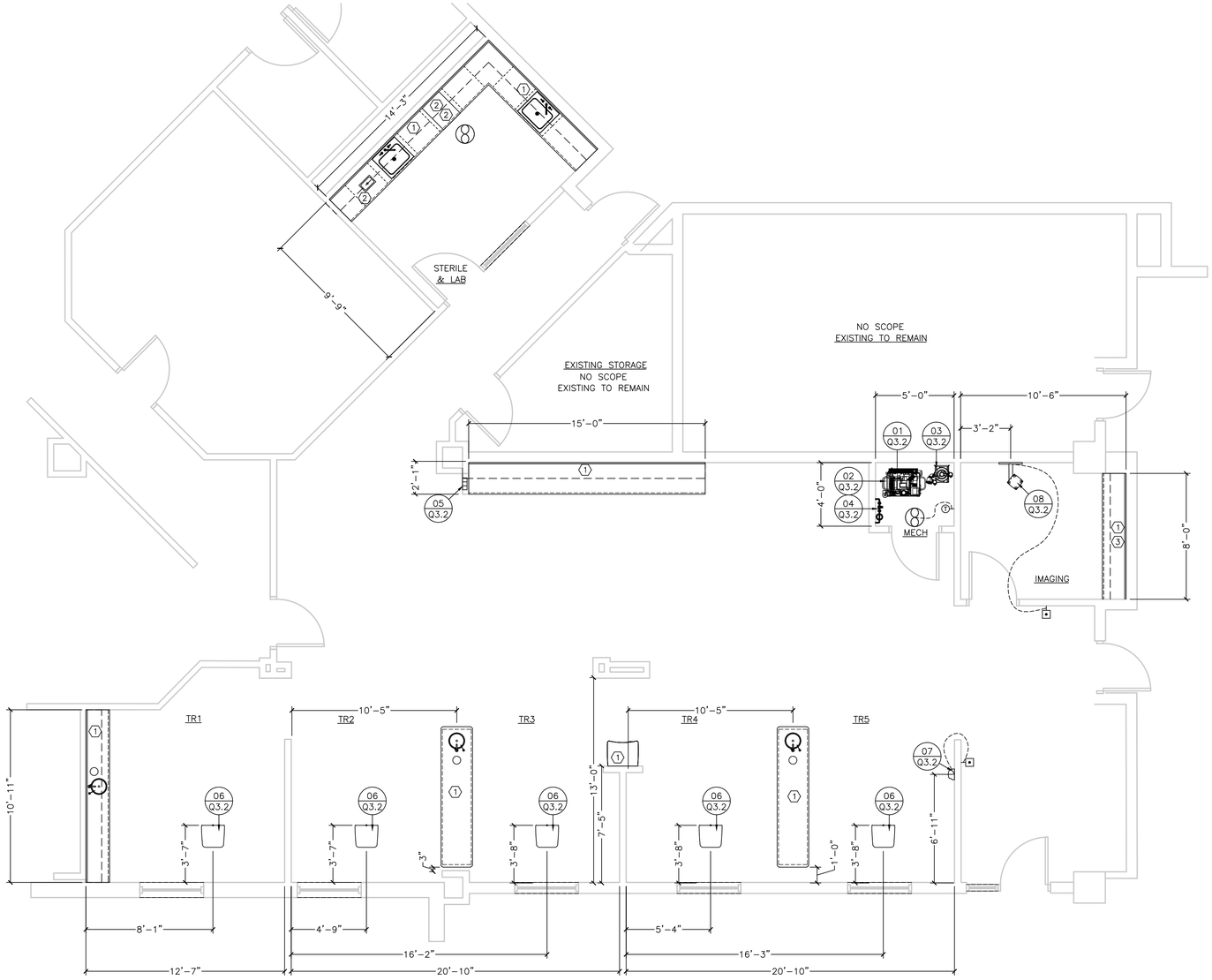
DRAWING TITLE :

