PROJECT MANUAL

Fargo Public Schools Maintenance Projects

PROJECT NO. 24-060

Bennett Elementary School
2000 58th Ave S, Fargo, ND 58104
Carl Ben Eielson Middle School
1601 13th Ave S, Fargo, ND 58103
Centennial Elementary School
4201 25th St S, Fargo, ND 58104
Davies High School
7150 25th St S, Fargo, ND 58104
Fargo Public Schools District Office
700 7th St S, Fargo, ND 58103
Eagles Elementary
3502 S University Dr, Fargo, ND 58104
Lincoln Elementary
2120 9th St S, Fargo, ND 58103
Longfellow Elementary
20 29th Ave NE, Fargo, ND 58102
North High School
801 17th Ave N, Fargo, ND 58102
Fargo Public Schools Operations Center
3901 40th Ave S, Fargo, ND 58104
South High School
1840 15th Ave S, Fargo ND 58103
Trollwood Performing Arts
801 50th Ave S, Moorhead, MN 56560
**Separated for City Review Only*
Washington Elementary
1725 Broadway N, Fargo, ND 58102

ISSUE DATE: 12/18/2024

PREPARED BY

ICON ARCHITECTURAL GROUP
3187 BLUESTEM DRIVE, STE 2
WEST FARGO, ND 58078
PHONE: 701-364-4007

SECTION 00 0103
PROJECT DIRECTORY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Identification of project team members and their contact information.

1.02 OWNER:

A. Name: Fargo Public School District #
   1. Address Line 1: 700 7th Street South .
   2. City: Fargo .
   3. State: North Dakota .
   4. Zip Code: 58103.
   5. Telephone: 701.466.1000.
   6. Fax:_____.

B. Primary Contact: All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
   1. Title: Director of Facilities .
   2. Name: James Hand.
   3. Email: handj@fargo.k12.nd.us.

1.03 CONSULTANTS:

A. Architect: Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
   1. Company Name: ICON Architectural Group.
      a. Address Line 1: 4000 Garden View Drive.
      b. Address Line 2: Suite 101.
      c. City: Grand Forks.
      d. State: North Dakota.
      e. Zip Code: 58201.
      f. Telephone: (701) 772-4266.
      g. Fax:(701) 772-4275.
   2. Primary Contact:
      a. Title: Architect.
      b. Name: Todd Blixt or John Holten .
      c. Email: toddblixt@iconarchitects.com or john.holten@iconarchitects.com.

B. Civil Engineering Consultant:
   1. Company Name: Lowry Engineering.
      a. Address Line 1: 5306 51st Ave. South.
      b. Address Line 2: Suite A.
      c. City: Fargo.
      d. State: North Dakota.
      e. Zip Code: 58104.
      f. Telephone: (701) 235-0199.
   2. Primary Contact:
      a. Title: Principal.
      b. Name: Andrew Thill .
      c. Email: athill@lowryeng.com.

C. Structural Engineering Consultant:
   1. Company Name: Heyer Engineering .

a. Address Line 1: 4180 24th Avenue South .
b. City: Fargo.
c. State: North Dakota.
d. Zip Code: 58104.
e. Telephone: 701.280.0949.

2. Primary Contact:
a. Title: Principal.
b. Name: Eric Greiff.
c. Email: eric@heyer-eng.com.

D. Mechanical Engineering Consultant:
1. Company Name: Martin Mechanical Design Inc..
a. Address Line 1: 1201 25th Ave. North.
b. City: Fargo.
c. State: North Dakota.
d. Zip Code: 58102.
e. Telephone: (701) 293-7957.
2. Company Name: MBN Engineering.
a. Address Line 1: 503 7th Street N..
b. Address Line 2: Suite 200.
c. City: Fargo.
d. State: North Dakota.
e. Zip Code: 58102.
f. Telephone: (701) 478-6336.

E. Electrical Engineering Consultant:
1. Company Name: CMTA, Inc..
a. Address Line 1: 2201 12th Street N..
b. Address Line 2: Suite E.
c. City: Fargo.
d. State: North Dakota.
e. Zip Code: 58102.
f. Telephone: (701) 280-0500.
2. Primary Contact:
a. Title: _____.
b. Name: _____.
c. Email: _____.

1.04 CONSTRUCTION MANAGER:

A. Company Name: McGough.
1. Address Line 1: 630 1st Ave N, Suite 4.
2. Address Line 2: _____.
3. City: Fargo.
4. State: ND.
5. Zip Code: 58102.
6. Telephone: _____.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

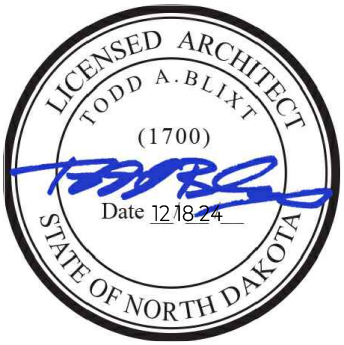
END OF SECTION 00 0103

SECTION 00 0107
SEALS PAGE

DESIGN PROFESSIONALS OF RECORD

1.01 ARCHITECT

TODD BLIXT
ND
MN



ARCHITECT:

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED ARCHITECT UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE: _____

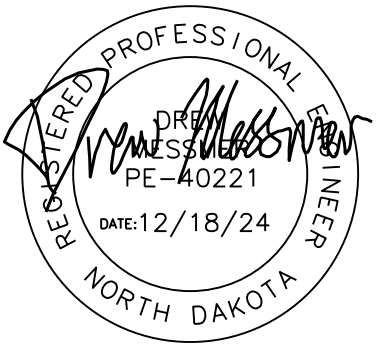
PRINTED NAME: TODD BLIXT

DATE: 12/18/24

LICENSE NUMBER: 62763

1.02 CIVIL ENGINEER

DREW MESSMER
ND
MN



I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

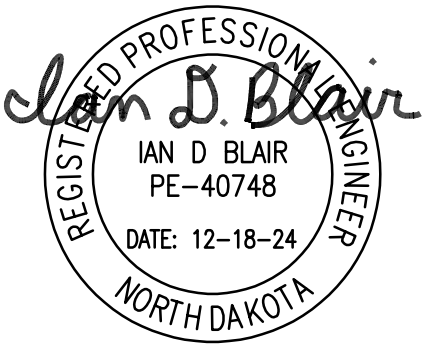
DREW MESSMER
DATE: 12/18/24
LICENSE #: 62823

1.03 STRUCTURAL ENGINEER

ERIC GREIFF
ND
MN

1.04 MECHANICAL ENGINEER

IAN BLAIR
ND



1.05 MECHANICAL ENGINEER

MATTHEW KRUEGER
ND
MN

I hereby certify that this drawing, specification or report was prepared by me or under my direct supervision and that I am a duly registered Engineer under the laws of the State of Minnesota.

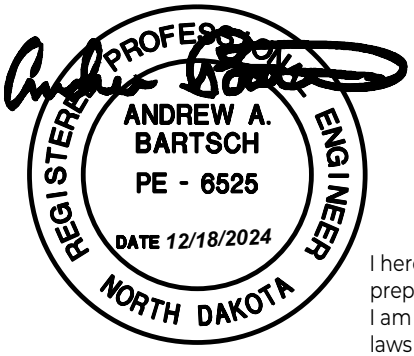
Dated: 12/17/24 Regt. No. 59611

Signed:

MATTHEW KRUEGER

1.06 ELECTRICAL ENGINEER

ANDREW BARTSCH
ND
MN



I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota

REG. NO. 48775 SIGNATURE:

DATE: 12/18/2024 PRINTED NAME: Andrew B. Bartsch

END OF SECTION 00 0107

SECTION 00 0110
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END OF SECTION 00 0110

SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.04 REFERENCE STANDARDS

A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

B. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase); Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.
   6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.

E. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
   1. Owner will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.

B. Submittal Form (before award of contract):
   1. Submit substitution requests by completing CSI/CSC Form 1.5C - Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submittal Form (after award of contract):
   1. Submit substitution requests by completing CSI/CSC Form 13.1A - Substitution Request (After Bidding/Negotiating). See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

C. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
   1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
   2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
   3. Bear the costs engendered by proposed substitution of:
      a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

D. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.
   3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION 01 2500

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Quality assurance.

C. References and standards.

D. Testing and inspection agencies and services.

E. Contractor's construction-related professional design services.

F. Contractor's design-related professional design services.

G. Control of installation.

H. Mock-ups.

I. Tolerances.

J. Manufacturers' field services.

K. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Document 00 7200 - General Conditions: Inspections and approvals required by public authorities.

B. Section 01 2100 - Allowances: Allowance for payment of testing services.

C. Section 01 3000 - Administrative Requirements: Submittal procedures.

D. Section 01 4216 - Definitions.

E. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.04 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
   1. Design Services Types Required:
      a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.
      b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary scaffolding.
   3. Temporary bracing.
   4. Temporary falsework for support of spanning or arched structures.
   5. Temporary foundation underpinning.
   6. Temporary stairs or steps required for construction access only.
   7. Temporary hoist(s) and rigging.
   8. Investigation of soil conditions to support construction equipment.

1.06 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.
   1. Submit a Request for Interpretation to Architect if the criteria indicated are not sufficient to perform required design services.

C. Scope of Contractor's Professional Design Services: Provide for the following items of work:

1.07 SUBMITTALS

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

B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
   1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
      a. Full name.
      b. Professional licensure information.
      c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.

C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
   1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
   2. Include required product data and shop drawings.
   3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
   4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.

j. Compliance with Contract Documents.
k. When requested by Architect, provide interpretation of results.

2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

G. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit report in duplicate within 30 days of observation to Architect for information.
2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

H. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications:
1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Contractor's Quality Control (CQC) Plan:
1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
1) Management and control of documents and records relating to quality.
2) Communications.

3) Coordination procedures.
4) Resource management.
5) Process control.
6) Inspection and testing procedures and scheduling.
7) Control of noncomplying work.
8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
9) Control of testing and measuring equipment.
10) Project materials certification.
11) Managerial continuity and flexibility.

c. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

1.09 REFERENCES AND STANDARDS

A. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

B. Obtain copies of standards where required by product specification sections.

C. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

1.10 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. 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.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.

D. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.

F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

I. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

J. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

K. Where possible salvage and recycle the demolished mock-up materials.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

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

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

D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.

3. Provide incidental labor and facilities:
    a. To provide access to Work to be tested/inspected.
    b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    c. To facilitate tests/inspections.
    d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

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

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

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect 30 days in advance of required observations.
    1. Observer subject to approval of Architect.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION 01 4000

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition, _____.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Owner personnel.

I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

C. Section 07 8400 - Firestopping.

1.03 SUBMITTALS

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

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and products to be used.
      e. Alternatives to cutting and patching.
      f. Effect on work of Owner or separate Contractor.
      g. Written permission of affected separate Contractor.
      h. Date and time work will be executed.

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

1.04 QUALIFICATIONS

A. For demolition work, employ a firm specializing in the type of work required.
   1. Minimum of 5 years of documented experience.

B. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.05 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

D. Perform dewatering activities, as required, for the duration of the project.

E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

F. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

I. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

A. See Section 01 1000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect 7 days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with ____ copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Contractor shall locate and protect survey control and reference points.

D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

G. Utilize recognized engineering survey practices.

H. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.
   4. Controlling lines and levels required for mechanical and electrical trades.

J. Periodically verify layouts by same means.

K. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.

4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. 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.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.
   5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

D. 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.

E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

G. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

H. Clean existing systems and equipment.

I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

J. Do not begin new construction in alterations areas before demolition is complete.

K. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.

8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

J. Patching:
1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.

G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

H. Prohibit traffic from landscaped areas.

I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect and Owner seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. See Section 01 7900 - Demonstration and Training.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

3.13 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Replace filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's comprehensive list of items to be completed or corrected.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Owner will occupy all of the building as specified in Section 01 1000.

F. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

H. Accompany Project Coordinator on Contractor's preliminary final inspection.

I. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

J. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION 01 7000

SECTION 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   3. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 3 EXECUTION

2.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.
   4. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Record Drawings: Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.

2.02 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

2.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Additional information as specified in individual product specification sections.

D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

2.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include test and balancing reports.

O. Additional Requirements: As specified in individual product specification sections.

2.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Operation and maintenance data.
      c. Field quality control data.
      d. Photocopies of warranties and bonds.
   4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

2.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.

F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION 01 7800

SECTION 01 7900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. Plumbing equipment.
   3. Electrical systems and equipment.
   4. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Finishes, including flooring, wall finishes, ceiling finishes.
   2. Fixtures and fittings.
   3. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 01 9113 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.

B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

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

B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Architect for transmittal to Owner.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.

1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
1. Perform demonstrations not less than two weeks prior to Substantial Completion.
2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Owner will provide classroom and seating at no cost to Contractor.

C. Provide training in minimum two hour segments.

D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
1. The location of the O&M manuals and procedures for use and preservation; backup copies.
2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
3. Typical uses of the O&M manuals.

F. Product- and System-Specific Training:
1. Review the applicable O&M manuals.
2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
4. Provide hands-on training on all operational modes possible and preventive maintenance.
5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 01 7900

SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

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

B. Section 01 1000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

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

D. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.

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

F. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

G. Section 31 2200 - Grading: Rough and fine grading.

1.03 DEFINITIONS

A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.

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

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

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

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

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.05 SUBMITTALS

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

B. Site Plan: Indicate:
   1. Areas for temporary construction and field offices.

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

1.06 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.

PART 3 EXECUTION

2.01 DEMOLITION

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

B. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with requirements in Section 01 7000.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. 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.
   5. Provide, erect, and maintain temporary barriers and security devices.
   6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
   9. 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.
   10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

C. Per the North Dakota Department of Environmental Quality, before any facility may be renovated, the affected part of the facility must be inspected for the presence of asbestos. Asbestos inspection may only be conducted by North Dakota certified asbestos inspectors. The testing shall be provided by the Owner. The Demolition Contractor or Owner shall notify the ND Dept. of Environmental Quality at least 10 days prior to work commencing and shall coordinate the required NDDEQ notifications with the Owner and Construction Manager. The building Owner and contractor(s) are directly responsible for compliance with State and Federal asbestos requirements during demolition and renovation projects. Architect shall not be responsible for any discovery, presence, handling, removal, disposal, or exposure of persons to, hazardous materials on this project site.

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

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

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

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

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

I. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Comply with requirements of Section 01 7419 - Construction Waste Management and Disposal.
   2. Dismantle existing construction and separate materials.
   3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

2.03 EXISTING UTILITIES

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

B. Protect existing utilities to remain from damage.

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

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

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

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

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

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

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

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

C. Remove existing work as indicated and required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction indicated.
   2. Remove items indicated on drawings.

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 to remain in operation, and maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. 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 as required.
   2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch to match new work.

2.05 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 02 4100

SECTION 04 0511
MASONRY MORTARING AND GROUTING
(BENNETT ELEMENTARY)
(CENTENNIAL ELEMENTARY IF NEEDED)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mortar for masonry.

B. Grout for masonry.

1.02 REFERENCE STANDARDS

A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.

B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.

C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

G. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

H. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

I. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

A. Field-mix all mortar and grout.

B. Mortar Color: Match existing.

C. Mortar Mix Designs: ASTM C270, Property Specification.
   1. Exterior, Non-loadbearing Masonry: Type N.

D. Grout Mix Designs:
   1. Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
      a. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.02 MATERIALS

A. Portland Cement: ASTM C150/C150M.
   1. Type: Type I - Normal; ASTM C150/C150M.
   2. Color: Standard gray.

B. Masonry Cement: ASTM C91/C91M.
   1. Type: Type N; ASTM C91/C91M.

C. Hydrated Lime: ASTM C207, Type S.

D. Quicklime: ASTM C5, non-hydraulic type.

E. Mortar Aggregate: ASTM C144.

F. Grout Aggregate: ASTM C404.

G. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): Match Existing.

H. Water: Clean and potable.

I. Bonding Agent: Latex type.

2.03 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.

D. Do not use anti-freeze compounds to lower the freezing point of mortar.

E. If water is lost by evaporation, re-temper only within two hours of mixing.

2.04 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

PART 3 EXECUTION

3.01 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

3.02 INSTALLATION

A. Install mortar and grout to requirements of section(s) in which masonry is specified.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

D. Do not displace reinforcement while placing grout.

E. Remove excess mortar from grout spaces.

END OF SECTION 04 0511

SECTION 04 2000
UNIT MASONRY
(BENNETT ELEMENTARY)
(CENTENNIAL ELEMENTARY IF NEEDED)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Common brick.

B. Flashings.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 04 0511 - Masonry Mortaring and Grouting.

B. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.

1.03 REFERENCE STANDARDS

A. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.

B. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

C. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

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

B. Product Data: Provide data for masonry units, mortar, and masonry accessories.

C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

D. Samples: Submit four samples of facing brick units to illustrate color, texture, and extremes of color range. Color or blend to match existing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Handle and store pre-faced concrete block units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

PART 2 PRODUCTS

2.01 BRICK UNITS

A. Manufacturers:
   1. Hebron Brick . https://www.hebronbrick.com/ to match existing brick.
   2. Substitutions: See section 01 6000 - Product Requirements.

2.02 MORTAR AND GROUT MATERIALS

A. Mortar and Grout: As specified in Section 04 0511.

2.03 FLASHINGS

A. Metal Flashing Materials: Stainless Steel, as specified in Section 07 6200.

2.04 ACCESSORIES

A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Full-Height Airspace Maintenance and Drainage Material: Mesh panels fitted between masonry ties.
      a. Drainage Material Thickness: 3/8 inch.
      b. Manufacturers:
         1) Advanced Building Products, Inc; Mortairvent-CW: www.advancedbuildingproducts.com/#sle.
         2) CavClear, a Division of Archovations Inc; CavClear Masonry Mat: www.cavclear.com/#sle.
         3) Substitutions: See Section 01 6000 - Product Requirements.

B. Weeps:
   1. Type: Polyester mesh.
   2. Color(s): As selected by Architect from manufacturer's full range.
   3. Manufacturers:
      a. Advanced Building Products, Inc; www.advancedbuildingproducts.com/#sle.
      b. Masonry Technology, Inc; Cavity Weep: www.mtidry.com/#sle.
      c. Mortar Net Solutions; WeepVent: www.mortarnet.com/#sle.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 COLD AND HOT WEATHER REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Brick Units:
   1. Bond: Match Existing.
   2. Mortar Joints: Match Existing.

3.04 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar and mortar smears as work progresses.

E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

F. Interlock intersections and external corners, except for units laid in stack bond.

G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.05 WEEPS/CAVITY VENTS

A. Install weeps in cavity walls at 24 inches on center horizontally on top of through-wall flashing at bottom of walls.

3.06 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.07 REINFORCEMENT AND ANCHORAGE - GENERAL

A. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.

3.08 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:

C. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

3.09 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.10 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 04 2000

SECTION 04 7200
CAST STONE MASONRY
(BENNETT ELEMENTARY)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural cast stone.

B. Architectural synthetic stone units.

C. Units required are:
   1. Exterior wall units, including column cap.

1.02 RELATED REQUIREMENTS

A. Section 04 0511 - Masonry Mortaring and Grouting: Mortar for setting cast stone.

B. Section 04 2000 - Unit Masonry: Installation of cast stone in conjunction with masonry.

C. Section 07 9200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

C. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

D. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

E. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

F. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023.

1.04 SUBMITTALS

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

B. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.

C. Mortar Color Selection Samples.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.

B. Number each piece individually to match shop drawings and schedule.

C. Store cast stone components and installation materials in accordance with manufacturer's instructions.

D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.

E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.

F. Store mortar materials where contamination can be avoided.

G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

2.01 ARCHITECTURAL CAST STONE

A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural granite, complying with ASTM C1364.
   1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
   2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
   3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet.
   4. Remove cement film from exposed surfaces before packaging for shipment.

B. Shapes: Provide shapes indicated on drawings.
   1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch or length divided by 360, whichever is greater, but not more than 1/4 inch.
   2. Unless otherwise indicated on drawings, provide:
      a. Wash or slope of 1:12 on exterior horizontal surfaces.
      b. Drips on projecting components, wherever possible.
      c. Raised fillets at back of sills and at ends to be built in.

C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.

2.02 ARCHITECTURAL SYNTHETIC STONE UNITS

A. Architectural Synthetic Stone Units: Factory-fabricated, high-density cementitious units made from cement, crushed stone, sand, and polymer reinforced with fiberglass strands; designed to simulate appearance of natural stone.
   1. Remove cement film from exposed surfaces before packaging for shipment.

B. Shapes: Provide shapes indicated on drawings.
   1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch or length divided by 360, whichever is greater, but not more than 1/4 inch.
   2. Unless otherwise indicated on drawings, provide:
      a. Wash or slope of 1:12 on exterior horizontal surfaces.
      b. Drips on projecting components, wherever possible.
      c. Raised fillets at back of sills and at ends to be built in.

C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.

2.03 MATERIALS

A. Portland Cement: ASTM C150/C150M.
   1. For Mortar: Type I or II, except Type III may be used in cold weather.

B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.

C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.

D. Admixtures: ASTM C494/C494M.

E. Water: Potable.

F. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.

G. Mortar: Portland cement-lime, as specified in Section 04 0511 ; do not use masonry cement.

H. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.

B. Do not begin installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 2000.

B. Mechanically anchor cast stone units indicated; set remainder in mortar.

C. Setting:
1. Drench cast stone components with clear, running water immediately before installation.
2. Set units in a full bed of mortar unless otherwise indicated.
3. Fill vertical joints with mortar.
4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.03 REPAIR

A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet.

B. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.

C. Repair methods and results subject to Architect 's approval.

3.04 CLEANING

A. Keep cast stone components clean as work progresses.

B. Clean completed exposed cast stone after mortar is thoroughly set and cured.
1. Wet surfaces with water before applying cleaner.
2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
3. Remove cleaner promptly by rinsing thoroughly with clear water.
4. Do not use acidic cleaners.

3.05 PROTECTION

A. Protect completed work from damage.

B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION 04 7200

SECTION 05 5213
PIPE AND TUBE RAILINGS
(NORTH HIGH SCHOOL)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Free-standing railings at steps.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of anchors in concrete.

B. Section 04 2000 - Unit Masonry: Placement of anchors in masonry.

C. Section 09 2116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

G. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.

H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

K. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

L. AWS C3.4M/C3.4 - Specification for Torch Brazing; 2016.

M. AWS C3.5M/C3.5 - Specification for Induction Brazing; 2016, with Amendment (2017).

N. AWS C3.9M/C3.9 - Specification for Resistance Brazing; 2020.

O. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

Q. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 SUBMITTALS

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

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.

D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

C. Fabricator Qualifications:
1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
3. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Handrails and Railings:
1. Alumi-Guard: www.alumi-guard.com/#sle.
2. Greco Aluminum Railings: www.grecorailings.com/#sle.
3. Superior Aluminum Products, Inc: www.superioraluminum.com/#sle.
4. Ultra Aluminum Manufacturing, Inc: www.ultrafence.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.
3. For anchorage to stud walls, provide backing plates, for bolting anchors.
4. Posts: Provide adjustable flanged brackets.

G. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

H. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
   1. Ease exposed edges to a small uniform radius.
   2. Welded Joints:
      a. Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.
      b. Stainless Steel: Perform welding in accordance with AWS D1.6/D1.6M.
   3. Brass/Bronze Brazed Joints:
      a. Perform torch brazing in accordance with AWS C3.4M/C3.4.
      b. Perform induction brazing in accordance with AWS C3.5M/C 3.5.
      c. Perform resistance brazing in accordance with AWS C3.9M/C3.9.

2.03 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.

C. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

D. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

E. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

F. Galvanizing: In accordance with requirements of ASTM A123/A123M.
   1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic.

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

2.04 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Weld connections that cannot be shop welded due to size limitations.
   1. Weld in accordance with AWS D1.1/D1.1M.
   2. Match shop welding and bolting.
   3. Clean welds, bolted connections, and abraded areas.
   4. Touch up shop primer and factory-applied finishes.
   5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with ADA Standards for accessible design at applicable locations.

D. Anchor railings securely to structure.

E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

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

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

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

END OF SECTION 05 5213

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof Sheathing.

B. Concealed wood blocking, nailers, and supports.

C. Miscellaneous wood nailers, furring, and grounds.

1.02 REFERENCE STANDARDS

A. PS 2 - Performance Standard for Wood Structural Panels; 2018.

B. PS 20 - American Softwood Lumber Standard; 2021.

1.03 SUBMITTALS

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

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

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

2.02 CONSTRUCTION PANELS

A. Roof Sheathing: Oriented strand board structural wood panel, PS 2, with factory laminated roofing underlayment layer.
   1. Sheathing Panel:
      a. Grade: Sheathing.
      b. Size: 4 feet wide by 8 feet long.
      c. Performance Category: 5/8 PERF CAT.
      d. Span Rating: 40/20.
      e. Edge Profile: Square edge.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

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

3.02 BLOCKING, NAILERS, AND SUPPORTS

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

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and

roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. Provide the following specific nonstructural framing and blocking:
   1. Handrails.
   2. Facia Blocking .

3.03 INSTALLATION OF CONSTRUCTION PANELS

3.04 CLEANING

A. Waste Disposal: See Section 01 7419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

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

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

END OF SECTION 06 1000

SECTION 07 2400
EXTERIOR INSULATION AND FINISH SYSTEMS
(BENNETT ELEMENTARY ONLY)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Composite wall and soffit cladding of rigid insulation and reinforced finish coating, Class PB.

B. Drainage and water-resistive barriers behind insulation board.

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim: Perimeter flashings.

B. Section 07 9200 - Joint Sealants: Sealing joints between EIFS and adjacent construction and penetrations through EIFS.

1.03 REFERENCE STANDARDS

A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

B. ASTM C297/C297M - Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions; 2016.

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

D. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).

E. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.

F. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2015 (Reapproved 2020).

G. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

I. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2018.

J. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).

K. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.

L. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).

M. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies; 2015, with Editorial Revision (2022).

N. NFPA 259 - Standard Test Method for Potential Heat of Building Materials; 2023, with Errata.

O. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.

P. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 SUBMITTALS

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

B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.

C. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures closest to the existing color and texture.

D. Verification Samples: Submit actual samples of selected coating on specified substrate, minimum 12 inches square, illustrating project colors and textures.

E. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

1.05 QUALITY ASSURANCE

A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.

B. EIFS Manufacturer Qualifications: Provide EIFS products other than insulation from the same manufacturer with qualifications as follows:
   1. Manufacturer of EIFS products for not less than 5 years.

C. Insulation Manufacturer Qualifications: Approved by manufacturer of EIFS and approved and labeled under third party quality program as required by applicable building code.

D. Installer Qualifications: Company specializing in the type of work specified and with at least three years of documented experience.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Construct mock-up of typical EIFS application on specified substrate, size as indicated on drawings, and including flashings, joints, and edge conditions.

C. Locate mock-up where directed.

D. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.

B. Storage: Store materials as directed by manufacturer's written instructions.
   1. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F and temperatures in excess of 90 degrees F.
   2. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.
   3. Protect insulation materials from exposure to sunlight.

1.08 FIELD CONDITIONS

A. Do not prepare materials or apply EIFS under conditions other than those described in the manufacturer's written instructions.

B. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.

C. Do not install coatings or sealants when ambient temperature is below 40 degrees F.

D. Do not leave installed insulation board exposed to sunlight for extended periods of time.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

C. Provide separate warranty from installer covering labor for repairs or replacement for a period of not less than 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design:
   1. Dryvit Systems, Inc; Dryvit Outsulation Plus MD EIFS, Class PB with Moisture Drainage: www.dryvit.com/#sle.

B. Other Acceptable Exterior Insulation and Finish Systems Manufacturers:
   1. Dryvit Systems, Inc; Dryvit Outsulation Plus MD EIFS, Class PB with Moisture Drainage: www.dryvit.com/#sle.
   2. Master Wall, Inc; Aggre-flex Drainage System - Class PB Drainage EIFS: www.masterwall.com/#sle.
   3. Sto Corp: www.stocorp.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 EXTERIOR INSULATION AND FINISH SYSTEM

A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on flat-backed insulation board adhesive-applied directly to water-resistive coating over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.

B. Fire Characteristics:
   1. Flammability: Pass, when tested in accordance with NFPA 285.
   2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
   3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot.

C. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum flatwise tensile bond strength of 15 psi, when tested in accordance with ASTM C297/C297M.

D. Adhesion to Water-Resistive Coating: For each combination of insulation board and substrate, when tested in accordance with ASTM C297/C297M, maximum adhesive failure of 25 percent unless flatwise tensile bond strength exceeds 15 psi in all samples.

E. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

F. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.

G. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches in size.

H. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.

I. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.

J. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.

K. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.

L. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons of sand.

2.03 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
   1. Texture: to match existing.
   2. Color: to match existing.

B. Base Coat: Fiber-reinforced, acrylic or polymer-based product compatible with insulation board and reinforcing mesh, Class PB.

C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.

D. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.

E. Water-Resistive Barrier Coating: Fluid-applied air and water barrier membrane; applied to sheathing; furnished or approved by EIFS manufacturer.

2.04 ACCESSORIES

A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.

B. Metal Flashings: See Section 07 6200.

C. Trim: EIFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.

D. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

B. Verify that substrate surface is flat, with no deviation greater than 1/4 in when tested with a 10 ft straightedge.

3.02 PREPARATION

A. Apply primer to substrate as recommended by EIFS manufacturer for project conditions.

3.03 INSTALLATION - GENERAL

A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.
   1. Where different requirements appear in either document, comply with the most stringent.
   2. Neither of these documents supercedes provisions of Contract Documents that defines contractual relationships between parties or scope of this work.

3.04 INSTALLATION - WATER-RESISTIVE BARRIER

A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.

B. Seal substrate transitions and intersections with other materials to form continuous water-resistive barrier on exterior of sheathing, using method recommended by manufacturer.

C. At door and window rough openings and other wall penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, sills, or frames, using method recommended by manufacturer.

D. Lap flexible flashing or flashing tape at least 2 inches on each side of joint or transition.

3.05 INSTALLATION - INSULATION

A. Install in accordance with manufacturer's instructions.

B. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.

C. On wall surfaces, install boards horizontally. On horizontal surfaces, install boards _____ .

D. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch.

E. Fill gaps greater than 1/16 inch with strips or shims cut from the same insulation material.

F. Rasp irregularities off surface of installed insulation board.

G. Adhesive Attachment: Use method required by manufacturer to achieve drainage efficiency specified; do not close up drainage channels when placing insulation board.

3.06 INSTALLATION - CLASS PB FINISH

A. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at terminations of EIFS. Install reinforcing fabric as recommended by EIFS manufacturer.
   1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches.
   2. Allow base coat to dry a minimum of 24 hours before next coating application.

B. Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.

C. Finish Coat Thickness: As recommended by manufacturer.

D. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.07 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.

3.08 PROTECTION

A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION 07 2400

SECTION 07 4113
METAL ROOF PANELS
(NORTH HIGH SCHOOL)
(DAVIES HIGH SCHOOL – GMP#2)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal roof panel system of preformed steel panels.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Roof sheathing.

B. Section 07 9200 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

D. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).

E. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2005 (Reapproved 2017).

1.04 SUBMITTALS

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

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Storage and handling requirements and recommendations.
   2. Installation methods.
   3. Specimen warranty.

C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
   1. Show work to be field-fabricated or field-assembled.

D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.
   1. Include typical panel joint in sample.
   2. Include typical fastening detail.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Test Reports: Indicate compliance of metal roofing system to specified requirements.

I. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

C. Special Warranty: Provide 2-year warranty for weathertightness of roofing system, including agreement to repair or replace metal roof panels that fail to keep out water commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Architectural Metal Roof Panel Manufacturers:
1. ATAS International, Inc; Belvedere Grand R: www.atas.com/#sle.
2. MBCI, a Cornerstone Building Brands Company; Perma-Clad Panel: www.mbci.com/#sle.
3. Petersen Aluminum Corporation; R-36 Panel: www.pac-clad.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
3. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F.

2.03 METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.
1. Steel Panels:
   a. Steel Thickness: Minimum 24 gauge, 0.024 inch.
2. Profile: Lapped seam, with integral sealant bead and exposed fastener system.
3. Texture: Smooth, with intermediate ribs for added stiffness.
4. Length: Full length of roof slope, without lapped horizontal joints.
5. Width: Maximum panel coverage of 24 inches.

2.04 ATTACHMENT SYSTEM

A. Exposed System: Provide manufacturer's recommended stainless steel fasteners engineered to meet performance requirements and equipped with appropriate sealant separators to provide weathertight connections that will accommodate anticipated thermal movement.

2.05 SECONDARY FRAMING

A. Secondary Framing for Roof Retrofit: Light gauge, asymmetrical section, steel zee profile framing precut with notches that match size, shape and spacing of existing metal roof seams.

B. Framing Material: ASTM A1011/A1011M Designation SS steel sheet.
   1. Profile: Manufacturer's standard cee, zee, asymmetrical zee, hat channel, plain channel, single slope eave strut, double slope eave strut, and angle.
   2. Thickness: 12 gauge, 0.1046 inch.
   3. Finish: Galvanized per ASTM A653/A653M, G90.

C. Framing Connectors: Factory-made formed steel sheet, ASTM A653/A653M SS Grade 50, with G60/Z180 hot dipped galvanized coating and factory punched holes.

2.06 FABRICATION

A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.07 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as selected by Architect from manufacturer’s standard line.

2.08 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
   1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
   3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Underlayment for Wood Substrate: ASTM D226/D226M roofing felt, perforated type; covered by water-resistant rosin-sized building paper.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Broom clean wood sheathing prior to installation of roofing system.

B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

C. Coordinate installation of waterproof membrane over roof sheathing with Section 06 1000.

D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

E. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

F. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
   1. Install roofing system with exposed fasteners prefinished to match panels.
   2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, trim, closure strips, caps, rib closures, ridge closures, and similar roof accessory items.

C. Install roofing felt and building paper slip sheet on roof sheathing before installing preformed metal roof panels; secure by methods acceptable to roof panel manufacturer, minimizing use of metal fasteners; apply from eaves to ridge in shingle fashion, overlapping horizontal joints at least 2 inches and side and end laps at least 3 inches; offset seams in building paper and seams in roofing felt.

D. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 07 4113

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, sheet metal roofing, and other items indicated in Schedule.

B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

A. Section 07 7123 - Manufactured Gutters and Downspouts.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

D. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2020.

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

F. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

G. CDA A4050 - Copper in Architecture - Handbook; current edition.

H. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

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

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sheet Metal Flashing and Trim:
   1. ALUCOBOND by 3A Composites USA; ALUCOBOND AXCENT: www.alucobondusa.com/#sle.
   2. Hickman Edge Systems; _____: www.hickmanedgesystems.com/#sle.
   3. Petersen Aluminum Corporation; _____: www.pac-clad.com/#sle.
   4. Taylor Metal Products; _____: www.taylormetal.com/#sle.

2.02 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal.

B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal, shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's standard colors.

C. Lead Sheet: ASTM B749, 0.047-inch minimum thickness; UNS Number L51121.

D. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch thick; smooth No. 4 - Brushed finish.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.04 FLASHING

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.05 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer Type: Zinc chromate.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Seal metal joints watertight.

E. Secure gutters and downspouts in place with concealed fasteners.

F. Connect downspouts to downspout boots, and grout connection watertight.

3.04 SCHEDULE

A. Fascia and Cornices:

B. Gutters and Downspouts:

C. Coping, Cap, Parapet, Sill and Ledge Flashings:

D. Flashings Associated with Shingle Roofing, including Valley, Hip, Ridge, Eave, Gutter Edge, Gable Edge, Chimney:

E. Counterflashings at Roofing Terminations (over roofing base flashings):

F. Counterflashings at Curb-Mounted Roof Items:

G. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports:

END OF SECTION 07 6200

SECTION 07 7123
MANUFACTURED GUTTERS AND DOWNSPOUTS
(SOUTH HIGH SCHOOL)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pre-finished aluminum downspouts.

1.02 REFERENCE STANDARDS

A. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

1.03 SUBMITTALS

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

B. Product Data: Provide data on prefabricated components.

C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Downspouts:
1. Alside, Inc: www.alside.com/#sle.
2. ATAS International, Inc: www.atas.com/#sle.
3. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.
4. Metal-Era Inc: www.metalera.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Pre-Finished Aluminum Sheet: ASTM B209/B209M, ___ alloy, ___ temper; 0.032 inch thick.
1. Finish: Plain, shop pre-coated with modified silicone coating.
2. Color: To match Existing.

2.03 COMPONENTS

A. Downspouts: CDA rectangular profile.

B. Anchors and Supports: Profiled to suit downspouts.
1. Anchoring Devices: In accordance with CDA requirements.
2. Downspout Supports: Brackets.

C. Fasteners: Galvanized steel, with soft neoprene washers.

2.04 FABRICATION

A. Form downspouts of profiles and size indicated.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate downspout accessories; seal watertight.

2.05 ACCESSORIES

A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets. To fit into existing PVC pipe in sidewalk.
   1. Configuration: Offset.
   2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
   3. Finish: Manufacturer's standard factory applied powder coat finish.
   4. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, and rubber coupling.
   5. Products:
      a. Downspoutboots.com, a division of J. R. Hoe & Sons: www.downspoutboots.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

3.02 PREPARATION

A. Paint concealed sheet metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. Install downspouts, and accessories in accordance with manufacturer's instructions.

B. Sheet Metal: Flash and seal gutters to downspouts and accessories.

C. Connect downspouts to downspout boots at 24 inches above grade. Seal connection watertight.

D. Connect downspouts to storm sewer system. Grout connection watertight.

END OF SECTION 07 7123

SECTION 07 9200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.02 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

B. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

D. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.

1.03 SUBMITTALS

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

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Backing material recommended by sealant manufacturer.
   4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   5. Substrates the product should not be used on.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

F. Installation Plan: Submit at least four weeks prior to start of installation.

G. Installation Log: Submit filled-out log for each length or instance of sealant installed.

H. Executed warranty.

1.04 QUALITY ASSURANCE

A. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

B. Installation Plan: Include schedule of sealed joints, including the following:
   1. Installation Log Form: Include the following data fields, with known information filled out.
      a. Date of installation.
      b. Name of installer.

c. Actual joint width; provide space to indicate maximum and minimum width.
d. Actual joint depth to face of backing material at centerline of joint.
e. Air temperature.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants:
1. Dow; _____: www.dow.com/#sle.
2. Hilti, Inc; _____: www.hilti.com/#sle.
3. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
4. Sika Corporation; _____: www.usa.sika.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints:
a. Seal the following joints:
1) Wall expansion and control joints.
2) Joints between doors, windows, and other frames or adjacent construction.
3) Joints between different exposed materials.
2. Do Not Seal:
a. Intentional weep holes in masonry.
b. Joints indicated to be covered with expansion joint cover assemblies.
c. Joints where sealant installation is specified in other sections.

2.03 JOINT SEALANTS - GENERAL

A. Colors: Selected from Manufacturer's standard color range.

2.04 NONSAG JOINT SEALANTS

2.05 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

B. Sealant Backing Rod, Closed-Cell Type:
1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
2. Size: 25 to 50 percent larger in diameter than joint width.

C. Overlay Extrusion for Glazing System Joint Protection: Rubber profiled extrusions placed over joints in glazing system and provided with watertight seal.
1. Profile: As required to match existing metal glazing cap requirements.

D. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

E. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

F. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

G. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

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

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

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

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

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

B. Provide joint sealant installations complying with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION 07 9200

SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS
(CENTENNAL ELEMENTARY)
(BENNETT ELEMENARY ONLY IF NEEDED – COLOR TO MATCH EXISTING)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

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

C. Section 12 2400 - Window Shades: Attachments to framing members.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

G. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

1.04 ADMINISTRATIVE REQUIREMENTS

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

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 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.
   1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

D. Samples: Submit two samples 2" x 2" inches in size illustrating finished aluminum surface, glass, glazing materials.

E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

G. Designer's qualification statement.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Specimen warranty.

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 in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Locate where directed.

C. Mock-up may remain as part of work.

1.08 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.

1.09 FIELD CONDITIONS

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

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. 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.

D. 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 MANUFACTURERS

A. Aluminum-Framed Storefronts:
   1. Kawneer North America; _____: www.kawneer.com/#sle.
   2. Manko Window Systems, Inc; _____: www.mankowindows.com/#sle.
   3. Oldcastle BuildingEnvelope; _____: www.oldcastlebe.com/#sle.
   4. Tubelite, Inc; _____: www.tubeliteinc.com/#sle.
   5. YKK AP America, Inc; _____: www.ykkap.com/commercial/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Position: Centered (front to back).
   2. Finish: Class I natural anodized.

a. Factory finish all surfaces that will be exposed in completed assemblies.

3. Finish Color: As selected by Architect from manufacturer's standard line.
4. 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.
5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
6. 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.
7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
10. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.

B. Performance Requirements

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
3. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.
3. Cross-Section: 2 by 4 1/2 inch nominal dimension.
4. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: See Section 08 8000.

2.04 MATERIALS

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

B. Fasteners: Stainless steel.

C. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.

D. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.

E. Sealant for Setting Thresholds: Non-curing butyl type.

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

G. Glazing Accessories: See Section 08 8000.

2.05 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

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

I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.02 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

3.03 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, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.04 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 4313

SECTION 08 8000
GLAZING
(CENTENNIAL ELEMENTARY)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing compounds.

1.02 REFERENCE STANDARDS

A. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

B. ASTM C1036 - Standard Specification for Flat Glass; 2021.

C. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

D. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

E. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

F. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

G. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

H. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.04 SUBMITTALS

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

B. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 12" by 12" inch in size of glass units.

E. Certificate: Certify that products of this section meet or exceed specified requirements.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide on-site glazing mock-up with the specified glazing components.

C. Locate where directed.

D. Mock-ups may remain as part of the Work.

1.07 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fabricators:
1. Tecnoglass; Insulating Glass: www.tecnoglass.com/#sle.
2. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
3. Viracon, Inc: www.viracon.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
3. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
1. In conjunction with weather barrier related materials described in other sections, as follows:

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.

2.04 INSULATING GLASS UNITS

A. Manufacturers:
1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
2. Guardian Glass, LLC: www.guardianglass.com/#sle.
3. Pilkington North America Inc: www.pilkington.com/na/#sle.Pilkington North America Inc : www.pilkington.com/na/#sle.

4. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.
5. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
6. _____.
7. Substitutions: See Section 01 6000 - Product Requirements.

B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

C. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Spacer Color: Black.
4. Edge Seal:
   a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
   b. Color: Black.
5. Purge interpane space with dry air, hermetically sealed.

D. Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with argon.
3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
   b. Coating: Self-cleaning type, on #1 surface.
   c. Coating: Low-E (passive type), on #2 surface.
4. Metal edge spacer.
5. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
6. Total Thickness: 1 inch.
7. Thermal Transmittance (U-Value), Summer - Center of Glass: .3, nominal.
8. Visible Light Transmittance (VLT): _____ percent, nominal.
9. Solar Heat Gain Coefficient (SHGC): _____, nominal.
10. Glazing Method: Dry glazing method, gasket glazing.

2.05 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - PLASTIC FILM

A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.

B. Place without air bubbles, creases or visible distortion.

C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required. Do not score the glass.

3.06 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.07 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.08 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 8000

SECTION 09 6813
TILE CARPETING
(TROLLWOOD PERFORMING ARTS ONLY)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

B. Removal of existing carpet.

1.02 RELATED REQUIREMENTS

A. Section 09 0561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

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; sizes, patterns, colors available, and method of installation.

C. Shop Drawings: Indicate layout of joints.

D. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

E. 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 Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.05 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting:
   1. Interface, Inc: www.interface.com/#sle.
   2. Mannington Commercial: www.manningtoncommercial.com#sle.
   3. Milliken & Company: www.milliken.com/#sle.
   4. Mohawk Group: www.mohawkgroup.com/#sle.
   5. J&J Flooring .
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Tile Carpeting, Type 1
   1. Product: Basis of Design: Intrinsic Accent 7311 manufactured by J&J Flooring.
   2. Tile Size: 24 by 24 inch, nominal.
   3. Color: Basis of Design: Essential Accent 3563.

2.03 ACCESSORIES

A. Edge Strips: Embossed aluminum, color as selected by Architect as needed.

B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

3.02 PREPARATION

A. Remove existing carpet.

B. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.

C. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

D. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Fully adhere carpet tile to substrate.

G. Trim carpet tile neatly at walls and around interruptions.

H. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove excess adhesive without damage, from floor, base, and wall surfaces.

C. Clean and vacuum carpet surfaces.

END OF SECTION 09 6813

SECTION 09 9113
EXTERIOR PAINTING
(BENNETT ELEMENTARY)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

D. Do Not Paint or Finish the Following Items:
1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

1.03 SUBMITTALS

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

B. Product Data: Provide complete list of products to be used, with the following information for each:
1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
2. MPI product number (e.g. MPI #47).
3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
4. Manufacturer's installation instructions.
5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.
2. Allow 30 days for approval process, after receipt of complete samples by Architect.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Locate where directed by Architect.

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

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
   1. Behr Paint Company: www.behr.com/#sle.
   2. Diamond Vogel Paints: www.diamondvogel.com/#sle.
   3. PPG Paints: www.ppgpaints.com/#sle.
   4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Colors: To be selected from manufacturer's full range of available colors. Color to Match Existing.
   1. Selection to be made by Architect after award of contract.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Exterior Light Industrial Coating, Water Based; MPI #161, 163, or 164.
      a. Products:
         1) Behr Premium Interior/Exterior Direct-To-Metal Paint Semi-Gloss [No.3200]. (MPI #163)
         2) PPG Paints Pitt-Tech Plus EP DTM Industrial Enamel, 90-1610 Series, Semi-Gloss. (MPI #163)
         3) Sherwin-Williams Pro Industrial DTM Acrylic, Semi-Gloss. (MPI #163)
         4) Substitutions: See Section 01 6000 - Product Requirements
   3. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Water Based Primer for Galvanized Metal; MPI #134.
      a. Products:
         1) PPG Paints Pitt-Tech Plus EP DTM Industrial Primer, 90-1912. (MPI #134)
         2) Sherwin-Williams DTM Primer/Finish (MPI #134)

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

H. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Sand metal surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 9113

SECTION 12 2400
WINDOW SHADES
(CENTENNIAL ELEMENTARY)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

B. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.04 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

F. Selection Samples: Include fabric samples in full range of available colors and patterns.

G. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

K. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

L. Maintenance contracts.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum ____ years of documented experience with shading systems of similar size and type.
   1. Manufacturer's authorized representative.

1.06 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.
   1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
   2. Full-sized mock-up may become part of the final installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: One year.
   2. Fabric: One year.
   3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Draper, Inc; Clutch Operated FlexShade NEXD: www.draperinc.com/#sle.
   2. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
   3. MechoShade Systems LLC; Mecho/7 System: www.mechoshade.com/#sle.
   4. SWFcontract, a division of Springs Window Fashions, LLC.; Pro Series Manual Solar Shade System: www.swfcontract.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades:
   1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Size: Verify on Site.
      c. Fabric: Light-Filtering Fabric: Woven fabric, stain and fade resistant. Color as celected by Architect from manufacturer's full range.
   2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   3. Roller Tubes: As required for type of shade operation.
      a. Material: Extruded aluminum, clear anodized finish.
      b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
   4. Hembars: Designed to maintain bottom of shade straight and flat.
      a. Style: Exposed aluminum bottom bar, flat profile with closed ends; clear anodized finish.
   5. Manual Operation for Interior Shades:
      a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
      b. Drive Chain: Continuous loop, beaded ball chain with restraining device, 95 lb minimum breaking strength; comply with WCMA A100.1. Provide upper and lower limit stops.
   6. Accessories:
      a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.

b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.

2.03 SHADE FABRIC

A. Fabric for Light-Filtering Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Manufacturers:
      a. Substitutions: See Section 01 6000 - Product Requirements.
   2. Performance Requirements:
      a. Flammability: Pass NFPA 701 large and small tests.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

C. Dimensional Tolerances: As recommended in writing by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.07 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION 12 2400

SECTION 12 3600
COUNTERTOPS

(CENTENNIAL ELEMENTARY SOLID SURFACE WINDOWSILLS)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solid surface material windowsill.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

C. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. AWI (QCP) - Quality Certification Program; Current Edition.

F. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

G. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.

H. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

I. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.

J. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

K. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

L. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

M. PS 1 - Structural Plywood; 2023.

N. WI (CCP) - Certified Compliance Program (CCP); Current Edition.

1.04 SUBMITTALS

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

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation .

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

H. Installer's qualification statement.

I. Installation Instructions: Manufacturer's installation instructions and recommendations.

J. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

B. Quality Certification:
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
   2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by certification program.
   4. Provide designated labels on installed products as required by certification program.
   5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements secified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

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

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 PRODUCTS

2.01 COUNTERTOPS

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

B. Solid Surfacing Windowsills: Solid surfacing sheet or plastic resin casting self-supporting over structural members.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Dupont: www.corian.com/#sle.
         2) Formica Corporation: www.formica.com/#sle.
         3) Wilsonart: www.wilsonart.com/#sle.
         4) Substitutions: See Section 01 6000 - Product Requirements.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Finish on Exposed Surfaces: _____.
      d. Color and Pattern: As selected by Architect from manufacturer's full line.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

5. Fabricate in accordance with manufacturer's standard requirements.

2.02 MATERIALS

A. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

B. Joint Sealant: Silicone sealant, clear.

2.03 ACCESSORIES

A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic cups with slot for wire passage.
   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. Doug Mockett & Company, Inc.
   2. Outside Diameter: 2 inches.
   3. Color: As selected by Architect from manufacturer's full colors.
   4. Coordinate locations with Architect and Electrical plans.

B. Fixed Top-Mounted Countertop Support Brackets:
   1. Material: Steel.
   2. Finish: Manufacturer's standard, factory-applied, textured powder coat.
   3. Color: Black.
   4. Size: of sufficient length and height to support the countertop depth indicated on Drawings.

C. Concealed Support Bracket
   1. Material: Steel
   2. Finish: Manufacturer's standard, factory-applied, textured powder coat.
   3. Size: of sufficient length and height to support the countertop depth indicated on Drawings.
   4. Products:
      a. Rakks Brackets; Inside Wall-Flush Mount EH Bracket: www.rakks.com
   5. Accessories: Provide blocking as required for use with Quartz and Solid Surface countertops.

2.04 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches (400 mm) on center.
   3. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install vanities in accordance with manufacturer’s instructions and approved shop drawings

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 ADJUSTING AND CLEANING

A. Clean countertops exposed and semi-exposed surfaces thoroughly.

B. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

C. Follow manufacturer's cleaning standards and guidelines.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 12 3600

SECTION 22 0100.10 - PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1APPLICABILIITY

A. The work covered by the Division of the Specifications consists of providing all labor, supervision, equipment, materials, all incidentals, related items and appurtenances, and performing all operations necessary to complete the installation of work in strict accordance with these specifications and drawings.

B. All work shall be finished, tested, and ready for operation. The word “Provide” shall mean “furnish and install complete and ready for use”.

1.2 DRAWINGS:

A. The drawings indicate the extent and general layout of the mechanical systems intended for the building. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, connections, and accessories which may be required. Provide offsets, fittings, valves, and accessories as may be required, to produce a complete and operating installation of type shown and specified.

B. Mechanical drawings are diagrammatic in nature and should not be scaled to obtain dimensions. Obtain dimensions and locations of partitions, walls, etc., from the Architectural dimensioned drawings. Consult the Architectural drawings for details of construction, location of suspended ceilings, ceiling heights, and other pertinent information. Architect's drawings shall not take precedence over field measurements.

C. All drawings and specifications shall be considered in bidding. The drawings and specifications are complimentary, and what is called for in either of these shall be as binding as though called for by both. Should any conflict arise between drawings and specifications, such conflict shall be brought to the attention of the Architect.

1.3 SUBMITTALS

A. All submittals to be reviewed, approved, and stamped by submitting contractor prior to submittal to engineer. Submittals not reviewed by submitting contractor prior to submittal to engineer will be returned marked "Not Reviewed".

1.4 APPROVED MANUFACTURERS

A. Where approved manufacturers are indicated in the specifications, the approval does not relieve the responsibility of the contractor to provide products and systems which meet the requirements of the specifications and drawings.

B. Performance, dimensions, electrical requirements, and functions shall be coordinated with the basis of design indicated on the drawings and in the specifications. If there are differences from the basis of design they should be brought to the attention of the Engineer.

C. Revisions required by the differences from basis of design, shall be provided to the Owner without additional cost. Revisions to the work of other contractors on the project, due to differences in equipment, shall be provided by the contractor supplying the equipment at no additional cost to the Owner.

1.5 INSTRUCTION OF OWNER'S EMPLOYEES:

A. Provide, without additional expense to the Owner, the services of competent instructors, who will give full instructions in the care, adjustment, and operation of all parts of the mechanical equipment to the Owner's employees who are to have charge of the equipment.

B. An operating and maintenance manual shall be made available to the Owner's operating personnel during the instruction and left with the Owner upon completion of the instruction.

C. Hours of instruction shall be divided up into a minimum of two (2) instruction periods. Provide a minimum of four (4) total hours of training for plumbing equipment and systems.

1.6 INSTALLATION OF EQUIPMENT:

A. All appliances and equipment shall be installed and connected in accordance with manufacturer's instructions and recommendations unless such instructions are in conflict with these specifications.

B. All equipment shall be installed in such a manner and location as to facilitate accessibility for maintenance and/or replacement.

1.7 COOPERATION WITH OTHER TRADES:

A. Cooperate with other trades so as to avoid interferences. Where required to avoid interferences with other work or to increase the headroom, the Contractor shall off-set the piping and/or re-route the duct work where directed by the Engineer. Carefully check all construction details to assure the proper installation of all work under this specification. Schedule the work such that it will keep pace with the work of other crafts and cause no delay.

1.8 INSPECTION OF SITE:

A. Before submitting a proposal on the work contemplated in these specifications and accompanying drawings, each bidder shall examine the site and familiarize himself with all of the existing conditions and limitations. No extras will be allowed because of Contractor's misunderstand as to the amount of work involved or lack of his knowledge of any condition in connection with the new construction.

1.9 CODES, ORDINANCES, REGULATIONS, & STANDARDS:

A. The entire installation shall be made in accordance with all state and local laws. If, in any instance, the plans and specifications conflict with such laws, the law shall take precedence. This, however, shall not be construed as relieving the contractor from complying with any requirements of the drawings and specifications that may be in excess of the rules and not contrary to the same.

B. All work shall conform to applicable state and local codes, ordinances, regulations, and/or standards.

1.10 PERMITS, LICENSES, AND FEES

A. The contractor shall secure and pay for all the associated permits, fees, licenses and inspections by government agencies necessary for proper execution and completion of the work that are customarily secured after execution of the contract and legally required at the time bids are received or negotiations concluded.

1.11 CONTRACTOR WARRANTIES

A. Contractor shall guarantee all equipment, materials, and workmanship for a period of one year from the date of final completion. Any defects in equipment, materials or workmanship that appear or cause any issues within the one year period shall be repaired at no additional cost, (this shall include materials and labor). Refer to all other specification sections for additonal guarantees/warranties requirements.

PART 2 - PRODUCTS

2.1 OPERATION & MAINTENANCE MANUALS

A. Contractor to provide Operation and Maintenance manuals to meet all requirements detailed by this section in addition to all requirements defined in Section 01 of this manual.

B. Manuals shall be bound in new 3 ring binders, 2" D-ring, black color, with the title "Operations and Maintenance Manual" and the project title and volume number clearly printed on the front cover and spine of the binders.

C. Manual shall include an index in the front of each manual for the sections included in the manual. Each section shall be referenced with plastic tabs.

D. Include in the front of each manual a complete listing of all mechanical contractors and sub-contractors used on the project. Include names, addresses and phone numbers for each contracted listed.

E. Manuals shall be arranged by specification number. Each piece of equipment shall be referenced by tag number with tabs. At the beginning of each section, the equipment supplier's name, address and phone number shall be provided.

F. Data for equipment included in the manuals:
1. Approved shop drawings clearly showing the models, sizes and capacities of equipment used. All shop drawings inlcuded in the manual shall have all review comments addressed.
2. Operations Manuals detailing step by step procedures for putting equipment into operation.
3. Maintenance Manuals from the manufacturer of each piece of equipment including instructions for installation, maintenance and lubrication. Manuals shall include parts lists for all replacement parts.
4. All equipment warranty information with warranty registration completed in owners name.

G. Include the following reports in the manuals:
1. Testing and balancing reports for air and water systems as specified.
2. Start-up reports.
3. Valve and damper tag lists.

H. Submit one hard copy of the Operation & Maintenance Manuals to the Engineer and the Contracting Officer for approval prior to delivery to the Owner.

2.2 SUB-BASES FOR EQUIPMENT:

A. Sub-bases shall be provided for all equipment such as water heaters, pumps, and air compressors. Each electric motor shall be mounted on the same sub-base as the driven machine.

B. Sub-bases generally consist of pads constructed of 2500 psi concrete with all exposed surfaces finished with cement mortar, troweled smooth. Machines other than those supported on isolation units shall be secured to concrete sub-bases with anchor bolts of ample size. All machines having bed plates and flexible and solidly connected motors shall be grouted under the full area of the bed plates with a non-shrinking, premixed grout. After grout has set, all wedges, shims, and jack bolts shall be removed and spaces filled with grout.

C. Premanufactured rooftop curbs and/or supports for any roof mounted item supplied under this division of the specifications shall be provided by the Mechanical Contractor. Sizes, locations, and installation shall be coordinated with the Roofing Contractor.

2.3 SUPPORTING STEEL, ROOF AND WALL OPENINGS:

A. Provide structural steel framework for supporting mechanical equipment as required.

B. Unless otherwise indicated by the drawings, lintels for new mechanical openings shall be provided by the contractor installing the pipe.

C. Unless otherwise indicated by the drawings, angles to frame a new roof opening through the roof deck shall be provided by the contractor installing the pipe through the roof.

D. All steel work shall be in conformance with the requirement of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings. Material shall conform to ASTM A36.

2.4 SLEAVES, CUTTING, AND CORE DRILLING:

A. Provide sleeves for piping openings in masonry walls.

B. The contractor shall saw cut or core drill existing masonry floors and walls for new piping penetrations. The contractor shall cut new openings through framed walls for piping penetrations. Provide headers as needed in frame walls.

2.5 FIRESTOPPING

A. Provide firestopping assemblies for the required fire ratings and listed in the current year certification books of UL, FM or ITS (Warnock Hersey).

B. See the Architectural drawings for required ratings. Refer to the Mechanical drawings for additional ratings. Provide firestopping for all penetrations of these assemblies.

2.6 SEALING PENETRATIONS IN NON-RATED WALLS AND FLOORS

A. Provide caulk at penetrations of non-rated walls and floors for piping. If the gap is too large for caulk, provide fiberglass insulation for backing. Conceal the fiberglass with either caulk or sheetmetal. Refer to specifications for sleeve requirements.

B. In mechanical rooms and other water-proof floor areas, provide sleeves or concrete pads at least 2" higher than the top of slab to prevent water from running through the annual space between the pipe and the floor opening. In addition to the sleeve, provide packing and caulking around the pipe inside the sleeve to prevent noise transmission through openings in the floor.

2.7 ACCESS DOORS IN CEILINGS AND WALLS

A. Provide metal lockable access doors in gypsum board ceilings and walls where needed for access to dampers or valves. Coordinate the installation of the access doors with the ceiling contractor. Confirm the location of the panels with the Architect. Provide rated doors where required, refer to archictects plans for rated walls/ceilings.

PART 3 - EXECUTION

3.1 FIRESTOPPING INSTALLATION

A. Verify openings are ready to receive the firestopping. Modify the openings as required to accommodate the requirements for the certified assembly drawing for the firestopping material.

B. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.

C. Remove incompatible materials that could adversely affect bond.

END OF SECTION

SECTION 22 0110.10 - PLUMBING DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

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

B. This section specifies the demolition and removal of all plumbing equipment and distribution conduits including but not limited to piping, controls, insulation, plumbing fixtures and accessories in existing building.

C. Unless otherwise noted in the Documents, all salvage items removed in connection with this Contract are to become the property of the Contractor, however the Owner shall have the first right of refusal on all equipment removed.

1.2 SUBMITTALS:

A. Proposed Dust Control and Noise Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

B. Schedule of selective demolition activities:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of building utility services.
3. Coordination for shutoff, capping and continuation of services.
4. Coordination of Owner's continued occupancy of portions of existing building and of Owner's occupancy of completed work.

C. Pre-demolition photographs or videotape showing existing pre-demolition conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before demolition work begins.

1.3 PROJECT CONDITIONS:

A. Owner will occupy portions of the building immediately adjacent to selective demolition area. Conduct demolition so Owner's operation will not be disturbed. Provide not less than 48 hours notice to Owner of activities that will affect the Owner's operations.

B. Maintain existing services to Owner occupied areas during demolition if possible or coordinate interruption of services prior to demolition.

C. Owner assumes no responsibility for condition of area to be selectively demolished.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

E. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify the Owner. Hazardous materials will be removed by Owner under a separate contract.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify field measurements and piping arrangements are as shown on Drawings.

B. Verify that abandoned equipment serves only abandoned facilities.

C. Demolition drawings are based on causal field observation and existing record documents. The demolition Drawings are diagrammatic and show the general scope of demolition work and do not show all the construction detail of the original record drawings. Report discrepancies to the Project Engineer before disturbing existing installation.

D. The Contractor shall visit the existing building and ground and review the existing building record drawings for details of existing installation to familiarize himself with existing conditions prior to submitting bid. No allowance will be made subsequently, in this connection, on behalf of the contractor for any error or negligence on his part.

E. Beginning of demolition means the Contractor accepts existing conditions.

3.2 PREPARATION:

A. Disconnect utilities in areas scheduled for removal. Notify Project Engineer and Owner of areas to be affected by plumbing demolition work prior to commencing.

3.3 SELECTIVE DEMOLITION AND EXTENSION OF EXISTING PLUMBING WORK:

A. Demolish and remove from site, and extend existing mechanical work under provisions of this Division and as indicated on the Drawings unless otherwise noted.

B. Salvage items noted to remain the property of the Owner shall be delivered to a location to be designated by the Owner. Contractor shall remove from construction areas all trash or debris as it accumulates and dispose of it off site at no additional cost to the Owner. All construction

areas shall be kept clean, safe, and orderly at all times. At the completion and acceptance for work, Contractor shall remove from the site all debris and surplus materials resulting from this work and dispose of them off site at no additional cost to the Owner.

C. Do not use cutting torches until work area is clear of flammable materials. At concealed spaces verify condition and contents of hidden space before starting flame cutting operations. Maintain Fire Watch and portable fire-suppression devices during flame-cutting operations. Maintain and evaluate ventilation during flame-cutting operations.

D. Maintain ventilation for dust control during selective demolition process. Verify Owner requirements for dust control and conform to their standards for all demolition activities.

E. Remove, relocate, and extend existing installations to accommodate new construction as required for proper installation and system operation.

F. Remove all accessories above grade. When removing equipment or devices all associated pipe, wiring, etc. shall be removed and capped as required. Cut piping, tubing, etc. behind walls, above ceilings and below floors, and patch surfaces to match existing conditions. Finishes will be by others unless otherwise noted in documents.

G. Neatly cut openings and holes plumb, square and true to dimension required. Use cutting methods least likely to damage construction to remain or adjoining construction. Cut and drill from exposed surfaces into concealed surfaces to avoid marring or spalling of finished surfaces. Temporarily cover openings to remain.

H. Patch all openings created by removal of plumbing equipment, pipes, etc. unless noted as being patched by others. Openings to be patched to match existing with similar material and finish unless otherwise noted.

I. Seal all existing roof penetrations, which will not be reused. Roof patching shall be the responsibility of the mechanical contractor.