DENTAL CABINET DRAWINGS

SHEET :

Q2.3

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1 DENTAL ELECTRICAL PLAN
SCALE: 1/4"=1'-0"

NOTES LEGEND

(1) – RECEPTACLES ABOVE &/OR BELOW COUNTERTOPS (VERIFY QUANTITY & LOCATION OF RECEPTACLES WITH BENCO REP. AT TIME OF LAYOUT)

(2) – ULTRASONIC CLEANER & AUTOCLAVE RECEPTACLE – 110V, DEDICATED 20 AMP CIRCUIT (VERIFY LOCATION WITH BENCO REP. AT TIME OF LAYOUT)

(3) – CAT 6 DATA DROP (VERIFY LOCATION WITH COMPUTER SUPPLIER)

ELECTRICAL LEGEND	
SYMBOL	DESCRIPTION
	THERMOSTATIC ON/OFF SWITCH
	WIRING, CONCEALED IN WALL OR CEILING
	EXHAUST FAN MOUNTED IN CEILING (VERIFY CFM REQUIREMENTS WITH ARCHITECT)
	EXPOSURE BUTTON

ELECTRICAL NOTES

1. ALL EQUIPMENT WILL BE SINGLE PHASE, UNLESS OTHERWISE NOTED.
2. ALL WIRING WILL BE CONCEALED WITHIN THE WALLS AND/OR FLOOR, UNLESS OTHERWISE NOTED.
3. THE ELECTRICIAN WILL TAG ALL WIRES AT TERMINATION POINTS.
4. THE ELECTRICIAN WILL REMOVE ALL EXISTING RECEPTACLES AND SWITCHES IN THE AREA OF WORK. THE ELECTRICIAN WILL EITHER INSTALL A BLANK PLATE OVER RECEPTACLE OR SWITCH BOX OR REMOVE BOX ENTIRELY. THE ELECTRICIAN WILL TERMINATE WIRING AND CONDUIT IN A MANNER IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE.
5. THE ELECTRICIAN WILL INSTALL COMPLETE AND MAKE FINAL HOOK–UP TO THE FOLLOWING DENTAL EQUIPMENT, SUPPLIED BY EITHER THE DOCTOR OR BENCO DENTAL, INCLUDING, BUT NOT LIMITED TO:
   - AIR COMPRESSOR
   - VACUUM PUMP
   - WATER CONTROL VALVE
   - CONTROL PANEL
6. THE ELECTRICIAN WILL BE ONSITE ON THE DAY(S) OF INSTALLATION TO WORK WITH THE BENCO REPRESENTATIVE ON FINAL HOOK–UP. THE ELECTRICIAN WILL SUPPLY AND INSTALL ANY AND ALL MATERIALS INDICATED IN THE ELECTRICAL DETAILS SHOWN AND MANUFACTURER'S INSTALLATION INSTRUCTION SHEETS.
7. IN THE EVENT OF ANY EQUIPMENT BEING RELOCATED TO ANOTHER LOCATION, ANY AND ALL CIRCUITS MUST BE TERMINATED BY THE ELECTRICIAN IN ACCORDANCE WITH LOCAL CODE. VERIFY RESPONSIBILITY WITH THE OWNER.
8. THE ELECTRICIAN WILL SEAL ALL PENETRATIONS THROUGH THE FLOOR WITH A FIRESTOP OR EQUIVALENT WATERPROOFING.
9. THE ELECTRICIAN WILL COMPLY WITH ALL BENCO INSPECTIONS, AS NOTED IN THE GENERAL NOTES ON THE FIRST PAGE OF THESE DOCUMENTS.
10. ALL 120 VOLT, 20 AMP OUTLETS INSTALLED WITHIN 6 FEET OF A SINK AND THOSE LOCATED OUTDOORS SHALL HAVE GFCI PROTECTION.
11. ALL 120 VOLT, 20 AMP DENTAL EQUIPMENT OUTLETS INSTALLED WITHIN 6 FEET OF A WATER SOURCE SHALL HAVE GFCI PROTECTION.

Clarion SOLUTIONS

BencoDental

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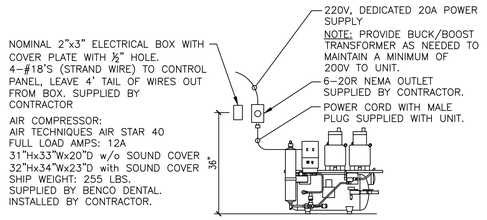
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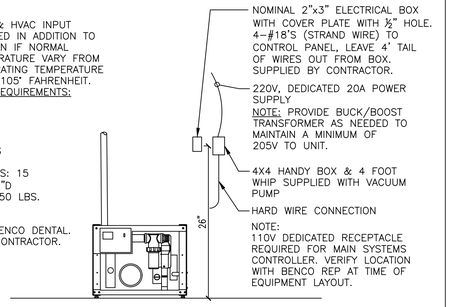
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SHEET : Q3.1

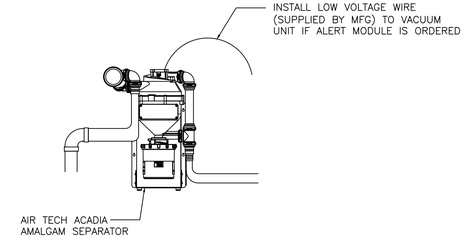
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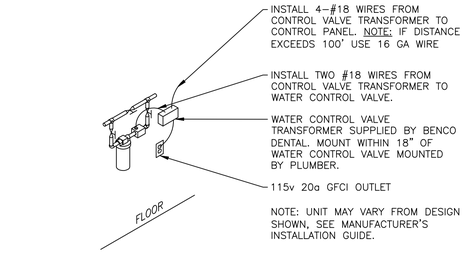
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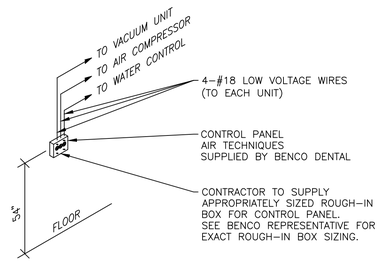
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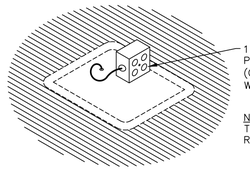
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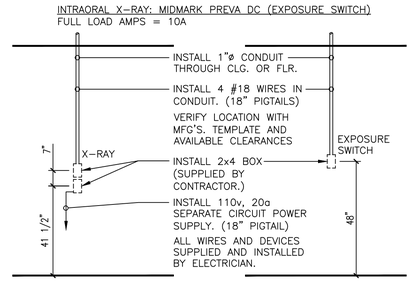
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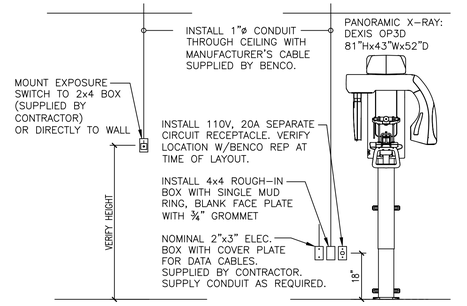
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DETAIL - DENTAL CHAIR RECEPTACLE | 06
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DETAIL - INTRAORAL X-RAY WIRING | 07
REF.: SOURCE: N.T.S.



DETAIL - PANORAMIC X-RAY WIRING | 08
REF.: SOURCE: N.T.S.

DETAIL | 09
REF.: SOURCE: N.T.S.