J. Remove, relocate or provide brackets, hangers, and other accessories as required.

K. Repair adjacent construction and finished damaged during demolition and extension work.

L. Maintain access to existing mechanical installations, which remain active.

3.4 CLEANING AND REPAIR:

A. Clean and repair existing materials and equipment, which remain or are to be returned to the Owner.

B. All building surfaces damaged and openings left by new Work or the removal or relocation of plumbing equipment, piping, etc., shall be repaired to original condition and painted by the Contractor.

END OF SECTION

SECTION 22 0553.10 - PLUMBING IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.2 SUBMITTALS

A. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Piping: Pipe markers.

B. Small-sized Equipment: Tags.

C. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.2 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.

2.3 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

B. Chart: Typewritten letter size list framed behind glass and secured to the wall. Either a floor plan of the building indicating location of valve or describe location by room number, etc. Also include description of service and duty of valve, unless obvious from location on the floor plan.

2.4 PIPE MARKERS

A. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Identify valves in main and branch piping with tags.

E. Identify piping, concealed above the ceiling or exposed within equipment rooms and tunnels, with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

3.3 IDENTIFICATION SCHEDULES

A. Chart: Submit valve chart, including valve tag number, location, function, and valve manufacturer's name and model number. Locate valve chart in mechanical room.

B. Plumbing Systems
1. Natural Gas Piping
   a. Pipe Markers
2. System Main Shut-off Valves
   a. Brass Identification Tag
3. Balancing Valves
   a. Brass Identification Tag

END OF SECTION

SECTION 22 0719.10 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

1.2 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

B. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.6 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 GLASS FIBER

A. Insulation: ASTM C547and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 650 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

3.3 SCHEDULES

A. Plumbing Systems:
1. Condensate Drains from Cooling Coils:
   a. Glass Fiber or Flexible Elastomeric
      1) All sizes: 1 inch

END OF SECTION

SECTION 22 1005.10 - PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Gas.
   2. Equipment drains and overflows.
   3. Flanges, unions, and couplings.
   4. Valves.
   5. Flow controls.

1.2 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

B. ASME B31.1 - Power Piping; 2018.

C. ASME B31.9 - Building Services Piping; 2017.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

E. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

F. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

H. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

I. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

J. NSF 61 - Drinking Water System Components - Health Effects; 2020.

K. NSF 372 - Drinking Water System Components - Lead Content; 2016.

1.3 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
1. Provide submittal for recirc valves showing size and temperature selection.

B. Project Record Documents: Record actual locations of valves.

1.4 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B 32 lead-free solder, alloy Sn95 solder.

B. PIPE SIZES SHOWN ON PLANS ARE MINIMUM REQUIRED PIPE SIZES. CONTRACTOR SHALL UPSIZE PIPING TO MATCH DRAIN PAN CONNECTION AS REQUIRED. CONDENSATE PIPING SHALL NOT BE DOWNSIZED FROM DRAIN PAN CONNECTION TO DRAIN.

2.3 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, class 150, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

B. Mechanical Press Sealed Fittings: Double pressed type, CSA certified and ICC listed for fuel gas service, utilizing HNBR sealing elements. The fittings shall have a marking with color to indicate gas service and a CSA label. The fittings shall have a connection feature assuring leakage of gases during testing of any unpressed connection.
   1. Manufacturers:
      a. Viega LLC: www.viega.com.

C. Provide dead end lock-up type gas pressure regulators on each line serving equipment, sized in accordance with equipment.
   1. Pipe regulator vent to the exterior. Regulators with vent limiting device are acceptable in well ventilated spaces.
   2. Regulators shall be sized to match the scheduled connected load at a nominal inlet pressure of 2 PSIG with a 1 pound pressure drop and a nomimal outlet pressure of 7" W.C.

2.4 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 BALL VALVES

A. Manufacturers:
   1. Apollo Valves: www.apollovalves.com/#sle.
   2. Nibco, Inc: www.nibco.com
   3. Viega LLC: www.viega.us
   4. Milwaukee.
   5. Stockham
   6. Jomar

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle solder, threaded or grooved ends with union.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Provide access panels where valves and fittings are not exposed. Coordinate with general contractor.

D. PVC solvent welded joints shall be made using a primer of contrasting color.

E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

F. Install piping to maintain headroom, conserve space, and not interfere with use of space.

G. Group piping whenever practical at common elevations.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

J. Provide handle stand-off extensions on valves to provide a minimum of 3/4" clearance between valve handle and piping insulation.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Install bell and spigot pipe with bell end upstream.

M. Install valves with stems upright or horizontal, not inverted.

N. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood. Where code allows vent limiting devices, they may be used in lieu of venting the regulator to the outdoors.

O. Provide primer and exterior paint of color selected by the Architect on all gas piping and devices outside the building.

P. Install water piping to ASME B31.9.

Q. Gas piping shall be installed and tested in accordance with local codes and NFPA, but in no case less than 25 psig air test for thirty minutes at the completion of the work.

R. All required gas pressure regulators to be installed no more than 5 equivalent feet from equipment connection. Piping from regulator to equipment connection to be equipment connection size. Where regulator cannot be installed within 5 equivalent feet from equipment connection, contact engineer for pipe sizing.

S. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

T. Press connections: copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

U. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

V. Pipe Hangers and Supports:
1. Install in accordance with MSS SP-58 and local code requirements.
2. Hanger spacing and application shall be in accordance with MSS SP-69 and local code requirements.
3. Provide oversized hangers on insulated pipe to allow insulation at full thickness to be provided on the piping.
4. Support horizontal piping as required by code.
5. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
6. Place hangers within 12 inches of each horizontal elbow.
7. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
8. Support vertical piping at every floor and as required by code. Support riser piping independently of connected horizontal piping.
9. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

10. Provide copper plated hangers and supports for copper piping.
11. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
12. Support cast iron drainage piping at every joint.
13. Provide hangers and supports as required by local code and authority having jurisdiction.

3.4 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball valves for throttling, bypass, or manual flow control services.

3.5 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope for pipes. Only where site conditions preclude this slope, pipes 4" and larger may be sloped at 1/8 inch per foot where first approved by the Authority Having Jurisdiction.

END OF SECTION

SECTION 23 0100.10 - HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 APPLICABILIITY

A. The work covered by the Division of the Specifications consists of providing all labor, supervision, equipment, materials, all incidentals, related items and appurtenances, and performing all operations necessary to complete the installation of work in strict accordance with these specifications and drawings.

B. All work shall be finished, tested, and ready for operation. The word “Provide” shall mean “furnish and install complete and ready for use”.

1.2 DRAWINGS:

A. The drawings indicate the extent and general layout of the mechanical systems intended for the building. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, connections, and accessories which may be required. Provide offsets, fittings, valves, and accessories as may be required, to produce a complete and operating installation of type shown and specified.

B. Mechanical drawings are diagrammatic in nature and should not be scaled to obtain dimensions. Obtain dimensions and locations of partitions, walls, etc., from the Architectural dimensioned drawings. Consult the Architectural drawings for details of construction, location of suspended ceilings, ceiling heights, and other pertinent information. Architect's drawings shall not take precedence over field measurements.

C. All drawings and specifications shall be considered in bidding. The drawings and specifications are complimentary, and what is called for in either of these shall be as binding as though called for by both. Should any conflict arise between drawings and specifications, such conflict shall be brought to the attention of the Architect.

1.3 SUBMITTALS

A. All submittals to be reviewed, approved, and stamped by submitting contractor prior to submittal to engineer. Submittals not reviewed by submitting contractor prior to submittal to engineer will be returned marked "Not Reviewed".

1.4 APPROVED MANUFACTURERS

A. Requests for substitution of materials and/or equipment other than those named in the specifications may be made to the Engineer. The request shall be made in duplicate and shall include a request for approval or substitution, pre-addressed, postage pre-paid envelope and information relating to the suitability of the product. No requests by fax. Requests shall be in

the Engineer's office not later than ten (10) days prior to Bid Date. Addenda will publish the approved requests.

B. Where approved manufacturers are indicated in the specifications, the approval does not relieve the responsibility of the contractor to provide products and systems which meet the requirements of the specifications and drawings.

C. Performance, dimensions, electrical requirements, and functions shall be coordinated with the basis of design indicated on the drawings and in the specifications. If there are differences from the basis of design they should be brought to the attention of the Engineer.

D. Revisions required by the differences from basis of design, shall be provided to the Owner without additional cost. Revisions to the work of other contractors on the project, due to differences in equipment, shall be provided by the contractor supplying the equipment at no additional cost to the Owner.

1.5 INSTRUCTION OF OWNER'S EMPLOYEES:

A. Provide, without additional expense to the Owner, the services of competent instructors, who will give full instructions in the care, adjustment, and operation of all parts of the mechanical equipment to the Owner's employees who are to have charge of the equipment.

B. An operating and maintenance manual shall be made available to the Owner's operating personnel during the instruction and left with the Owner upon completion of the instruction.

C. The instruction provided for each system shall be as specified in other sections of this specification. Have the Owner's employees sign a statement that they were present for the training session. Submit a copy of the sign-in sheet with close-out documents.

1.6 INSTALLATION OF EQUIPMENT:

A. All appliances and equipment shall be installed and connected in accordance with manufacturer's instructions and recommendations unless such instructions are in conflict with these specifications.

B. All equipment shall be installed in such a manner and location as to facilitate accessibility for maintenance and/or replacement.

C. As a part of the work of this contract, the Mechanical Contractor shall make any changes in the pulleys, belts, and dampers, and shall install additional dampers required for correct balance as recommended by air balance agency, at no additional cost to the Owner.

D. The use of permanent HVAC system for temporary heating, cooling, ventilating and air conditioning is prohibited.

1.7 COOPERATION WITH OTHER TRADES:

A. Cooperate with other trades so as to avoid interferences. Where required to avoid interferences with other work or to increase the headroom, the Contractor shall off-set the piping and/or re-

route the duct work where directed by the Engineer. Carefully check all construction details to assure the proper installation of all work under this specification. Schedule the work such that it will keep pace with the work of other crafts and cause no delay.

1.8 INSPECTION OF SITE:

A. Before submitting a proposal on the work contemplated in these specifications and accompanying drawings, each bidder shall examine the site and familiarize himself with all of the existing conditions and limitations. No extras will be allowed because of Contractor's misunderstand as to the amount of work involved or lack of his knowledge of any condition in connection with the new construction.

1.9 CODES, ORDINANCES, REGULATIONS, & STANDARDS:

A. The entire installation shall be made in accordance with all state and local laws. If, in any instance, the plans and specifications conflict with such laws, the law shall take precedence. This, however, shall not be construed as relieving the contractor from complying with any requirements of the drawings and specifications that may be in excess of the rules and not contrary to the same.

B. All work shall conform to applicable state and local codes, ordinances, regulations, and/or standards.

1.10 PERMITS, LICENCES, AND FEES

A. The contractor shall secure and pay for all the associated permits, fees, licenses and inspections by government agencies necessary for proper execution and completion of the work that are customarily secured after execution of the contract and legally required at the time bids are received or negotiations concluded.

1.11 CONTRACTOR WARRANTIES

A. Contractor shall guarantee all equipment, materials, and workmanship for a period of one year from the date of final completion. Any defects in equipment, materials or workmanship that appear or cause any issues within the one year period shall be repaired at no additional cost, (this shall include materials and labor). Refer to all other specification sections for additonal guarantees/warranties requirements.

1.12 TRENCHING, BACKFILL AND COMPACTION

A. Provide trenching, backfill and compaction for buried mechanical systems. Refer to Divisions 1 and 31 specifications for requirements.

B. As a minimum requirement, the fill shall be either subsoil excavated on-site or engineered fill. The fill shall be free of lumps larger than 3 inches, rocks larger than 2 inches, frozen or spongy and wet material not capable of compaction in place.

PART 2 - PRODUCTS

2.1 OPERATION & MAINTENANCE MANUALS

A. Contractor to provide Operation and Maintenance manuals to meet all requirements detailed by this section in addition to all requirements defined in Section 01 of this manual.

B. The contractor shall furnish two (2) hard copy Operation and Maintenance Manuals for the mechanical systems.

C. Manuals shall be bound in new 3 ring binders, 2" D-ring, black color, with the title "Operations and Maintenance Manual" and the project title and volume number clearly printed on the front cover and spine of the binders.

D. Manual shall include an index in the front of each manual for the sections included in the manual. Each section shall be referenced with plastic tabs.

E. Include in the front of each manual a complete listing of all mechanical contractors and sub-contractors used on the project. Include names, addresses and phone numbers for each contracted listed.

F. Manuals shall be arranged by specification number. Each piece of equipment shall be referenced by tag number with tabs. At the beginning of each section, the equipment supplier's name, address and phone number shall be provided.

G. Data for equipment included in the manuals:
1. Approved shop drawings clearly showing the models, sizes and capacities of equipment used. All shop drawings inlcuded in the manual shall have all review comments addressed.
2. Operations Manuals detailing step by step procedures for putting equipment into operation.
3. Maintenance Manuals from the manufacturer of each piece of equipment including instructions for installation, maintenance and lubrication. Manuals shall include parts lists for all replacement parts.
4. All equipment warranty information with warranty registration completed in owners name.

H. Include the following reports in the manuals:
1. Testing and balancing reports for air and water systems as specified.
2. Start-up reports.
3. Valve and damper tag lists.

I. Submit one hard copy of the Operation & Maintenance Manuals to the Engineer and the Contracting Officer for approval prior to delivery to the Owner.

2.2 SUB-BASES FOR EQUIPMENT:

A. Sub-bases shall be provided for all equipment such as fans, water heaters, boilers, pumps, air compressors, and refrigeration machines. Each electric motor shall be mounted on the same sub-base as the driven machine.

B. Sub-bases generally consist of pads constructed of 2500 psi concrete with all exposed surfaces finished with cement mortar, troweled smooth. Machines other than those supported on isolation units shall be secured to concrete sub-bases with anchor bolts of ample size. All machines having bed plates and flexible and solidly connected motors shall be grouted under the full area of the bed plates with a non-shrinking, premixed grout. After grout has set, all wedges, shims, and jack bolts shall be removed and spaces filled with grout.

C. Premanufactured rooftop curbs and/or supports for any roof mounted item supplied under this division of the specifications shall be provided by the Mechanical Contractor. Sizes, locations, and installation shall be coordinated with the Roofing Contractor. Where the roof is pitched, the curb shall be designed for the pitch of the roof. Curbs shall be insulated.

2.3 MECHANICAL ANCHORS TO CONCRETE

A. Anchors shall have current ICC-ES report that demonstrates compliance with ACI 355.2 supplemented by ICC-ES AC 193.

2.4 SUPPORTING STEEL, ROOF AND WALL OPENINGS:

A. Provide structural steel framework for supporting mechanical equipment as required.

B. Unless otherwise indicated by the drawings, lintels for new mechanical openings shall be provided by the contractor installing the pipe or duct.

C. Unless otherwise indicated by the drawings, angles to frame a new roof opening through the roof deck shall be provided by the contractor installing the pipe or duct through the roof.

D. All steel work shall be in conformance with the requirement of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings. Material shall conform to ASTM A36.

2.5 SLEAVES, CUTTING, AND CORE DRILLING:

A. Provide sleeves for piping and ductwork openings in masonry walls.

B. The contractor shall saw cut or core drill existing masonry floors and walls for new ductwork and/or piping penetrations. The contractor shall cut new openings through framed walls for ductwork and/or piping penetrations. Provide headers as needed in frame walls.

2.6 FIRESTOPPING

A. Provide firestopping assemblies for the required fire ratings and listed in the current year certification books of UL, FM or ITS (Warnock Hersey).

B. See the Architectural drawings for required ratings. Refer to the Mechanical drawings for additional ratings. Provide firestopping for all penetrations of these assemblies.

2.7 SEALING PENETRATIONS IN NON-RATED WALLS AND FLOORS

A. Provide caulk at penetrations of non-rated walls and floors for ductwork and piping. If the gap is too large for caulk, provide fiberglass insulation for backing. Conceal the fiberglass with either caulk or sheetmetal. Refer to specifications for sleeve requirements.

B. In mechanical rooms and other water-proof floor areas, provide sleeves or concrete pads at least 2" higher than the top of slab to prevent water from running through the annual space between the duct or pipe and the floor opening. In addition to the sleeve, provide packing and caulking around the duct or pipe inside the sleeve to prevent noise transmission through openings in the floor.

2.8 ACCESS DOORS IN CEILINGS AND WALLS

A. Provide metal lockable access doors in gypsum board ceilings and walls where needed for access to dampers or valves. Coordinate the installation of the access doors with the ceiling contractor. Confirm the location of the panels with the Architect. Provide rated doors where required, refer to architects plans for rated walls/ceilings.

PART 3 - EXECUTION

3.1 FIRESTOPPING INSTALLATION

A. Verify openings are ready to receive the firestopping. Modify the openings as required to accommodate the requirements for the certified assembly drawing for the firestopping material.

B. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.

C. Remove incompatible materials that could adversely affect bond.

3.2 TRENCHING, BACKFILL AND COMPACTION

A. Refer to Divisions 1 and 31 specifications for requirements.

B. Compact to minimum of 95 percent of maximum dry density. Cut out soft areas and backfill. Do not fill with frozen materials. Place and compact in layers not exceeding 8 inches compacted depth. Correct areas that are over-excavated. Maintain moisture content of fill materials to obtain compaction density.

END OF SECTION

SECTION 23 0110.10 - HVAC DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

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

B. This section specifies the demolition and removal of all HVAC, equipment and distribution conduits including but not limited to ductwork, air outlets, piping, controls, insulation and accessories in existing building.

C. Unless otherwise noted in the Documents, all salvage items removed in connection with this Contract are to become the property of the Contractor, however the Owner shall have the first right of refusal on all equipment removed.

1.2 SUBMITTALS:

A. Proposed Dust Control and Noise Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

B. Schedule of selective demolition activities:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of building utility services.
3. Coordination for shutoff, capping and continuation of services.
4. Coordination of Owner's continued occupancy of portions of existing building and of Owner's occupancy of completed work.

C. Pre-demolition photographs or videotape showing existing pre-demolition conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before demolition work begins.

1.3 PROJECT CONDITIONS:

A. Owner will occupy portions of the building immediately adjacent to selective demolition area. Conduct demolition so Owner's operation will not be disturbed. Provide not less than 48 hours notice to Owner of activities that will affect the Owner's operations.

B. Maintain existing services to Owner occupied areas during demolition if possible or coordinate interruption of services prior to demolition.

C. Owner assumes no responsibility for condition of area to be selectively demolished.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

E. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify the Owner. Hazardous materials will be removed by Owner under a separate contract.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify field measurements and existing ductwork arrangements are as shown on Drawings.

B. Verify that abandoned equipment serves only abandoned facilities.

C. Demolition drawings are based on causal field observation and existing record documents. The demolition Drawings are diagrammatic and show the general scope of demolition work and do not show all the construction detail of the original record drawings. Report discrepancies to the Project Engineer before disturbing existing installation.

D. The Contractor shall visit the existing building and ground and review the existing building record drawings for details of existing installation to familiarize himself with existing conditions prior to submitting bid. No allowance will be made subsequently, in this connection, on behalf of the contractor for any error or negligence on his part.

E. Beginning of demolition means the Contractor accepts existing conditions.

3.2 PREPARATION:

A. Disconnect HVAC systems in areas scheduled for removal. Notify Project Engineer and Owner of areas to be affected by hvac demolition work prior to commencing.

B. Disconnect automatic temperature controls in areas scheduled for removal. Notify Project Engineer and Owner of area to be affected by control demolition work prior to commencing.

3.3 SELECTIVE DEMOLITION AND EXTENSION OF EXISTING HVAC WORK:

A. Demolish and remove from site, and extend existing hvac work under provisions of this Division and as indicated on the Drawings unless otherwise noted.

B. Salvage items noted to remain the property of the Owner shall be delivered to a location to be designated by the Owner. Contractor shall remove from construction areas all trash or debris as it accumulates and dispose of it off site at no additional cost to the Owner. All construction areas shall be kept clean, safe, and orderly at all times. At the completion and acceptance for work, Contractor shall remove from the site all debris and surplus materials resulting from this work and dispose of them off site at no additional cost to the Owner.

C. Do not use cutting torches until work area is clear of flammable materials. At concealed spaces verify condition and contents of hidden space before starting flame cutting operations. Maintain Fire Watch and portable fire-suppression devices during flame-cutting operations. Maintain and evaluate ventilation during flame-cutting operations.

D. Maintain ventilation for dust control during selective demolition process. Verify Owner requirements for dust control and conform to their standards for all demolition activities.

E. Remove, relocate, and extend existing installations to accommodate new construction as required for proper installation and system operation.

F. Remove all accessories above grade. When removing hvac equipment or terminal devices all associated pipe, duct, ATC devices, wiring, etc. shall be removed and capped as required. Cut piping, duct, tubing, etc. behind walls, above ceilings and below floors, and patch surfaces to match existing conditions. Finishes will be by others unless otherwise noted in documents.

G. Neatly cut openings and holes plumb, square and true to dimension required. Use cutting methods least likely to damage construction to remain or adjoining construction. Cut and drill from exposed surfaces into concealed surfaces to avoid marring or spalling of finished surfaces. Temporarily cover openings to remain.

H. Patch all openings created by removal of hvac equipment, ATC devices, duct, pipes, etc. unless noted as being patched by others. Openings to be patched to match existing with similar material and finish unless otherwise noted.

I. Seal all existing roof penetrations, which will not be reused. Roof patching shall be the responsibility of the mechanical contractor.