DETAIL | 10
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DETAIL | 11
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DETAIL | 14
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DETAIL | 15
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DETAIL | 16
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Clarion SOLUTIONS

BencoDental

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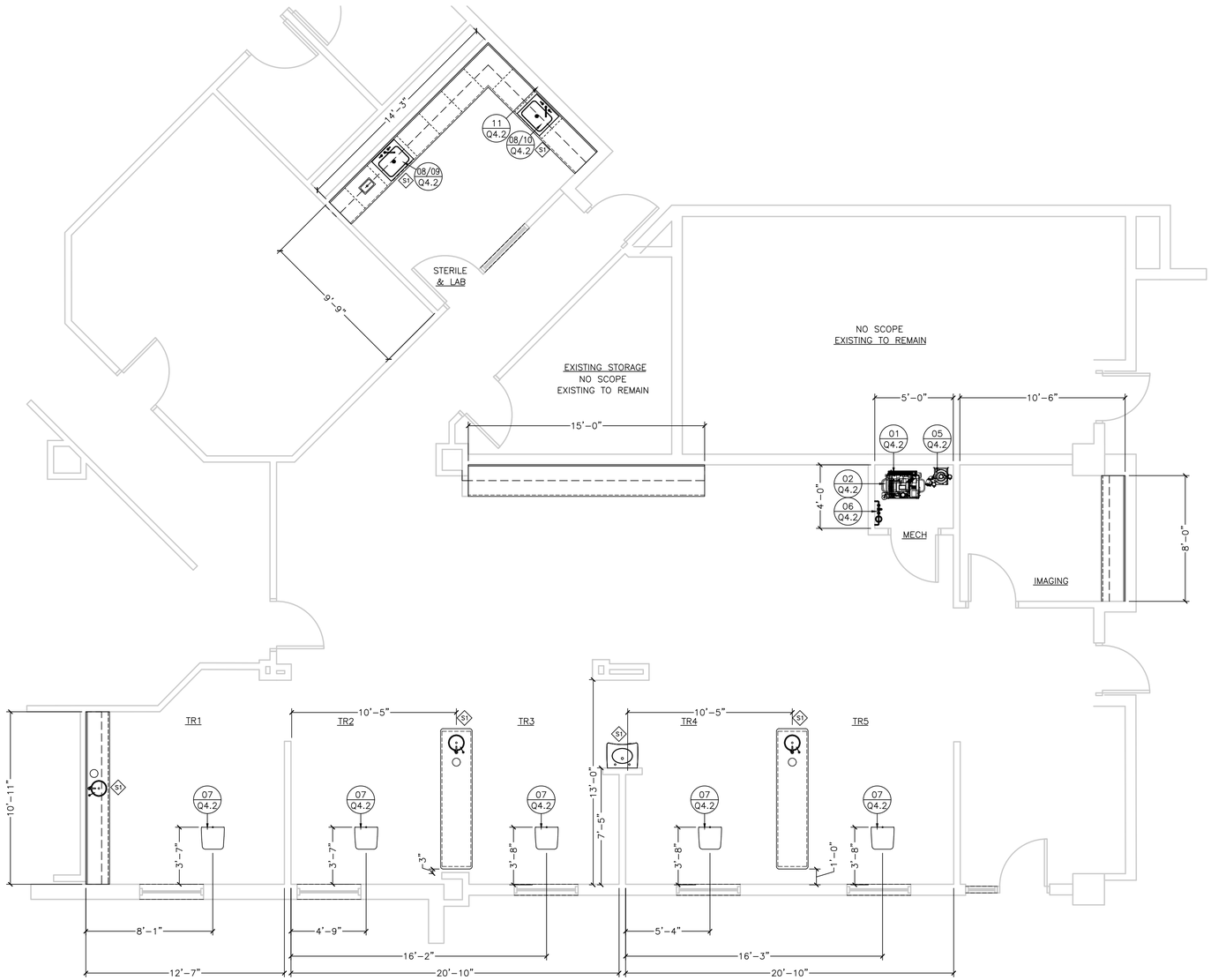
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DRAWING TITLE :
DENTAL ELECTRICAL DETAILS