J. Remove, relocate or provide brackets, hangers, and other accessories as required.

K. Repair adjacent construction and finished damaged during demolition and extension work.

L. Maintain access to existing mechanical installations, which remain active.

3.4 CLEANING AND REPAIR:

A. Clean and repair existing materials and equipment, which remain or are to be returned to the Owner.

B. All building surfaces damaged and openings left by new Work or the removal or relocation of hvac equipment, piping, etc., shall be repaired to original condition and painted by the Contractor.

END OF SECTION

SECTION 23 0500.20
BASIC HVAC REQUIREMENTS
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification sections throughout the project manual.

3.02 DEFINITIONS

A Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene monomer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

G Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

1. Any item listed as furnished shall also be installed, unless otherwise noted.
2. Any item listed as installed shall also be furnished, unless otherwise noted.

3.03 QUALITY ASSURANCE

A Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

D Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. It is the sole responsiblity of the contractor to obtain and procure permits. The Engineer is not lialble for any costs associated with the cost of permits or delays associated with permitting or obtaining permits under this division. The engineer at times may submit the permit in advance to help with project timeline. However, this fact does not relieve the installing contractor(s) from tracking and ensuring permitting proccess is being completed.
4. Pay all charges for permits or licenses.
5. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
6. Pay all charges arising out of required inspections by an authorized body.
7. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
8. It is the sole responsiblity of the contractor to obtain and procure permits. The Engineer is not liable for any costs associated with delays associated with permitting or obtaining permits under this division.
9. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter’s Laboratories, Inc.

E Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. Make application for and pay for service connections, such as gas.
4. Make application for and pay for all meters and metering systems required by the utility company.

F Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets,

etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
    a. Any item listed as furnished shall also be installed, unless otherwise noted.
    b. Any item listed as installed shall also be furnished, unless otherwise noted.

G Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit or Cadd platforms
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by Engineer.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by Engineer for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by Engineer as to the accuracy or correctness of the information provided. Engineer accepts no responsibility or liability for the Contractor’s use of these documents.
9. Electrical Characteristics for Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

3.04 SUBMITTALS

A Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

B General Submittal Procedures: The following are required:

1. Transmittal: Each transmittal shall include the following:
   a. Date
   b. Project title and number
   c. Contractor's name and address
   d. Division of work (e.g., plumbing, heating, ventilating, etc.)
   e. Description of items submitted and relevant specification number
   f. Notations of deviations from the contract documents
   g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors' names and addresses
   e. Supplier and manufacturer's names and addresses
   f. Division of work (e.g., plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor's review stamps
3. Composition:
   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
   c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
   b. Unstamped submittals will be rejected.

c. The Contractor's review shall include, but not be limited to, verification of the following:
    1) Only approved manufacturers are used.
    2) Addenda items have been incorporated.
    3) Catalog numbers and options match those specified.
    4) Performance data matches that specified.
    5) Electrical characteristics and loads match those specified.
    6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    7) Dimensions and service clearances are suitable for the intended location.
    8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
    9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.

6. Submittal Identification and Markings:
    a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
    b. The Contractor shall clearly indicate the size, finish, material, etc.
    c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
    d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    a. Submittal file name: 2024-105SD 23 XX XX description.pdf
5. File Size: Electronic file size shall be limited to a maximum of 10MB. Larger files shall be transmitted via a pre-approved method.

3.05 CHANGE ORDERS

A A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

B Change order work shall not proceed until authorized.

3.06 EQUIPMENT SUPPLIERS' INSPECTION

A The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Base Mounted Pumps
2. Boilers, Burners and Boiler Trim
3. Water Chillers, Fluid Coolers, Central Heat Pumps

B Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C Submit copies of start-up reports to the Architect/Engineer and include copies of Owner’s Operation and Maintenance Manuals.

3.07 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B Coordinate the installation of heavy and large equipment with the Construction Manager or General Contractor. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

C Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

3.08 WARRANTY

A Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship from date of substantial completion.

B Provide 24 month warranty, unless otherwise noted, to the owner for all pumps, boilers, controllers, chillers, condensing units to ensure units have gone through entire cycle of seasons.

C The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

D Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

3.09 INSURANCE

A Contractor shall maintain insurance coverage of a minimum of 5 Million.

3.10 MATERIAL SUBSTITUTION

A Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality required.

B Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fits in the allocated space.

C Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.

D This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.

E This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.

F All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 PRODUCTS

4.01 NOT APPLICABLE

PART 3 EXECUTION

5.01 JOBSITE SAFETY

A Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

5.02 PROJECT CLOSEOUT

A The following paragraphs supplement the requirements of Division 1.

B Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including marked-up or reproducible drawings and specifications.
3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
4. Inspection by State Boiler Inspector.
5. Start-up reports on all equipment requiring a factory installation inspection or start- up.
6. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

5.03 OPERATION AND MAINTENANCE MANUALS

A General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
   a. O&M file name: O&M.div23.contractor.YYYYMMDD

5. File Size: Electronic file size shall be limited to a maximum of 10MB. Larger files shall be divided into files that are clearly labeled as “1 of 2”, “2 of 2”, etc.
6. Provide the Owner with an approved copy of the O&M manual in digital format which is tabbed and bookmarked accordingly.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect’s/Engineer’s shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

5.04 RECORD DOCUMENTS

A The following paragraph supplements Division 1 requirements:

1. Contractor shall maintain at the job site a separate and complete set of mechanical drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the mechanical systems.

B Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other

1. units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance

located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C Refer to Section 23 09 00 for additional requirements for Temperature Control documents.

D Before completion of the project, a set of reproducible mechanical drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.

E Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

F Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

G Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

5.05 ADJUST AND CLEAN

A Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C Remove all rubbish, debris, etc., accumulated during construction from the premises.

5.06 SPECIAL REQUIREMENTS

A Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.

B All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner’s designated representative prior to setting equipment.

C Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner’s designated representative will result in removal and reinstallation of the equipment at the Contractor’s expense.

END OF SECTION 23 0500.20

SECTION 23 0514.10 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable frequency controllers.

1.2 REFERENCES

A. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems; National Electrical Manufacturers Association; 2006.

B. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives; National Electrical Manufacturers Association; 2006.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2003.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.

1.3 SUBMITTALS

A. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.

C. Test Reports: Indicate field test and inspection procedures and test results.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Manufacturer's Field Reports: Indicate start-up inspection findings.

F. Operation Data: NEMA ICS 7.1. Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions. The AC Drive manufacturer shall supply a comprehensive 8-1/2 x 11-inch bound instruction/installation manual that includes wiring diagrams, layout diagrams, and outline dimensions. This manual must be 3-hole punched for insertion in a shop manual supplied by the installing contractor.

G. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.

1.4 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.6 MAINTENANCE SERVICE

A. Provide service and maintenance of controller for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Square D; Model Altivar S-Flex 21: www.squared.com.

B. Allen Bradley; Model Power Flex 40.

C. ABB; Model ACH580

D. Danfoss; Model VLT

E. Taco SmartDrive (As manufactured by Danfoss, Model VLT)

F. Yaskawa; Model HV600

2.2 DESCRIPTION

A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
   1. Employ microprocessor-based inverter logic isolated from power circuits.
   2. Employ pulse-width-modulated inverter system.
   3. Design for ability to operate controller with motor disconnected from output.
   4. AC Drive shall be sized to operate a variable torque load.
   5. The speed range shall be from a minimum speed of 1.0 Hz to a maximum speed of 60 Hz.

6. The AC Drive shall be protected against short circuits, between output phases and to ground.
7. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function will provide up to 6 programmable restart attempts. The time delay before restart attempts will be 30 seconds.
8. The AC Drive shall have a solid-state UL 508 C listed overload protective device and meet IEC 60947.

B. Enclosures: NEMA 250, Type 1, suitable for equipment application in places regularly open to the public. The enclosure shall provide a fully coordinated 22 kAIC rating marked on the enclosure nameplate. Short circuit coordination to UL 508C Power Conversion Equipment and NEMA ICS 7.1.

C. Finish: Manufacturer's standard enamel.

2.3 OPERATING REQUIREMENTS

A. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

B. Operating Ambient: 0 degrees C to 40 degrees C.

C. Minimum Efficiency at Full Load: 97 percent.

D. Current Limit Adjustment: 110 percent of rated.

E. Acceleration Rate Adjustment: 0.1 to 999 seconds.

F. Deceleration Rate Adjustment: 0.1 to 999 seconds.

G. Input Signal: 4 to 20 mA DC or 0 to 10 volts, 2 inputs.

H. Output: 1 analog 4 to 20 mA or 0 to 10 volt, selectable.

I. 0.96 displacement power factor minimum.

J. Class 10 overload protection.

K. Adjustable switching frequency from 6 to 16 kHz.

L. Provide 3 percent line reactor for harmonic mitigation.

2.4 COMPONENTS

A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current. Indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON. Provide programming buttons, LOCAL/REMOTE button, stop button, run button with run status indicator.

B. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control.

C. Control Power Source: Separate circuit.

D. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.

E. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode. The combination enclosure shall include terminal point connection for fire /freeze state interlock, to prevent drive operation.

F. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.

G. Disconnecting Means: Include integral fused disconnect switch or circuit breaker on the line side of each controller. Provide mechanism to padlock in the OFF position.
1. Provide 3 spare fuses for fused disconnect switch per drive.

H. Wiring Terminations: Match conductor materials and sizes indicated.

2.5 SOURCE QUALITY CONTROL

A. Shop inspect and perform standard productions tests for each controller.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surface is suitable for controller installation.

B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.2 INSTALLATION

A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Provide fuses in fusible switches; refer to Section 26 2813.10 for product requirements.

D. Provide shaft grounding kits on all motors with variable frequency drives installed on them.

E. Provide engraved plastic nameplates.

F. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place in clear plastic holder.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide the service of the manufacturer's field representative to prepare and start controllers.

B. The AC Drive manufacturer shall provide a factory certified technical representative to inspect the contractor's installation, test and start-up the AC Drive(s) furnished under this specification. The start-up service shall be quoted as a separate line item.

3.4 ADJUSTING

A. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

3.5 DEMONSTRATION

A. Demonstrate operation of controllers in automatic and manual modes.

B. Provide on-site training course of 2 hours shall be provided by a representative of the AC Drive manufacturer to plant and/or maintenance personnel.

END OF SECTION

SECTION 23 0519.10 - METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Static pressure gauges.

1.2 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.

B. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

B. Project Record Documents: Record actual locations of components and instrumentation.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi.

2.2 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

2.3 SOLAR POWERED DIGITAL THERMOMETERS

A. Omega SPT10 or equivalent.

B. Case: Hi-impact ABS

C. Range: -40 to150°C (-40 to 300°F)

D. Display: 9.5 mm (3?8") High LCD digits

E. Case: Hi-impact ABS

F. Range: -40 to150°C (-40 to 300°F)

G. Display: 9.5 mm (3/8") High LCD digits

H. Accuracy: 1% of reading or 1°, whichever is greater

I. Autorange Resolution:
1. 1°: -40 to 27°C (-40 to 19°F)
2. 0.1°: -28.0 to 93.0°C (-19.9 to 199.9°F)
3. 1°: 94 to 150°C (200 to 300°F)

J. Recalibration: Internal potentiometer

K. Lux Rating: 10 Lux (1' candle)

L. Display Update: 10 seconds

M. Ambient Operating: -30 to 140°F

N. Ambient Temp Error: Zero

O. Humidity: 95% RH non-condensing

P. Sensor: Glass passivated thermistor

Q. Stem interchangeable with industrial glass thermometers.

2.4 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

2.5 STATIC PRESSURE GAUGES

A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

D. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 23 0943.10. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

E. Provide instruments with scale ranges selected according to service with largest appropriate scale.

F. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

G. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

H. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION

SECTION 23 0519.20
METERS AND GAUGES FOR HVAC PIPING
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A Pressure gauges and pressure gauge taps.

B Thermometers and thermometer wells.

3.02 RELATED REQUIREMENTS

3.03 REFERENCE STANDARDS

A ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.

B ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).

C ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).

D UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

3.04 SUBMITTALS

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

B Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

3.05 FIELD CONDITIONS

A Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

4.01 PRESSURE GAUGES

A Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Stainless Steel casing with brass or stainless burbon tube sensor.
2. Size: 3-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi.
5. Liquid Filled: Glycerine

4.02 PRESSURE GAUGE TAPPINGS

A Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

B 1/4" Copper tubing with isolation ball valves from suction and discharge of pumps.

4.03 STEM TYPE THERMOMETERS

A Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.

4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.

4.04 DIAL THERMOMETERS

A Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.

1. Size: 3 inch diameter dial.
2. Lens: Clear glass.
3. Accuracy: 1 percent.

PART 3 EXECUTION

5.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Provide one pressure gauge per pump, installing taps on suction and discharge of pump. Pipe to gauge with valves.

C Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

D Install thermometers in air duct systems on flanges.

E Provide instruments with scale ranges selected according to service with largest appropriate scale.

F Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

G Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

SECTION 23 0553.10 - HVAC IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Adhesive Film Labels.

C. Tags.

D. Pipe markers.

1.2 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

1.3 SUBMITTALS

A. Chart and Schedule: Submit a valve chart and schedule, including valve tag number, location and function.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Identification of Equipment Outside the Building:
1. **All equipment provided by Division 23 outside the building shall be identified with laminated engraved plastic nameplates. Printed labels will not be accepted. Equipment outside the building may be on the roof, mounted on the exterior wall, set on grade, or other locations exposed to weather. Common equipment outside the building may include, but is not limited to, the following: exhaust fans, packaged rooftop units, make-up air units, condensing units, air cooled chillers, cooling towers, drycoolers, dust collectors, and pumps.**

B. Identification Inside the Building:
1. Air Handling Units, Energy Recovery Units, Heat Pumps, Furnaces, Fan Coil Units, Exhaust Fans and similar fan systems: Adhesive film labels..
2. Automatic Controls: Tags or Adhesive film labels. Key to control schematic.
3. Control Panels: Adhesive film labels.
4. Dampers: Tags or adhesive film labels on the actuator.
5. Boilers: Adhesive film labels.
6. Piping: Pipe markers.
7. Pumps: Adhesive film labels..

8. Small-sized Equipment: Tags.
9. Thermostats: Adhesive film labels behind the cover.
10. Valves: Tags . Key to the plans and the valve schedule.
11. Balancing Valves: Tags indicating design gpm and pressure drop. Key to the equipment served.

2.2 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
1. Letter Color: White.
2. Letter Height: 1/2 inch.
3. Background Color: Black.

2.3 ADHESIVE FILM LABELS

A. Description: Machine printed, black letters, by thermal transfer or equivalent process on a white background. Minimum letter height shall be 1/2 inch. The laminated label shall provide a durable surface resistant to water, glycol, heat and cold.

2.4 TAGS

A. Metal Tags: Aluminum or brass with stamped letters or with an adhesive film label; tag size minimum 1-1/2 inch diameter with smooth edges.

B. Chart: Typewritten letter size list in anodized aluminum frame. Either a floor plan of the building indicating location of valve or describe location by room number, etc. Also include description of service and duty of valve, unless obvious from location on the floor plan.

2.5 PIPE MARKERS

A. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install identification labels at locations for the most convenient viewing without interference with operation and maintenance of equipment.

C. Install tags with corrosion resistant chain.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Tag automatic controls, instruments, and relays. Key to control schematic.

G. Identify piping concealed above accessible ceilings with plastic pipe markers. Piping in equipment rooms, garages, tunnels and similar un-finished type spaces shall be identified with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with the axis of piping. Location of identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 23 0593.10 - TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic and plumbing recirculating hot water systems.

1.2 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. AABC MN-1 - AABC National Standards for Total System Balance; 2002.

C. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems; 2019, with Errata (2022).

D. SMACNA - HVAC Air Duct Leakage Test Manual, current edition.

1.3 SUBMITTALS

A. Duct Leakage Testing Reporting: Provide written report when test is successful for each section of tested.

B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
   2. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   3. Form of Test Reports: Reports in accordance with one of the referenced standards.
   4. Units of Measure: Report data in I-P (inch-pound) units only.

PART 2 EXECUTION

2.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.
   2. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
   3. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute.
   4. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Certified by one of the following:
   a. AABC, Associated Air Balance Council: upon completion submit AABC National Performance Guaranty.
   b. NEBB, National Environmental Balancing Bureau.
   c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

2.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.
16. Suitable access to balancing valves and equipment is provided.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

2.3 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

2.4 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

2.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct. A pitot tube traverse shall be required at each supply, return, exhaust, outside air, and relief air fan unless otherwise noted.

C. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

D. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

H. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

I. Test air handling system in economizer mode. Verify proper operation and adjust, if necessary.

2.6 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Effect system balance with automatic control valves fully open to heat transfer elements.

D. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

E. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

F. For variable volume hydronic systems, report the minimum required pipe pressure at the pressure transducer location(s) in order to provide design supply water flows. Transmit in writing the required minimum pressure to the temperature controls subcontractor for programming the variable speed drive.

2.7 SCOPE

A. Test, adjust, and balance all mechanical and plumbing equipment indicated on the drawings and specifications. Submit reports on NEBB or AABC forms.

END OF SECTION

SECTION 23 0593.20
TESTING, ADJUSTING, AND BALANCING FOR HVAC
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

3.02 RELATED REQUIREMENTS

A Section 01 2100 - Allowances: Inspection and testing allowances.

3.03 PRICE AND PAYMENT PROCEDURES

A Cash Allowance: See Section 01 2100 for additional requirements.

B Allowance includes testing, adjusting, and balancing of mechanical systems.

3.04 REFERENCE STANDARDS

A ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).

3.05 SUBMITTALS

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

B TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Include at least the following in the plan:
    a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    d. Final test report forms to be used.
    e. Procedures for formal deficiency reports, including scope, frequency and distribution.

C Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

5.01 GENERAL REQUIREMENTS

A Perform total system balance in accordance with one of the following:

B Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

2. Having minimum of three years documented experience.
3. Certified by one of the following:

D TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

E Pre-Qualified TAB Agencies:

1. Design Control.
2. Balancing Professionals.
3. MNDak Testing and Balancing

5.02 EXAMINATION

A Verify that systems are complete and operable before commencing work. Installing Contractor shall ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

5.03 PREPARATION

A Hold a pre-balancing meeting at least one week prior to starting TAB work.

B Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.

5.04 ADJUSTMENT TOLERANCES

A Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C Hydronic Systems: Adjust to within plus or minus 10 percent of design.

5.05 RECORDING AND ADJUSTING

A Field Logs: Maintain written logs including:

1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B Ensure recorded data represents actual measured or observed conditions.

C Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

5.06 WATER SYSTEM PROCEDURE

A Adjust water systems to provide required or design quantities.

B Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D Effect system balance with automatic control valves fully open to heat transfer elements.

E Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

5.07 SCOPE

A Test, adjust, and balance the following:

1. HVAC Pumps.
2. Water Tube Boilers.

5.08 MINIMUM DATA TO BE REPORTED

A Duct Traverses:

1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

SECTION 23 0713.10 - DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

1.2 REFERENCE STANDARDS

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

C. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum ten years of experience and approved by manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible blanket.
1. 'K' value: maximum 0.31 at 75 degrees F, when tested in accordance with ASTM C 518. Lower 'K' values may be required in some cases to meet the required R-value in the schedule.
2. Maximum Water Vapor Absorption: 5.0 percent by weight.

B. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

C. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Duct Application:
1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

3.3 SCHEDULES

A. R-values listed in the schedule are minimum values. The requirement is for installed R-value assuming 25% compression of the insulation. PCF is an abbreviation for pounds per cubic foot.

B. Combustion Air Duct:
   1. Flexible Glass Fiber: 2 inches thick, 1.50 pcf

C. Exhaust Ducts Within 10 ft of Exterior Openings:
   1. Flexible Glass Fiber: 2 inches thick, 1.50 pcf

D. Outside Air Intake, Relief Ducts & Outside/Return Mixed Air Ducts:
   1. Flexible Glass Fiber: 2 inches thick, 1.50 pcf

E. Air-Conditoned Supply Ducts routed exposed through non-air conditioned spaces.
   1. Flexible Glass Fiber: 2 inches thick, 0.75 pcf (R-5)

F. Ducts in Mechanical Rooms:
   1. Supply Ducts
      a. Rigid Glass Fiber: 2 inches thick, 3 pcf (R-8)
   2. Outside Air, Mixed Air, Combustion Air and Relief Air Ducts
      a. Rigid Glass Fiber: 2 inches thick, 3 pcf (R-8)

G. ALL Ductwork located in Attic Space:
   1. Flexible Glass Fiber: R-12 total

END OF SECTION

SECTION 23 0716.10 - HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Equipment insulation.

1.2 REFERENCE STANDARDS

A. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Factory Insulated Equipment: Do not insulate.

C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Insulated equipment containing fluids below ambient temperature; insulate entire system.

G. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

H. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

I. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

J. Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

K. Inserts and Shields:
1. Application: Equipment 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between hangers and inserts.
3. Insert Location: Between support shield and equipment and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoin
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

L. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

3.3 SCHEDULE

A. Heat Pump Systems;
1. Pump Bodies: 1" Flexible Elastomeric

END OF SECTION

SECTION 23 0719.10 - HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

1.2 REFERENCE STANDARDS

A. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

B. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017.

C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020.

D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

E. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2017, with Editorial Revision (2018).

F. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.

G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.5 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 GLASS FIBER

A. Insulation: ASTM C547and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. Maximum Service Temperature: 650 degrees F.
   2. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

3.3 SCHEDULE

A. Heating Systems:
1. Heating Supply and Return (Glycol and Non-Glycol):
   a. Glass Fiber
      1) 1-1/4" and less: 1 1/2 inch
      2) 1-1/2" and larger: 2 inch

B. Cooling Systems:
1. Chilled Water:
   a. Glass Fiber
      1) 4" and less: 1 1/2 inch
      2) 5" and larger: 2 inch
2. Geothermal Heat Pump Piping:
   a. Glass Fiber

1) 4" and less: 1 1/2 inch
2) 5" and larger: 2 inch

END OF SECTION

SECTION 23 0719.20
HVAC PIPING INSULATION
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A Piping insulation.