SHEET :
Q3.2

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1 DENTAL PLUMBING PLAN
SCALE: 1/4"=1'-0"

SINK LEGEND

S1 SINK – SINK, FAUCET AND STRAINER PROVIDED WITH CABINETRY SUPPLIED BY BENCO. PLUMBER SHALL INSTALL HOT AND COLD WATER LINES, WASTE AND TRAP ROUGH-IN PER LOCAL CODES. PLUMBER SHALL BE RESPONSIBLE FOR FINAL HOOKUP. SEE MANUFACTURER'S SPECIFICATIONS FOR EXACT LOCATION AND REQUIREMENTS.

PLUMBING NOTES

1. THE PLUMBER WILL SUPPLY AND INSTALL A WATER PRESSURE REGULATOR ON INCOMING WATER SUPPLY. THE PLUMBER WILL SET THE REGULATOR NOT TO EXCEED 65 PSI.
2. THE PLUMBER WILL INSTALL THE WATER FILTER (AND THE WATER SOFTENER, AS NEEDED) ON THE COLD WATER MAIN ENTERING THE DENTAL SUITE. THE WATER FILTER WILL BE SUPPLIED BY EITHER BENCO DENTAL OR THE DOCTOR.
3. THE PLUMBER WILL SUPPLY AND INSTALL SEPARATE MANUAL SHUT-OFF VALVES ON ALL SINKS, DENTAL UNITS, AND OUTLETS REQUIRING WATER AND/OR AIR.
4. ALL SINKS AND FAUCETS WILL BE CONNECTED BY THE PLUMBER.
5. ALL PIPES WILL BE CONCEALED WITHIN THE WALLS AND/OR THE FLOOR, UNLESS OTHERWISE NOTED ON THE BENCO DRAWINGS.
6. THE PLUMBER WILL SEAL ALL PENETRATIONS THROUGH THE FLOOR WITH A FIRESTOP OR EQUIVALENT WATERPROOFING.
7. ALL PIPES WILL BE FLUSHED CLEAR OF ALL DEBRIS BY THE PLUMBER.
8. THE PLUMBER WILL BE ONSITE ON THE DAY(S) OF INSTALLATION TO WORK WITH THE BENCO REPRESENTATIVE ON THE FINAL HOOK-UP. THE PLUMBER WILL SUPPLY AND INSTALL ANY AND ALL MATERIALS INDICATED IN THE PLUMBING DETAILS SHOWN AND THE MANUFACTURER'S INSTALLATION INSTRUCTION SHEETS.
9. THE PLUMBER WILL PROVIDE AND INSTALL ALL WATER SAFETY DEVICES (i.e. CHECK VALVES, BACKFLOW PREVENTERS, ETC.) IN ACCORDANCE WITH LOCAL CODE.

PLUMBING NOTES

10. THE PLUMBER WILL INSTALL COMPLETE AND MAKE FINAL HOOK-UP TO THE FOLLOWING DENTAL EQUIPMENT, SUPPLIED BY THE DOCTOR AND/OR BENCO DENTAL, INCLUDING, BUT NOT LIMITED TO:
    - AIR COMPRESSOR
    - VACUUM PUMP
    - AIR/WATER SEPARATORS
    - WATER CONTROL VALVE AND FILTER ASSEMBLY