B Jacketing and accessories.

3.02 RELATED REQUIREMENTS

3.03 REFERENCE STANDARDS

A ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

B ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).

C ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.

D ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

E ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

G UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

3.04 SUBMITTALS

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

B Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

3.05 QUALITY ASSURANCE

A Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 5 years of experience.

3.06 DELIVERY, STORAGE, AND HANDLING

A Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

3.07 FIELD CONDITIONS

A Maintain ambient conditions required by manufacturers of each product.

B Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

4.01 REGULATORY REQUIREMENTS

A Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

4.02 GLASS FIBER, RIGID

A Manufacturers:

1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Johns Manville Corporation: www.jm.com/#sle.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com/#sle.
5. Owens Corning Corporation; VaporWick Pipe Insulation: www.ocbuildingspec.com/#sle.

B Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
1. K Value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

D Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

E Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F Vapor Barrier Lap Adhesive: Compatible with insulation.

G Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

4.03 JACKETING AND ACCESSORIES

A PVC Plastic.
1. Manufacturers:
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil, 0.010 inch.
e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

5.01 EXAMINATION

A Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B Verify that surfaces are clean and dry, with foreign material removed.

5.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install in accordance with NAIMA National Insulation Standards.

C Exposed Piping: Locate insulation and cover seams in least visible locations.

D Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

5.03 SCHEDULE

A Heating Systems:

1. Heating Water Supply and Return (Hot water and Glycol Systems)
   a. 140 Degrees F and below < 1.5" diamter shall be 1" Thick. 2" Diameter and greater shall be 1.5"
   b. 141-200 degrees F < 1.5" diameter shall be 1" Thick. 2" Diameter and greater shall be 2"
   c. Comply also with Table C403.12.3 of IECC 2021

B Other Systems:

1. Piping Exposed to Freezing with Heat Tracing: 1 1/2" Thick

C If there is a conflict between IECC 2021 Table C403.12.3 Minimum pipe insulation thickness and this specification. Use the thicker insulation value.

END OF SECTION 23 0719.20

SECTION 23 0913.10 - INSTRUMENTATION AND CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control panels.

B. Control Valves:
   1. Globe pattern.
   2. Electronic operators.

C. Damper Operators:

D. Input/Output Sensors:
   1. Temperature sensors.

E. Thermostats:
   1. Electric room thermostats.

F. Emergency Shutdown Switches

1.2 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

C. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; 2013.

1.3 SUBMITTALS

A. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

B. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

1.4 QUALITY ASSURANCE

A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience approved by manufacturer.

PART 2 PRODUCTS

2.1 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.2 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

B. NEMA 250, general purpose utility enclosures with enameled finished face panel.

C. Provide common keying for all panels.

2.3 CONTROL VALVES

A. Globe Pattern:
1. Hydronic Systems:
   a. Rate for service pressure of 125 psig at 250 degrees F.
   b. Size for 3 psig maximum pressure drop at design flow rate.

B. Electronic Operators:
1. Select operator for full shut off at maximum pump differential pressure.

2.4 CONTROL DAMPERS (EXCEPT OUTSIDE AIR AND RELIEF AIR DAMPERS)

A. Performance: Test in accordance with AMCA 500-D.

B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage, 0.1046 inch.

C. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage, 0.0299 inch, attached to minimum 1/2 inch shafts with set screws.

D. Blade Seals: Synthetic elastomeric, inflatable, mechanically attached, field replaceable.

E. Jamb Seals: Spring stainless steel.

2.5 OUTSIDE AIR AND RELIEF AIR CONTROL DAMPERS

A. Approved Manufacturers:
1. Greenheck
2. Ruskin
3. Tamco
4. Nailor

B. Dampers larger than 10"x10" or 10"Ø shall meet the following requirements:
1. Basis of design: Greenheck ICD-45.
2. Construction:
   a. Rectangular dampers shall consist of: .125 (3.2mm) aluminum channel frame insulated with polystyrene on four sides and thermally broken with dual polyurethane resin gaps; aluminum airfoil blade internally insulated polyurethane foam and thermally broken. Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow in either direction or pressure on either side of the damper. Axle will be 1/2 in. (13mm) diameter plated steel; bearings are dual bearing with acetal inner sleeve, flanged outer bearing resulting in no metal-to-metal or metal-to-plastic contact.
   b. Blade and jamb seals to be silicone rubber and external (out of the airstream) blade-to-blade linkage.
3. Ratings:
   a. Dampers manufacturer's printed application and performance data including pressure, velocity, leakage, and temperature limitations shall be submitted for approval showing damper suitable for pressures to 8 in. wg (1993 Pa), velocities to 4000 fpm (20.3 m/s), standard air leakage less than 8 cfm/sq. ft. @ 4 in. wg and temperatures to 200 °F
   b. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D.

2.6 DAMPER OPERATORS

A. Direct Coupled Electronic Operators:
1. Spring return control damper actuators shall be direct coupled type which require no crankarm and linkage and be capable of direct mounting. The actuator must provide proportional damper control in response to a 2 to 10 VDC or a 4 to 20 mA control input from an electronic controller or positioner.
2. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation.
3. Actuators shall have control direction of rotation switch accessible on its cover. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback or master-slave applications.
4. Actuators shall be UL listed and CSA certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards.
5. Verify damper operator requirements, including but not limited to voltage, with controls contractor prior to purchase of dampers.

2.7 INPUT/OUTPUT SENSORS

A. Temperature Sensors:
1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.

2.8 THERMOSTATS

A. Electric Room Thermostats:
1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
2. Service: Cooling and heating.

2.9 EMERGENCY SHUTDOWN SWITCHES

A. ADA compliant emergency power off push button switch station. Provide with red push switch. Rated for indoor/outdoor use as required. Designed for single gang box installation.
1. Provide switch/switches for boilers at boiler rooms doors. Coordinate exact switch locations and quantity with local boiler inspector.
2. Provide at any other locations called out on plans.

B. Label for use and provide with clear (lift to open) cover.

C. Provide all associated wiring and controls as required for a complete system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Ensure installation of components is complementary to installation of similar components.

G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches above floor.

C. Provide mixing dampers of opposed blade construction arranged to mix streams.

D. Provide isolation (two position) dampers of parallel blade construction.

E. Provide all power, transformers, relays, control wiring, conduit and all other electrical components as required to control the mechanical equipment. Provide all wiring in conduit.

3.3 SCHEDULES

A. Control Valve Schedule (Normal Position)
1. Heat Pumps - Normally Closed.
2. Unit Heaters - Normally Open.
3. Hot Water Coils - Normally Open.
4. Chilled Water Coils - Normally Closed.

END OF SECTION

SECTION 23 0923.10 - DIRECT-DIGITAL CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. System description.

B. Operator interface.

C. Power supplies and line filtering.

D. System software.

E. Controller software.

1.2 SUBMITTALS

A. Product Data: Provide data for each system component and software module.

B. Shop Drawings:
1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
2. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
3. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
4. Indicate description and sequence of operation of operating, user, and application software.

C. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.

D. Designer's Qualification Statement.

E. Installer's Qualification Statement.

F. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

G. Operation and Maintenance Data:
1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

H. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.3 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70.

B. Designer Qualifications: Perform design of system using manufacturer's software under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.

D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum five years of documented experience and approved by manufacturer.

E. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.4 WARRANTY

A. Provide five year manufacturer's warranty for field programmable micro-processor based units.

1.5 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
1. Limiting use of software to equipment provided under these specifications.
2. Limiting copying.
3. Preserving confidentiality.
4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Siemens Industry, Inc. Building Technologies: Apogee as installed by G&R Controls.

2.2 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

E. DDC contractor to coordinate all building controls power requirements with electrical contractor. All costs associated with building controls power requirements to be by DDC contractor.

F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.3 OPERATOR INTERFACE

A. PC Based Work Station:
1. Connected to server for full access to all system information.

B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.

2.4 CONTROLLERS

A. Building Controllers:
1. General:
   a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
   b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
   c. Share data between networked controllers.
   d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
   e. Utilize real-time clock for scheduling.
   f. Continuously check processor status and memory circuits for abnormal operation.
   g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
   h. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
   b. Perform routing when connected to a network of custom application and application specific controllers.

c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:
   a. Conditioned Space:
      1) Mount within dustproof enclosures.
      2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. Input/Output Interface:
1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
   a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
   b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
   a. Allow monitoring of On/Off signals from remote devices.
   b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
   c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
   a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
   b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
   a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
   b. Outputs provided with three position (On/Off/Auto) override switches.
   c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
   a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
   b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
   c. Drift to not exceed 0.4 percent of range per year.

8. Tri State Outputs:
   a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
   b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
   c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
   a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
   b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.5 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:
1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:
1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
   a. Dielectric strength of 1000 volts minimum.
   b. Response time of 10 nanoseconds or less.
   c. Transverse mode noise attenuation of 65 dB or greater.
   d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.6 LOCAL AREA NETWORK (LAN)

A. Provide communication between control units over local area network (LAN).

B. LAN Capacity: Not less than 60 stations or nodes.

C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

D. LAN Data Speed: Minimum 19.2 Kb.

E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

F. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.7 SYSTEM SOFTWARE

A. Operating System:
1. Concurrent, multi-tasking capability.
   a. Common Software Applications Supported: Microsoft Excel.
2. System Graphics:
   a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
   b. Animation displayed by shifting image files based on object status.
   c. Provide method for operator with password to perform the following:
      1) Move between, change size, and change location of graphic displays.
      2) Modify on-line.
      3) Add, delete, or change dynamic objects consisting of:
         (a) Analog and binary values.
         (b) Dynamic text.
         (c) Static text.
         (d) Animation files.
3. Custom Graphics Generation Package:
   a. Create, modify, and save graphic files and visio format graphics in PCX formats.
   b. HTML graphics to support web browser compatible formats.
   c. Capture or convert graphics from AutoCAD.
4. Standard HVAC Graphics Library:
   a. All HVAC Equipment
   b. All Ancillary Equipment

B. Workstation System Applications:
1. Automatic System Database Save and Restore Functions:
   a. Current database copy of each Building Controller is automatically stored on hard disk.
   b. Automatic update occurs upon change in any system panel.
   c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
   a. Save database from any system panel.
   b. Clear a panel database.
   c. Initiate a download of a specified database to any system panel.

3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
   a. Context-sensitive system assists operator in operation and editing.
   b. Available for all applications.
   c. Relevant screen data provided for particular screen display.
   d. Additional help available via hypertext.
5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.
6. System Diagnostics:
   a. Operations Automatically Monitored:
      1) Workstations.
      2) Printers.
      3) Modems.
      4) Network connections.
      5) Building management panels.
      6) Controllers.
   b. Device failure is annunciated to the operator.
7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
   b. Configurable Objects:
      1) Alarm limits.
      2) Alarm limit differentials.
      3) States.
      4) Reactions for each object.
8. Alarm Messages:
   a. Descriptor: English language.
   b. Recognizable Features:
      1) Source.
      2) Location.
      3) Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
   a. Logging.
   b. Printing.
   c. Starting programs.
   d. Displaying messages.
   e. Dialing out to remote locations.
   f. Paging.
   g. Providing audible annunciation.
   h. Displaying specific system graphics.
10. Custom Trend Logs:
    a. Definable for any data object in the system including interval, start time, and stop time.
    b. Trend Data:

1) Sampled and stored on the building controller panel.
2) Archivable on hard disk.
3) Retrievable for use in reports, spreadsheets and standard database programs.
4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.

11. Alarm and Event Log:
    a. View all system alarms and change of states from any system location.
    b. Events listed chronologically.
    c. Operator with proper security acknowledges and clears alarms.
    d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
    a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    b. Status Available by the Following Methods:
        1) Menu.
        2) Graphics.
        3) Custom Programs.
13. Reports and Logs:
    a. Reporting Package:
        1) Allows operator to select, modify, or create reports.
        2) Definable as to data content, format, interval, and date.
        3) Archivable to hard disk.
    b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
    c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
    d. Set to be printed on operator command or specific time(s).
14. Reports:
    a. Standard:
        1) Objects with current values.
        2) Current alarms not locked out.
        3) Disabled and overridden objects, points and SNVTs.
        4) Objects in manual or automatic alarm lockout.
        5) Objects in alarm lockout currently in alarm.
        6) Logs:
            (a) Alarm History.

            (b) System messages.

            (c) System events.

            (d) Trends.

    b. Custom:
        1) Daily.
        2) Weekly.
        3) Monthly.
        4) Annual.
        5) Time and date stamped.
        6) Title.

7) Facility name.

c. Tenant Override:
   1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
   2) Annual report showing override usage on a monthly basis.

d. Electrical, Fuel, and Weather:
   1) Electrical Meter(s):
      (a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.

      (b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.

   2) Fuel Meter(s):
      (a) Monthly showing daily natural gas consumption for each meter.

      (b) Annual summary showing monthly consumption for each meter.

   3) Weather:
      (a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.

C. Workstation Applications Editors:
1. Provide editing software for each system application at PC workstation.
2. Downloaded application is executed at controller panel.
3. Full screen editor for each application allows operator to view and change:
   a. Configuration.
   b. Name.
   c. Control parameters.
   d. Set-points.
4. Scheduling:
   a. Monthly calendar indicates schedules, holidays, and exceptions.
   b. Allows several related objects to be scheduled and copied to other objects or dates.
   c. Start and stop times adjustable from master schedule.
5. Custom Application Programming:
   a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
   b. Programming Features:
      1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
      2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
      3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
      4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
      5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.

6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values cab be used in IF/THEN comparisons, calculations, programming statement logic, etc.
9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.8 CONTROLLER SOFTWARE

A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.

B. System Security:
1. User access secured via user passwords and user names.
2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
3. User Log On/Log Off attempts are recorded.
4. Automatic Log Off occurs following the last keystroke after a user defined delay time.

C. Object or Object Group Scheduling:
1. Weekly Schedules Based on Separate, Daily Schedules:
   a. Include start, stop, optimal stop, and night economizer.
   b. 10 events maximum per schedule.
   c. Start/stop times adjustable for each group object.

D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.

E. Alarms:
1. Binary object is set to alarm based on the operator specified state.
2. Analog object to have high/low alarm limits.
3. All alarming is capable of being automatically and manually disabled.
4. Alarm Reporting:
   a. Operator determines action to be taken for alarm event.
   b. Alarms to be routed to appropriate workstation.
   c. Reporting Options:

F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.

G. PID Control Characteristics:
1. Direct or reverse action.
2. Anti-windup.

3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
4. User selectable controlled variable, set-point, and PED gains.

H. Staggered Start Application:
1. Prevents all controlled equipment from simultaneously restarting after power outage.
2. Order of equipment startup is user selectable.

I. Energy Calculations:
1. Accumulated instantaneous power or flow rates are converted to energy use data.
2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.

J. Anti-Short Cycling:
1. All binary output objects protected from short-cycling.
2. Allows minimum on-time and off-time to be selected.

K. On-Off Control with Differential:
1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.

L. Run-Time Totalization:
1. Totalize run-times for all binary input objects.
2. Provides operator with capability to assign high run-time alarm.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.

C. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches above floor.

D. All control wiring routed in exposed areas to be in conduit. Refer to electrical specifications for additional requirements. Contractor's option to route control wiring above ceilings and in concealed space using J-hooks.

E. Provide all power, transformers, relays, control wiring, conduit and all other electrical components as required to control the mechanical equipment. Provide all wiring in conduit.

3.3 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

B. Provide basic operator training for 4 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 20 hours dedicated instructor time. Provide training on site.

3.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate complete and operating system to Owner.

END OF SECTION

SECTION 23 0950.20
GAS DETECTION AND ALARM
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A Refrigerant Gas Detection

B Boiler Room Gas detection monitors and alarms

3.02 SUBMITTALS

A Product Data: For each type of gas monitor, include sensing range in ppm, temperature and humidity range, alarm outputs, display range, furnished specialties, installation requirements, and electric power requirement.

B Provide Wiring Diagrams: Power, signal, and control wiring.

C Closeout Submittals: Owner and Maintenance Data.

3.03 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B Documents at Project Site: Maintain at project site one copy of manufacturer's instructions, erection drawings, and shop drawings.

3.04 WARRANTY

A See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B Manufacturer Warranty: Provide 2-year manufacturer warranty for enitre system. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

4.01 BOILER ROOM GAS DETECTORS AND MONITORS

A Manufacturers:

1. American Gas Safety (AGS) Mini Merlin
2. Approved Alternatives

B The device will be 120 Vac powered, individually powered and capable of accepting the inputs of multiple devices. The unit will clearly display the condition of an alarm and provide hazardous or toxic gas levels via ppm or % of VOL. The device shall provide a re-set and test function. The device shall incorporate dual sensor technology to detect Methane and CO (Carbon Monoxide) without the requirement for additional components. The unit shall be UL certified and listed. Mount the panel per manufacturer’s instructions and recommendations.

C The device panel will be capable of transmitting alarm conditions to a BMS system through its dry contact relay output. For local activation of fans or louvers (or other equipment), the relay will change state in alarm and revert back once the alarm has been removed.

D The device panel will be capable of operating within relative humidity ranges of 5-95% non-condensing and temperature ranges of -4° F to 140° F (-20° C to 60° C).

E The device will be certified and listed to ANSI/UL 61010-1 3rd edition and CAN/CSA-C22.2 No. 61010-1.

F The device will energize a 120v output to control gas solenoid valves and electrical contactors. In alarm the device shall de-energize this control output.

G For local activation of audible alarms, the transmitter shall have an on-board device able to generate an audible output of 85 dBA @ 10 ft.

H The unit shall provide a traffic signal type colored TFT display, Green – all clear, Yellow – warning (low alarm) Red – Alarm.

I Detector alarm levels are to be activated and the unit is to be installed in accordance with the following parameters:

J The sensors shall be UL listed to comply with UL2075 and incorporate filters to only look for the desired hazardous or toxic gases selected.

K Local Building Codes recommendations take precedence over these parameters. Coverage can differ depending on application.

L Accessories

1. Detector Guards type AGSGUARD. The grid is made of a 9-gauge steel wire. The guard must be designed to allow calibration without removing the guards
2. Remote Panic Button type AGSEBSTW Panic Button will be constructed of tough polycarbonate with a stainless steel back plate capable of operating within relative humidity ranges of 0-100% and temperature ranges of -40° F to 250° F (-40° C to 121° C). Unit will be clearly labeled "EMERGENCY BOILER SHUT-OFF" with 5/8" black text on yellow background with red mushroom type button. Unit will be certified and listed to UL safety standards and be ADA compliant.
3. Gas Valve type MERLIN4INF shall be 120v actuated flanged gas solenoid with an operating pressure 0f 0-5PSI. Constructed of die-cast aluminum with a fluid powered actuator. The valves should be UL listed as a safety shut-off valve with a closing time of < 1second.
4. Electric Contactor type AGS4P50ANO shall be 120V energized electrically held normally open contactor providing 4 Poles (circuits) at 50 AMP at 120v 50/60HZ. Contactor shall be UL listed.

4.02 SOURCE QUALITY CONTROL

A See Section 01 4000 - Quality Requirements for additional requirements.

PART 3 EXECUTION

5.01 INSTALLATION

A Install in accordance with manufacturer's written instructions. See drawing schedule for basis of design. If alternate manufacturer is provided. Contractor shall provide all modifications necessary to install a fully functional system.

B Comply with ASHRAE.

C Install sampling inlets that are accessible to personnel.

D Wall mount air-sampling multiple-point monitors with top of unit 60 inches above finished floor.

E Run air-sampling conduit and wire from monitor to air-sampling point, in size as required by monitor manufacturer.

F Extend air-sampling tubing from exhaust part of multiple-point monitors to outside.

G Visible Alarm-Indicating Devices: Install adjacent to each alarm horn at each entry door to refrigeration equipment room, and position at least 6 inches

H The basis of design provides one 120 volt circuit by electrical contractor to the alarm panel. Div 23 contractor to provide all 24 volt wiring and conduit to provide interconnection to all remote sensors and alarms. Any modifications to the basis of design shall be covered by Div. 23

5.02 SYSTEM STARTUP

A Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B Perform tests and inspections and prepare test reports.

C Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D Tests and Inspections:

1. Inspect field-assembled components, equipment installation, and electrical connections for compliance with requirements.
2. Test and adjust controls and safeties.

E Test Reports: Prepare a written report to record the following:

F Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

G Repair or replace malfunctioning units and retest as specified above.

5.03 CLOSEOUT ACTIVITIES

A Demonstrate proper operation of equipment to Owner's designated representative.

B Training: Train Owner's personnel on operation and maintenance of system.

1. Training Reference: Operation and maintenance manual and additional training materials as required.
2. Provide minimum of two hours of training.

END OF SECTION 23 0950.20

SECTION 23 1123.20
FACILITY NATURAL-GAS PIPING
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A Pipe, pipe fittings, valves, and connections for natural gas piping systems.

3.02 RELATED REQUIREMENTS

A Section 09 9123 - Interior Painting.

B Section 33 5216 - Gas Hydrocarbon Piping.

3.03 REFERENCE STANDARDS

A ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.

B ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.

C ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

D ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

E ASME B31.1 - Power Piping; 2022.

F ASME B31.9 - Building Services Piping; 2020.

G ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

H ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.

I MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

3.04 SUBMITTALS

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

B Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

D Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

3.05 QUALITY ASSURANCE

A Perform work in accordance with applicable codes.

B Valves: Manufacturer's name and pressure rating marked on valve body.

C Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

D Welder Qualifications: Certified in accordance with ASME BPVC-IX.

E Identify pipe with marking including size, ASTM material classification, and ASTM specification.

3.06 DELIVERY, STORAGE, AND HANDLING

A Provide temporary protective coating on cast iron and steel valves.

B Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.07 FIELD CONDITIONS

PART 2 PRODUCTS

4.01 NATURAL GAS PIPING, ABOVE GRADE

A Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.

1. Manufacturers:
   a. Wheatland Tube Company: www.wheatland.com/#sle.
2. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
3. Joints: Threaded or welded to ASME B31.1.

4.02 FLANGES, UNIONS, AND COUPLINGS

A Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous Pipe: Class 150 malleable iron threaded unions.

4.03 PIPE HANGERS AND SUPPORTS

A Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.

4.04 BALL VALVES

A Construction, 3 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends with union.

4.05 STRAINERS

A Size 2 inch and Under:

1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

B Size 1-1/2 inch to 4 inch:

1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

4.06 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A Manufacturers:

1. Maxitrol Company: www.maxitrol.com/#sle.

B Compliance Requirements:

1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.

C Materials in Contact With Gas:

1. Housing: Aluminum, steel (free of non-ferrous metals).
2. Seals and Diaphragms: NBR-based rubber.

D Maximum Inlet Operating Pressure: 5 psi.

1. Appliance Regulator: 5 psi.

2. Line Pressure Regulator: 5 psi.

E Maximum Body Pressure: 10 psi.

F Output Pressure Range: 7 inch wc to 11 inch wc.

PART 3 EXECUTION

5.01 EXAMINATION

A Verify that excavations are to required grade, dry, and not over-excavated.

5.02 PREPARATION

A Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B Remove scale and dirt, on inside and outside, before assembly.

C Prepare piping connections to equipment with flanges or unions.

5.03 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C Install piping to maintain headroom, conserve space, and not interfere with use of space.

D Group piping whenever practical at common elevations.

E Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

F Provide access where valves and fittings are not exposed.

G Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

H Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

1. Painting of interior piping system with two coats of rustoleum paint. Paint color and stencil labeling shall be Yellow with black lettering.

I Install valves with stems upright or horizontal, not inverted.

J Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

K Sleeve pipes passing through partitions, walls and floors.

L Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

5.04 APPLICATION

A Install unions downstream of valves and at equipment or apparatus connections.

B Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

5.05 SERVICE CONNECTIONS

A Mechanical Contractor shall provide, coordinate, and pay for all utility costs for new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 2 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

5.06 SCHEDULES

A Pipe Hanger Spacing:

1. Metal Piping:
   a. Pipe Size: 1/2 inches to 1-1/4 inches:
      1) Maximum Hanger Spacing: 6 ft.
      2) Hanger Rod Diameter: 3/8 inches.
   b. Pipe Size: 1-1/2 inches to 2 inches:
      1) Maximum Hanger Spacing: 8 ft.
      2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION 23 1123.20

SECTION 23 2112.10 - GROUND-COUPLED HEAT EXCHANGER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ground-coupled heat exchanger and connections to building piping system, serving:
   1. Heat pump system

1.2 SUBMITTALS

A. Product Data, Polyethylene Piping: Provide manufacturer's data for piping and pipe fittings, showing compliance with specified requirements.
   1. Provide manufacturer's recommendations for fusion jointing.
   2. Include certification of long term hydrostatic basis, or test reports.

B. Shop Drawings: Show complete piping layout, water table, water level, depths of excavation, final depths of piping, backfill placement, point of entrance to building, point of connection to equipment and fittings used for all joints and connections.

C. Test Reports, Piping: Indicate test method and results of hydrostatic pressure tests.

D. Record Documents: Record actual locations of all underground piping installed relative to Owner's permanent structure on same property.

E. Operation and Maintenance Data: Provide procedures for pressurizing, charging, and isolation for equipment replacement.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of documented experience and accredited by IGSHPA. The contractor must have a current well drilling license issued by the state in which the work is performed.

B. Heat Fusion Technician Certification: IGSHPA training and certification, certified within three years from the date of project commencement.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping and fittings to project site in shipping containers with labeling in place.
   1. Comply with local and state regulations.
   2. Verify that labels on piping indicate manufacturer's name, pipe or tube size, and PE cell classification.
   3. Verify that piping complies with specifications and is undamaged.

B. Protect from weather, humidity and temperature variations, dirt and dust, and other environmental contaminants.

C. Store piping capped or plugged until time of installation.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pipe: High density polyethylene pipe, type PE3408, PE3608, or PE4710, with minimum ASTM D3350 cell classification of PE345364C.
1. Pipe Used in Vertical Bore Applications: Comply with ASTM D3035 with minimum working pressure rating of 160 psi.
2. Other Pipe of 3 Inches Diameter and Larger: Comply with ASTM D3035 or ASTM F714, with minimum working pressure rating of 100 psi.
3. Other Pipe 1.25 Inches But Less Than 3 Inches In Diameter (Nominal): Comply with ASTM D3035 with minimum working pressure rating of 110 psi.
4. Other Pipe Less Than 1.25 Inches in Diameter (Nominal): Comply with ASTM D3035 with minimum working pressure rating of 160 psi.
5. Long Term Hydrostatic Design Basis: 1600 psi at 73 degrees F, when tested in accordance with ASTM D2837; appropriate listing in current edition of PPI TR-4 will constitute evidence of compliance with this requirement; otherwise, submit independent test results.
6. Joints and Fittings: Polyethylene of same type as pipe, of sizes and types suitable for the pipe being used; use only heat fusion or stab-type mechanical fittings that are quality controlled to provide a leak-free union between piping ends that is stronger than the piping itself. Do not use other barbed fittings or hose clamps.
   a. Electrofusion Type Fittings: Comply with ASTM F1055.
   b. Butt Fusion Fittings: Comply with ASTM D3261.
   c. Socket Type Fittings: Comply with ASTM D2683.
   d. Where threaded fittings must be used for connection to equipment or dissimilar piping, use fittings and thread sealant compatible and effective with antifreeze used.

B. Heat Exchange Fluid: Water and antifreeze solition, 25 percent propylene glycol by volume, refer to specification 23 2500.10 HVAC water treatment for requirements.

C. Detectable Underground Tape: Magnetic detectable conductor in 2 inch wide rot-resistant plastic tape or mesh, brightly colored, imprinted with "Water Line" in large letters.

D. Backfill for Vertical Boreholes: Thermally enhanced bentonite.
1. Grout shall have conductivity of 0.85.

2.2 GEOTHERMAL WELL MANIFOLDS

A. Manifolds: High-density polyethylene (HDPE) pipe and fittings, joined together with heat fusion, shall be used for all of the vault's circuit and main header piping. All HDPE pipe and heat fused materials shall be manufactured from high-density, high molecular weight PE 3408 polyethylene compound that meets or exceeds ASTM D 3350 cell classification 345464C, and is listed by the Plastic Pipe

B. Institute in PPI TR-4 with HDB ratings of 1600 psi (11.04 MPa) at 73°F (23°C) and 800 psi (5.52 M Pa) at 140°F (60°C).

C. All circuits 2” and greater shall include butterfly valves constructed of lug type/lever with cast iron body, aluminum-bronze disc, EPDM Seat, 416 stainless steel stem, rated at 200 psi.

D. Circuits smaller than 2” and all fill ports shall be ball valves with full port opening with blow out proof stem, 600 psi non-shock cold WOG.

E. Pressure/temperature ports shall be brass and have a dual seal core of Nordel, good up to 350°F for water and shall be rated zero leakage from vacuum to 1000 psig. Plug shall be capable of receiving a 1/8” pressure or temperature probe.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate in accordance with requirements of authorities having jurisdiction.

3.2 POLYETHYLENE PIPING

A. Join piping and fittings using heat fusion or electrofusion; do not use solvents, adhesives, or mechanical fittings.

B. Provide flanges or unions to connect heat exchanger piping to equipment or piping of different type; locate all transitions between piping of different types inside the building or otherwise accessible (i.e. above grade).

C. Keep dirt, water, and debris out of pipe assemblies; cap or plug open ends until connected to adjacent piping.

D. Do not bend piping to shorter radius than recommended by pipe manufacturer; do not kink piping; use elbow or other fittings for sharp bends.

E. Partially backfill radius bends in narrow trenches by hand to ensure that piping is properly supported and to prevent kinking.

F. All underground piping to have magnetic detectable tape installed over piping.

G. Testing: Perform hydrostatic test on all piping; portions of assembled piping may be tested separately.
1. Prior to testing, isolate piping from all connections to building systems.
2. Flush all dirt and debris using potable water flowing at twice the normal operating flow rate for a minimum of four hours or until no dirt or debris is visible, whichever is longer.
3. Plug or cap piping.
4. Pressurize piping to 150 psi for 30 minutes and monitor.
5. If there is any pressure loss or visible leakage, identify leak and repair in accordance with manufacturer's recommendations.
6. Repeat test until there is no loss of pressure for the duration of the test.

H. Where piping passes through foundation walls, provide sleeves sealed with non-hardening, waterproof material.

I. Flushing, filling and propylene glycol/water solution for the ground-coupled heat exchanger and hydronic system is the responsiblity specification 23 2500.10 HVAC water treatment. The well field driller is not responsible for providing glycol/water solution for the ground coupled heat exchanger or the hydronic system.

3.3 BACKFILLING

A. Install in compliance with local authorities having jurisdiction.

B. Protect piping from displacement.

3.4 CLEANING

A. Leave adjacent paved areas broom clean.

B. Clear debris, including excess backfill and excavated dirt and rock, from heat exchanger area.

3.5 PROTECTION

A. Protect area during excavation from excess runoff and erosion.

B. Protect pipe protrusions from damage until connections to building systems are installed.

END OF SECTION

SECTION 23 2113.10 - HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water and glycol piping, above grade.

C. Chilled water piping, above grade.

D. Pipe hangers and supports.

E. Unions, flanges, mechanical couplings, and dielectric connections.

F. Valves:
1. Ball valves.
2. Butterfly valves.

1.2 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

E. ASME B31.9 - Building Services Piping; 2017.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

H. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

I. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.

J. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.

K. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use unions and flanges downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

C. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Use ball or butterfly valves for throttling, bypass, or manual flow control services.

E. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

1.4 SUBMITTALS

A. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

B. Product Data:
1. Indicate balancing valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this sectionwith minimum ten years of experience.

C. All welding of pipe shall be performed by AWS certified welders.

1.6 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. All welding of pipe shall be performed by AWS certified welders.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

1.9 EXTRA MATERIALS

A. Provide two repacking kits for each size and valve type.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Valves: Provide valves where indicated:

2.2 HEATING WATER AND GLYCOL PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
1. Fittings: ASTM B 16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type fittings.
2. Joints: Threaded, or AWS D1.1 welded.
3. Pressed Joints and Fittings: Viega MegaPress.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
1. Solder Joints for 2 inch and smaller/Brazed Joints for 2-1/2 inch and larger: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
   a. Solder: ASTM B32 lead-free solder, HB alloy (9l-5 tin-antimony) or tin and silver.
2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
3. Mechanical Press Sealed Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of ASME B16.51 and IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer.

4. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver.

2.3 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
   1. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.
   2. Joints: Threaded or AWS D1.1 welded.
   3. Pressed Joints and Fittings: Viega MegaPress.

B. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), hard drawn using one of the following joint types:
   1. Solder Joints for 2 inch and smaller/Brazed Joints for 2-1/2 inch and larger: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
   2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
   3. Mechanical Press Sealed Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of ASME B16.51 and IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer.
   4. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Provide oversized hangers on insulated pipe to allow insulation at full thickness to be provided on the piping.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

D. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.

F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

G. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

H. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.

I. Vertical Support: Steel riser clamp.

J. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

K. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.5 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Less:
1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:
1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
2. Mechanical Couplings: Comply with ASTM F1476.
3. Gasket Material: EPDM suitable for operating temperature range from -30 degrees F to 250 degrees F complying with ASTM D-2000.
4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
6. Manufacturers:
   a. Grinnell Products, a Tyco Business: www.grinnell.com.
   b. Victaulic Company: www.victaulic.com.
   c. Gruvlock, Anvil

2.6 BALL VALVES

A. Manufacturers:
1. Apollo Valves: www.apollovalves.com
2. Nibco
3. Jomar.
4. Milwaukee.
5. Viega LLC: www.viega.us/#sle.
6. Stockham

B. Up To and Including 2 Inches:
1. Bronze one piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, lever handle, solder ends with union.

2.7 BUTTERFLY VALVES

A. Manufacturers:
1. Apollo Valves: www.apollovalves.com/#sle.
2. Milwaukee
3. Nibco, Inc: www.nibco.com.
4. Stockham

B. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.

C. Body: Class 150, cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck. Body shall be grooved end black enamel coated ductile iron where grooved piping is allowed.

D. Operator: 10 position lever handle.

E. For use in pipes 2-1/2 inch and larger.

2.8 MANUAL BALANCING VALVE

A. Manufacturers:
1. Griswold Controls: www.griswoldcontrols.com.
2. Tour & Andersson
3. Armstrong
4. ITT Bell & Gossett: www.bellgossett.com.
5. Pro Hydronics Specialties
6. Gerand.
7. Taco, Inc: www.taco-hvac.com.
8. Nexus
9. Hydronic Components Inc
10. Stockham

B. Manual Balancing Valves:
1. Construction Option 1: Class 125, brass body housing including a full port isolation ball valve with memory stop, venturi measurement device, dual pressure/temperature test valves, and unions on inlet and outlet.
2. Construction Option 2: Class 125, brass body housing including a y-pattern globe style calibrated port balancing valve design, dual pressure/temperature test valves, and unions on inlet and outlet. Provide wheel handle with memory stop for balancing adjustments.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment using jointing system specified.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements. Install chilled water piping to ASME B31.5 requirements.
   1. Sleeve pipe passing through partitions, walls and floors.
   2. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
   3. Slope piping and arrange to drain at low points. Provide 1/2" ball valve and cap at each high point for manual air vent. Provide 1/2" ball valve and cap at each low point for drain.
   4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
   5. Install temperature controls devices furnished by the controls contractor. Review requirements with the controls contractor. Provide themo-wells for temperature sensors.

C. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
   2. Support horizontal piping as required by code and piping manufacturer.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and` adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   7. Provide copper plated hangers and supports for copper piping.

D. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

E. Provide handle stand-off extensions on valves to provide a minimum of 3/4" clearance between valve handle and piping insulation.

F. Provide oversized hangers on insulated pipe to allow insulation at full thickness to be provided on all cold temperature piping and hot temperature piping 2 inch and larger.

G. Provide access panels where valves and fittings are not exposed. Coordinate with general contractor.

H. Use eccentric reducers to maintain top of pipe level.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

J. Install valves with stems upright or horizontal, not inverted.

K. All new hydronic heating/cooling system piping shall be pressure tested at 1-1/2 times the maximum system design pressure; but not less than 100 psi (hydrostatically) for 15 minutes (minimum).

L. For grooved pipe installations, a factory trained representative shall provide on-site training to contractor for use of grooving tools and product installation.

M. Press connections: copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

END OF SECTION

SECTION 23 2113.20
HYDRONIC PIPING
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A Hydronic system requirements.

B Heating/Cooling water and glycol piping, above grade.

C Equipment drains and overflows.

D Pipe hangers and supports.

E Unions, flanges, mechanical couplings, and dielectric connections.

F Valves:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Pressure independent temperature control valves and balancing valves.

G Flow controls.

3.02 RELATED REQUIREMENTS

A Section 08 3100 - Access Doors and Panels.

B Section 09 9123 - Interior Painting.

C Section 23 0719.20 - HVAC Piping Insulation.

D Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

3.03 REFERENCE STANDARDS

A ANSI/FCI 70-2 - Control Valve Seat Leakage; 2021.

B ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

C ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

D ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250; 2018.

E ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

F ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

G ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.

H ASME B31.9 - Building Services Piping; 2020.

I ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

J ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.

K ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).

L ASTM B32 - Standard Specification for Solder Metal; 2020.

M ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

N ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

O ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.

P ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

Q AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.

R AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

S AWWA C606 - Grooved and Shouldered Joints; 2022.

T MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

3.04 ADMINISTRATIVE REQUIREMENTS

A Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

3.05 SUBMITTALS

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

B Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.
2. Provide manufacturers catalog information.
3. Indicate valve data and ratings.
4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

D Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E Project Record Documents: Record actual locations of valves.

F Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

3.06 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum 5 years of experience.

C Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

D Coupling Manufacturer:

1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
2. A distributor's representative is not considered qualified to perform the training.

3.07 DELIVERY, STORAGE, AND HANDLING

A Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B Provide temporary protective coating on cast iron and steel valves.

C Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.08 FIELD CONDITIONS

A Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

4.01 HYDRONIC SYSTEM REQUIREMENTS

A Comply with ASME B31.9 and applicable federal, state, and local regulations.

B Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
3. Grooved mechanical joints may be used in accessible locations only.
   a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Engineer.
   b. Use rigid joints unless otherwise indicated.
4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D Valves: Provide valves where indicated:

4.02 HEATING/CHILLED WATER AND GLYCOL PIPING, ABOVE GRADE

A Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:

1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
2. Threaded Joints: ASME B16.3, malleable iron fittings.
3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B Copper Tube: ASTM B88 (ASTM B88M), Type M (C), drawn, using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
   a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
3. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

4.03 GROOVEED MECHANICAL JOINTS AND COUPLINGS

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

1. Anvil; an ASC Engineered Solution.
2. Victaulic Company.

B Source Limitations: Obtain grooved mechanical-joint fittings and couplings from single manufacturer.

C Warranty:

1. Removal and Replacement of all items leaking or found defective for a period of 10 years.

D Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

E Couplings: Rigid Type Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

1. Temperature Limitations: 230 Degrees F
2. All Gaskets shall be compatible with fluid type and capable of glycol concentrations of up to and including 50%

4.04 EQUIPMENT DRAINS AND OVERFLOWS

A Copper Tube: ASTM B88 (ASTM B88M), Type M (C), drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

4.05 PIPE HANGERS AND SUPPORTS

A Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 Inches and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
16. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

4.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A Unions for Pipe of 2 Inches and Less:

1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B Flanges for Pipe 2 Inches and Greater:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.

3. Gaskets: 1/16 inch thick, preformed neoprene.

C Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.
2. Mechanical Couplings: Comply with ASTM F1476.
3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F. Gasket shall be capable of 50% concentrations of EG or PG glycol solutions
5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
7. Manufacturers:
   a. Anvil International: www.anvilintl.com/#sle.
   b. Victaulic Company: www.victaulic.com/#sle.
8. Warranty
   a. Provide all the labor and material to remove and replace all defective or leaking components. Warranty shall cover damage to materials and finishes for a period of 10 years.

4.07 BALL VALVES

A Manufacturers:

1. Anvil International: www.anvilintl.com/#sle.
2. Apollo Valves: www.apollovalves.com/#sle.
3. Grinnell Products: www.grinnell.com/#sle.
4. Victaulic Company: www.victaulic.com/#sle.

B Up To and Including 2 Inches:

1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

C Over 2 Inches:

1. Ductile iron body, chrome plated stainless steel ball, teflon or Virgin TFE seat and stuffing box seals, lever handle, flanged ends, rated to 800 psi.

4.08 BUTTERFLY VALVES

A Manufacturers:

1. Anvil International: www.anvilintl.com/#sle.
2. Apollo Valves: www.apollovalves.com/#sle.
3. Grinnell Products: www.grinnell.com/#sle.
4. Victaulic Company: www.victaulic.com/#sle.

B Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck.

C Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.

D Operator: 10 position lever handle.

4.09 SWING CHECK VALVES

A Manufacturers:

1. Anvil International: www.anvilintl.com/#sle.
2. Apollo Valves: www.apollovalves.com/#sle.
3. Grinnell Products: www.grinnell.com/#sle.
4. Victaulic Company: www.victaulic.com/#sle.

B Up To and Including 2 Inches:

1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.

C Over 2 Inches:

1. Iron body, bronze trim, stainless steel, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged or grooved ends.

4.10 SPRING LOADED CHECK VALVES

A Manufacturers:

1. Anvil International: www.anvilintl.com/#sle.
2. Victaulic Company: www.victaulic.com/#sle.

B Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.

4.11 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES AND BOILER BYPASS VALVES

A Manufacturers:

1. Belimo.

B Control Valves: Factory-fabricated pressure independent with internal differential pressure regulator (DPRV), which automatically adjusts to normal changes in system pressure and provides 100 percent control valve authority at all positions of the valve.

1. Maintain proportional and linear flow coil characteristics.
2. PICV to accurately control the flow from 0 to 100 percent full rated flow with an operating pressure differential range of 3 to 60 psig.
3. Provide ANSI/FCI 70-2 Class 4 shut-off on all sizes and field serviceable.
4. Provide control valve to incorporate control, balancing, and flow limiting. Hydronic system pressure independent control valve bodies to comply with ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure and have the following characteristics:
    a. 2 NPS and Smaller: Class 150 bronze or brass body with union connections, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, and screwed ends with backseating capacity repackable under pressure.
    b. 2-1/2 NPS and Larger: Class 125 iron or ductile iron body, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, flanged ends with backseating capacity repackable under pressure.
    c. Pressure Control Seat: Brass construction with vulcanized EPDM.
    d. Sizing: Line-size or smaller provide associated reducing fittings
    e. Fittings and Components: All fittings and components to meet ANSI standards and be compatible with readily available components. 8-inch valves and above to be provided with

proper companion flanges.

f. Close-Off (Differential) Pressure Rating: Combination of actuator, DPRV action, and trim to provide a minimum close-off pressure rating of 150 percent of total system (pump) head. Provide actuator from the same manufacturer as the pressure independent control valve.