***PLEASE NOTE: THE VACUUM PUMP DOES NOT APPLY TO NFPA CATEGORY 1 SYSTEM.

11. AN ELECTRIC MASTER WATER CONTROL VALVE AND FILTER ASSEMBLY IS REQUIRED FOR ANY/ALL COLD WATER LINES FEEDING ALL DENTAL EQUIPMENT. THIS WATER CONTROL VALVE AND FILTER ASSEMBLY IS REQUIRED WHETHER SUPPLIED BY BENCO, THE DOCTOR, OR THE PLUMBER. THE PLUMBER IS TO VERIFY THE EXACT LOCATION OF THE WATER CONTROL VALVE AND FILTER ASSEMBLY WITH THE DOCTOR/OWNER, AND A BENCO REP AT THE TIME OF LAYOUT AND PRIOR TO EQUIPMENT SELECTION.
12. THE PLUMBER WILL COMPLY WITH ALL BENCO INSPECTIONS, AS NOTED IN THE GENERAL NOTES ON THE FIRST PAGE OF THESE DOCUMENTS.
13. GENERAL DENTAL PLUMBING TERMINATION LOCATIONS SHOWN ARE FOR GRAPHICALLY DISPLAYING ORIGINATION AND TERMINATION POINTS. FIELD CONDITIONS MAY ALTER PLUMBING LINE LAYOUT, PER PLUMBERS DISCRETION. THE FINAL LAYOUT OF THE PLUMBING LINES IS THE RESPONSIBILITY OF THE PLUMBER.
14. IN ACCORDANCE WITH NFPA 99 DENTAL COMPRESSED AIR SHALL NOT BE USED FOR RESPIRATION.
15. NFPA, 99.15.3.3.5 VACUUM PIPING
16. NFPA, 99.15.3.3.6 NITROUS OXIDE SCAVENGING (CATEGORY 2 ONLY)

Clarion SOLUTIONS

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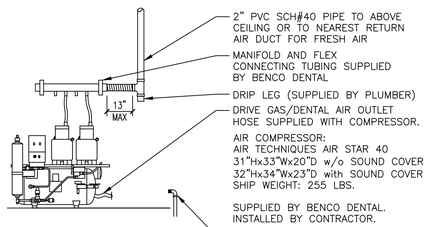
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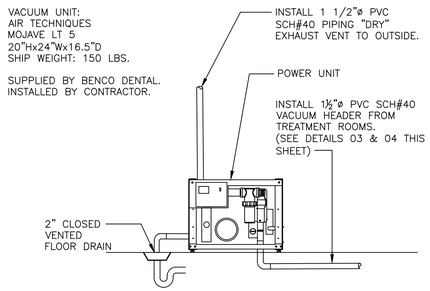
DRAWING TITLE :
DENTAL PLUMBING PLAN

SHEET :
Q4.1

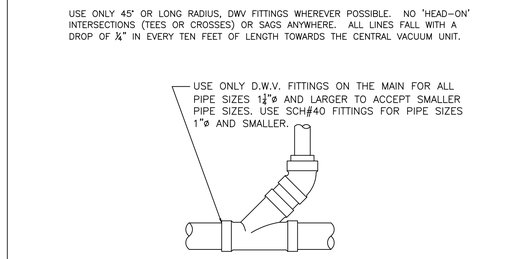
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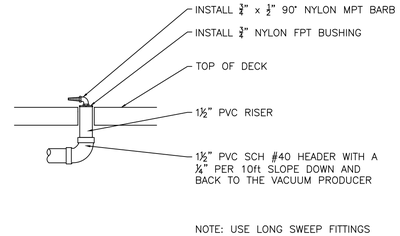
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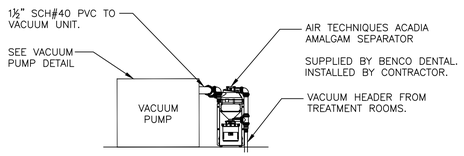
DETAIL - VACUUM PUMP | 02
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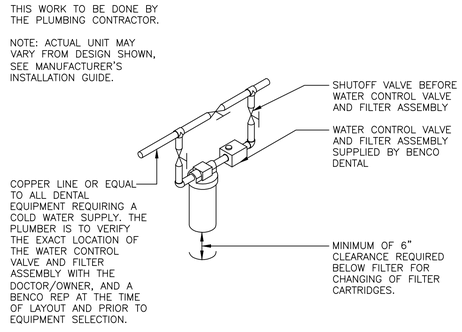
DETAIL - VACUUM PIPING | 03
REF.: SOURCE: | N.T.S.



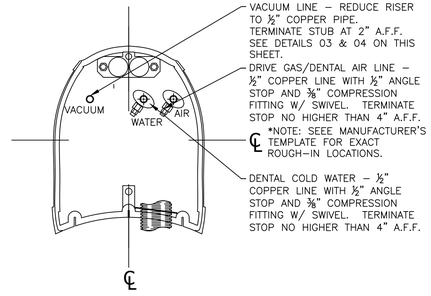
DETAIL - VACUUM PIPING | 04
REF.: SOURCE: | N.T.S.



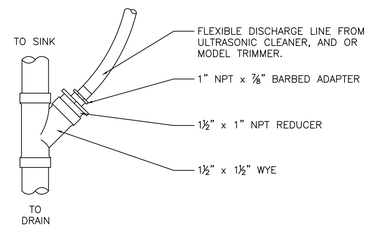
DETAIL - AMALGAM SEPARATOR | 05
REF.: SOURCE: | N.T.S.



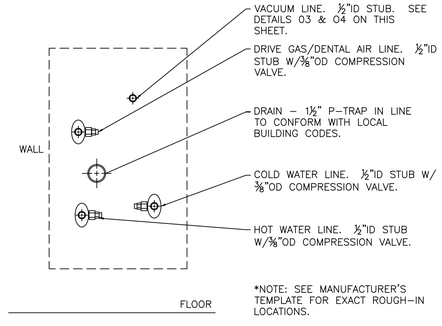
DETAIL - WATER CONTROL VALVE | 06
REF.: SOURCE: | N.T.S.



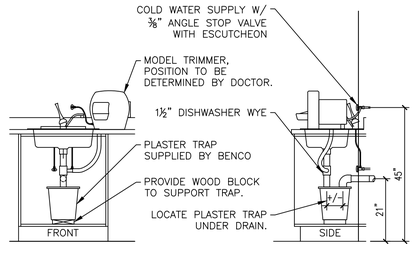
DETAIL - TYPICAL UTILITY CENTER | 07
REF.: SOURCE: | N.T.S.



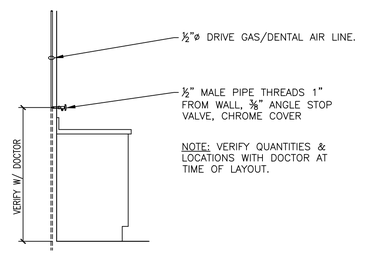
DETAIL - WYE WASTE LINE CONNECTION | 08
REF.: SOURCE: | N.T.S.



DETAIL - STERILIZATION CABINET PIPING | 09
REF.: SOURCE: | N.T.S.



DETAIL - MODEL TRIMMER / PLASTER TRAP | 10
REF.: SOURCE: | N.T.S.



DETAIL - TYPICAL AIR OUTLET | 11
REF.: SOURCE: | N.T.S.

DETAIL | 12
REF.: SOURCE: | N.T.S.

DETAIL | 13
REF.: SOURCE: | N.T.S.

DETAIL | 14
REF.: SOURCE: | N.T.S.

DETAIL | 15
REF.: SOURCE: | N.T.S.

DETAIL | 16
REF.: SOURCE: | N.T.S.

Clarion SOLUTIONS

BencoDental

JUANITA SANCHEZ HIGH SCHOOL
PROVIDENCE, RI

ISSUED :	DATE :
DESIGN SCHEMATIC	05/18/2026
DCD (FOR REVIEW)	06/09/2026
DCD	06/11/2026
DCD REVISION 1	10/05/2026
DCD REVISION 2	10/15/2026

PROJECT # :
25-HU29052-EP -

DRAWN BY : / REVIEWED BY:	CHECKED BY :
EP	ALH

DRAWING TITLE :
DENTAL PLUMBING DETAILS

SHEET :
Q4.2