C Electronic Actuators: Direct-mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.

D Provide actuator with visible position indication. Fail positions on power failure to include in-place, open or closed as indicated in the controls specifications.

1. Valves: Sized for maximum circuit flow rate and nominally, line-sized.
2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
3. Fail-Safe Operation: Mechanical, spring-return mechanism or capacitance return.
4. Power Requirements (Two-Position Spring Return): 24 VAC.
5. Power Requirements (Modulating): Maximum 10 VA at 24 VAC or 8 watts at 24 VDC.
6. Proportional Signal: 0 to 10 VDC or 2 to 10 VDC or 4 to 20 mA, and 2 to 10 VDC position feedback signal.
7. Provide plenum-rated actuators for service above ceilings to possess UL listings and approvals.
8. Temperature Rating: 40 to 104 degrees F.

4.12 FLOW CONTROLS

A Manufacturers:

1. Anvil International: www.anvilintl.com/#sle.
2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
3. Griswold Controls: www.griswoldcontrols.com/#sle.
4. ITT Bell & Gossett: www.bellgossett.com/#sle.
5. Taco, Inc: www.taco-hvac.com/#sle.
6. Victaulic Company: www.victaulic.com/#sle.
7. Nexus

B Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi.

PART 3 EXECUTION

5.01 PREPARATION

A Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C Remove scale and dirt on inside and outside before assembly.

D Prepare piping connections to equipment using jointing system specified.

E Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

5.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Route piping in orderly manner, parallel to building structure, and maintain gradient.

C Install piping to conserve building space and to avoid interference with use of space.

D Group piping whenever practical at common elevations.

E Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

F Slope piping and arrange to drain at low points.

G Grooved Joints:

1. Install in accordance with the manufacturer's latest published installation instructions.
2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

H Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 2-inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

I Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 0719.20.

J Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100 .

K Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

L Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. See Section 09 9123.

M Install valves with stems upright or horizontal, not inverted.

5.03 SCHEDULES

A Hanger Spacing for Copper Tubing.

B As Per manufacturers recommendations or as stated below.

1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. 2-1/2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 3 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
7. 6 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.

C Hanger Spacing for Steel Piping.

1. 1/2 Inch to 1 1/2" Inch, Maximum span, 7 feet; minimum rod size, 3/8 inch.
2. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.

3. 2-1/2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
4. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
5. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
6. 6 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.

END OF SECTION 23 2113.20

SECTION 23 2114.10 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air vents.

B. Suction diffusers.

C. Pressure-temperature test plugs.

1.2 REFERENCE STANDARDS

1.3 SUBMITTALS

A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 AIR VENTS

A. Manual Type: Short vertical section of pipe to form air chamber, with 1/2" ball valve, 3/4" hose thread and cap.
   1. Under Finned Tube Radiation Cover Only: Contactors option to provide manual coin operated vent with brass needle valve.

2.2 STRAINERS

A. Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. Keckley
3. Titan FCI

B. Size 2 inch and Under:
1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:
1. Provide flanged or grooved iron body for 175 psi working pressure, Y pattern with 1/16 inch or 3/64 inch stainless steel perforated screen.

2.3 SUCTION DIFFUSERS

A. Manufacturers:
1. ITT Bell & Gossett: www.bellgossett.com/#sle.
2. Taco: http://www.taco-hvac.com.
3. Armstrong

B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh start up screen, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

PART 3 EXECUTION

3.1 INSTALLATION

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

B. Provide manual air vents at system high points and as indicated.

C. Provide valved drain and hose connection on strainer blow down connection.

D. Support pump fittings with floor mounted pipe and flange supports.

E. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

F. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

G. Pipe relief valve outlet to nearest floor drain.

END OF SECTION

SECTION 23 2114.20
HYDRONIC SPECIALTIES
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A Compression tanks.

B Expansion tanks.

C Air vents.

D Air separators.

E Strainers.

F Suction diffusers.

G Combination pump discharge valves.

H Pressure-temperature test plugs.

I Balancing valves.

J Relief valves.

K Glycol system.

3.02 RELATED REQUIREMENTS

A Section 22 1006 - Plumbing Piping Specialties: Backflow preventers.

B Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

3.03 REFERENCE STANDARDS

A ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

B ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping; 2021a.

C ASTM F2389 - Standard Specification for Pressure-Rated Polypropylene (PP) Piping Systems; 2023.

3.04 SUBMITTALS

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

B Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

C Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D Project Record Documents: Record actual locations of flow controls.

E Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

3.05 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

3.06 DELIVERY, STORAGE, AND HANDLING

A Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

4.01 COMPRESSION TANKS

A Manufacturers:

1. American Wheatley, a Company of Global Flow Products, LLC: www.wheatleyhvac.com/#sle.
2. Amtrol Inc: www.amtrol.com/#sle.
3. Taco, Inc: www.taco-hvac.com/#sle.
4. Calefactio

B Construction: Closed, welded steel, tested, and stamped in accordance with ASME BPVC-VIII-1; cleaned, prime coated, and supplied with steel support saddles; with tappings for installation of accessories.

1. Pressure Rating: 100 psi.

C Gauge Glass Set: Brass compression stops, guard, and 3/4 inch red line glass, maximum 24 inches length, long enough to cover tank for 2 inches above bottom to 2 inches below top.

D Quick Connect Air Inlet:

1. Compressed Air: 72 inches of 1/4 inch diameter braided reinforced air hose, air chuck, check valve, and shut-off valve on supply from control air compressor.
2. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.

E Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure, double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass. Refer to Section 22 1006.

F Hot Water Heating System:

1. Select expansion tank pressure relief valve at _____ psi maximum.
2. Set pressure reducing valve at 12 psi.

G Chilled Water System:

1. Select expansion tank pressure relief valve at _____ psi maximum.
2. Set pressure reducing valve at 12 psi.

4.02 EXPANSION TANKS

A Manufacturers:

1. Amtrol Inc: www.amtrol.com/#sle.
2. Armstron
3. Bell & Gossett, a brand of Xylem, Inc; DIAPHRAM D SERIES: www.bellgossett.com/#sle.
4. Taco, Inc: www.taco-hvac.com/#sle.
5. Grundfos.

B Acceptance Volume Capacity: As indicated on drawings.

C Maximum Rated Working Pressure: 125 psi.

D Maximum Allowable Service Temperature: 240 degrees F.

E Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible butyl diaphragm or bladder seal factory precharged to 12 psi, and steel support stand.

F Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

G Accessories: Provide air-charging fitting, bulls eye sight glass, pressure gauge, and tank drain ball valve.

4.03 AIR VENTS

A Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B Float Air Vent:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

C Maximum Fluid Pressure: 150 psi.

D Maximum Fluid Temperature: 250 degrees F.

4.04 AIR SEPARATORS

A Centrifugal Air Separators/Strainers:

1. Manufacturers:
   a. Armstrong International, Inc: www.armstronginternational.com/#sle.
   b. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
   c. Taco, Inc: www.taco-hvac.com/#sle.
   d. Caleffi.
   e. Grundfos
2. Primed steel body, tested and stamped in accordance with ASME BPVC-VIII-1 with integral bronze strainer, tangential flanged inlet and outlet connections, and internal stainless steel air collector tube.
3. Maximum Service Flow and Pressure: 16 gpm at 125 psi.
4. Accessories: Provide epoxy coating finish, removable strainer, and tank-bottom magnets.

4.05 STRAINERS

A Size 2 inch and Under:

1. Provide threaded, grooved, or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.
2. Body Material by Fluid Service:
   a. Cast Iron or Brass:
      1) Steam: Up to 250 psi at 450 degrees F.
      2) Liquids: Up to 400 psi at 150 degrees F.

B Size 2-1/2 inch to 4 inch:

1. Provide flanged or grooved iron body for up to 175 psi working pressure, up to 250 degrees F working temperature, Y-pattern strainer with 1/16 inch or 3/64 inch stainless steel perforated screen.
2. Body Material by Fluid Service:
   a. Cast Iron:
      1) Steam: Up to 125 psi at 350 degrees F.
      2) Liquids: Up to 200 psi at 150 degrees F.

4.06 SUCTION DIFFUSERS

A Manufacturers:

1. Bell & Gossett, a brand of Xylem, Inc; _____: www.bellgossett.com/#sle.
2. Victaulic Company of America: www.victaulic.com/#sle.
3. Taco
4. Grundfos

B Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning.

C Class 125:

1. Horizontally or vertically mounted angle-pattern fitting with integral-cast vanes, fine particle mesh screen and magnetic drain plugs for particle removal without disassembly.
2. Maximum Operating Service: 175 psi and 300 degrees F.
3. Sizes, Material, and Connection:
   a. 2 inch and Smaller: Cast iron body, threaded.
   b. 2-1/2 to 12 inch: Ductile iron body, flanged.

D Class 150, Size 1-1/2 to 4 inch:

1. Angle-pattern flanged carbon steel fitted with integral vanes, removable strainer, and magnetic drain plugs for particle removal without disassembly.
2. Maximum Operating Service:
   a. Class 150: 150 psi at 450 degrees F.

E Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

4.07 PUMP CONNECTORS

A Manufacturers:

1. The Metraflex Company; Vane Flex: www.metraflex.com/#sle.
2. Engineered Flexible Products.
3. Twin City Hose
4. Grundfos

B Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.

1. Maximum Operating Service: 150 psi at 120 degrees F.
2. Accommodate the Following:
   a. Axial Deflection in Compression and Expansion:
   b. Force developed by 1.5 times specified maximum allowable operating pressure.
3. End Connections: Same as specified for pipe jointing.
4. Provide pump connector with integral vanes to reduce turbulent flow.
5. Provide necessary accessories including, but not limited to, swivel joints.

4.08 COMBINATION PUMP DISCHARGE VALVES

A Manufacturers:

1. Crane Co.: www.craneco.com/#sle.
2. Taco, Inc: www.taco-hvac.com/#sle.
3. Victaulic Company of America: www.victaulic.com/#sle.
4. Bell and Gossett.
5. Grundfos

B Quarter-Turn Plug Type: Flanged cast-iron body with bolt-on bonnet, position indicator, stainless steel stem, backflow preventer, memory stop, metering connectors, bubble-tight shutoff, and wrench-adjustable plug flow regulator.

C Triple-Duty Globe Type: Grooved cast-iron angle pattern body with bolt-on bonnet, position indicator, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, metering connectors, flow shutoff mechanism, and adjustable flow handle.

4.09 PRESSURE-TEMPERATURE TEST PLUGS

A Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.

B Application: Use extended length plugs to clear insulated piping.

4.10 BALANCING VALVES

A Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
3. FNW: www.fnw.com/#sle.
4. Hays Fluid Controls: www.haysfluidcontrols.com/#sle.
5. Nexus Valve, Inc: www.nexusvalve.com/#sle.
6. Gerand Engineering
7. Griswold Controls
8. Pro Hydronics
9. Hydronic Components Inc.

B Size 2 inch and Smaller:

1. Provide ball or globe style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and female sweat, NPT threaded, press, or soldered connections.
2. Metal construction materials consist of bronze or brass.
3. Non-metal construction materials consist of Teflon or EPDM.
4. Maximum Service Operation: 300 psi at 250 degrees F.

C Size 2-1/2 inch and Larger:

1. Provide ball, globe, or butterfly style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and flanged, grooved, or weld-end connections.
2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, or EPDM.
4. Maximum Service Operation: 175 psi at 250 degrees F.

4.11 RELIEF VALVES

A Manufacturers:

B Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

C Steam Relief at Maximum Vessel Pressure: 30 psi.

4.12 GLYCOL SYSTEM

A Manufacturers:

1. Axiom.

B Side Stream Filter Assembly Axiom SFP-20 or Equal

1. Hydronic Filter Package shall include the following.
2. 20" Stainless Stell Filter Housing with 0.8 Gallon Volume

3. Sight Flow Indicator
4. Isolation Ball Valves
5. Pressure Relief Valve and Drain
6. Twenty 25 micron filters
7. Manual Balancing Valve

C Packaged Hydronic System Feeder: Axiom SF-100 or equal

1. Storage: 55 gal polypropylene tank with bolt-removable hinged solid cover and enamel coated carbon steel tank-stand.
2. Pump:
   a. Thermally protected 1/4 hp motor at 115 to 120 VAC, single phase rated for indoor service.
   b. Maximum Service Operation: 100 psi at 85 degrees F.
3. Mechanical Accessories: System isolation valves, strainer, and pressure gauges.
4. Flexible connection hose with check valve
5. Control Panel:
   a. Plug in single-point system connection rated at 115 to 120 VAC, single phase.
   b. Interface: Hand switches with indicating lights for ON, FAULT, and LOW LEVEL.
   c. Pressure Switch: Panel-mounted and prewired for 10 psi cut-in and 40 psi cut-out, adjustable.
   d. Low Level Cut-Off Switch: Prewired to shut-down unit upon activation. Tank-side mounted.
   e. Auxiliary Dry Contacts: Low level, high level, and fault/alarm for remote monitoring.
   f. Alarm: Audio-visual device with panel-mounted silencing switch to activate upon system fault or alarm with audio pressure level rated for 90 dB.
6. Pressure Relief Valve: System-mounted brass valve tubed from pump discharge side into tank with adjustable setpoint between 20 psi and 150 psi.

D Glycol Solution: Propylene Glycol - Dow Chemical Company

1. Water-based solution mix containing 35 percent propylene glycol by volume required for cooling or heating system operating temperature range.
2. Cooling or heating System Operating Temperature Range: Between freezing and boiling points of 3 and 220 degees F at 14.7 psia.

PART 3 EXECUTION

5.01 INSTALLATION

A Install specialties in accordance with manufacturer's instructions.

B Where large air quantities can accumulate, provide enlarged air collection standpipes.

C Provide manual air vents at system high points and as indicated.

D Provide air separator on suction side of system circulation pump and connect to expansion tank.

E Provide valved drain and hose connection on strainer blowdown connection.

F Provide pump suction fitting on suction side of base-mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

G Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.

H Support pump fittings with floor-mounted pipe and flange supports.

I Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

J Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

K Pipe relief valve outlet to nearest floor drain or to glycol recovery tank

L Clean and flush glycol system before adding glycol solution, see Section 23 2500.

M Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

N **Prior to Starting Work**

1. Perform tests determining strength of glycol and water solution and submit written test results.
2. Provide results to owner along with any recommendations from the testing agency.
3. Failure to test prior to starting work will result in the contractor tanking responsiblity of the entire system to become 35% Propylene Glycol with approprirate inhibitors.

5.02 MAINTENANCE

A See Section 01 7000 - Execution Requirements for additional requirements relating to maintenance service.

B Provide service and maintenance of glycol system for one year from date of Substantial Completion at no extra charge to Owner.

C Perform Quarterly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Report findings in detail in writing, including analysis and amounts of glycol or water added.

D Explain corrective actions to Owner's maintenance personnel in person.

END OF SECTION 23 2114.20

SECTION 23 2123.10 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Close Coupled pumps.

B. Inline wet rotor pumps.

C. Base-mounted pumps.

1.2 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators; 2018.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

B. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

C. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Armstrong Fluid Technology, Inc: www.armstrongfluidtechnology.com/#sle.

B. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com/#sle.

C. Taco : www.taco-hvac.com.

D. Grundfos

2.2 INLINE WET ROTOR PUMP

A. Type: Wet rotor inline pump with ECM motor with built in electrical overload and dry run protection.
   1. Provide with integeral controller with multiple pressure and temperature control operating modes.

B. Casing: Cast iron, with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to motor shaft extension.

D. Shaft: Alloy steel with bronze sleeve.

E. Bearings: Grease-lubricated ball bearings.

F. Performance and Electrical Characteristics: See plans.

G. Seal For Cleaning: Provide a standard seal in the pumps. After cleaning has been completed and the system has the correct solution, the final pump seals shall be installed.

H. Final Seal: After cleaning is done and the correct solution has been used to fill the system, the pump seal shall be changed. Turn the cleaning seals over to the Owner. The final seal shall be a high performance seal made for the following conditions.
   1. Temperature Range: -20 to 250 deg F.
   2. PH Range: 7.0 to 12.5
   3. Maximum Dissolved Solids: 25,000 ppm
   4. Maximum Undissolved Solids: 40 ppm
   5. Maximum Silica: 20 ppm
   6. Maximum Glycol Concentration: 60%

2.3 CLOSE COUPLED PUMPS

A. Type: Horizontal shaft, single stage, close coupled, for 175 psi maximum working pressure.

B. Casing: Cast iron, with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to motor shaft extension.

D. Shaft: Alloy steel with bronze sleeve.

E. Bearings: Grease-lubricated ball bearings.

F. Performance and Electrical Characteristics: See plans.

G. Seal For Cleaning: Provide a standard seal in the pumps. After cleaning has been completed and the system has the correct solution, the final pump seals shall be installed.

H. Final Seal: After cleaning is done and the correct solution has been used to fill the system, the pump seal shall be changed. Turn the cleaning seals over to the Owner. The final seal shall be a high performance seal made for the following conditions.
1. Temperature Range: -20 to 250 deg F.
2. PH Range: 7.0 to 12.5
3. Maximum Dissolved Solids: 25,000 ppm
4. Maximum Undissolved Solids: 40 ppm
5. Maximum Silica: 20 ppm
6. Maximum Glycol Concentration: 60%

2.4 BASE-MOUNTED PUMPS

A. Type: Horizontal shaft, single stage, direct connected, end suction design, radially or horizontally split casing, for 175 psi maximum working pressure.

B. Casing: Cast iron, or ductile iron with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Bearings: Oil lubricated roller or ball bearings.

E. Shaft: Alloy steel with bronze shaft sleeve.

F. Seal For Cleaning: Provide a standard seal in the pumps. After cleaning has been completed and the system has the correct solution, the final pump seals shall be installed.

G. Final Seal: After cleaning is done and the correct solution has been used to fill the system, the pump seal shall be changed. Turn the cleaning seals over to the Owner. The final seal shall be a high performance seal made for the following conditions.
1. Temperature Range: -20 to 250 deg F.
2. PH Range: 7.0 to 12.5
3. Maximum Dissolved Solids: 25,000 ppm
4. Maximum Undissolved Solids: 40 ppm
5. Maximum Silica: 20 ppm
6. Maximum Glycol Concentration: 60%

H. Drive: Flexible coupling with coupling guard.

I. Baseplate: Factory provided, channel steel construction with integral drain rim.

J. Performance and Electrical Characteristics: See plans.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Provide line sized shut-off valve and pump suction fitting on pump suction, and line sized soft seat check valve and line sized shut-off valve on pump discharge.

D. Provide drains for bases and seals, piped to and discharging into floor drains.

E. PROVIDE LASER ALIGNMENT AND CERTIFY ALIGNMENT OF BASE MOUNTED PUMPS PRIOR TO START-UP. Include the alignment report in the Operation & Maintenance Manuals.
1. Angular Alignment Tolerances: +/-0.5 Mils per inch.
2. Verical/Horizontal Alignment Tolerances: +/-2 Mils per inch.

F. Check, align, and certify alignment of base-mounted pumps prior to start-up.

G. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place using non-shrinking grout.

H. Lubricate pumps before start-up.

END OF SECTION

SECTION 23 2123.20
HYDRONIC PUMPS
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A In-line pumps.

3.02 RELATED REQUIREMENTS

A Section 23 0513 - Common Motor Requirements for HVAC Equipment.

B Section 23 0934 - Variable-Frequency Motor Controllers for HVAC.

3.03 REFERENCE STANDARDS

A IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; 2020 (Corrigendum 2022).

B NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

3.04 SUBMITTALS

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

B Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C Millwright's Certificate: Certify that base mounted pumps have been aligned.

D Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

E Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

F 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 Cartridges for Side-Stream Filters: 1 Case for size of filter (Minimum 20).

PART 2 PRODUCTS

4.01 MANUFACTURERS

A Armstrong Fluid Technology, Inc: www.armstrongfluidtechnology.com/#sle. **None integrated VFD pumps only.**

B Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com/#sle.

C Grundfos Pumps Corporation: www.grundfos.com/#sle.

D Taco.

4.02 GENERAL

A Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B Minimum Quality Standard: UL 778.

C Base Mounted Pumps: Aligned by qualified millwright.

D Electrical Requirements:

1. Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.
2. Variable Frequency Drives (VFDs): Provide in accordance with Section 23 0934, except for integral-VFDs.
3. Enclosures: Provide unspecified product(s) required to fit motor:

4.03 IN-LINE PUMPS

A Closed-Coupled, Single-Stage Pump: Vertical pump with radially- or horizontally-split casing; rated for discharge pressures up to 175 psi.

B Casing: Cast iron with seal flush connection, threaded suction, and discharge ports with gauge port and drain plug.

C Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

D Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.

E Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.

F Electrical:

1. Motor: 3600 RPM ECM
2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
3. Integral Controls: See Pump Schedule for VFD location and configuration
   a. Variable Frequency Drive (VFD): Factory-fitted and tested with dedicated terminal box for power, instrumentation and related control wiring.
   b. DDC Controller: VFD-integrated or external controller module with visual-tactile interface and minimum of 2 analog inputs, 2 digital inputs, and real-time clock. Provide differential pressure sensor and temperature sensor with thermowell and thermal grease.
   c. BAS, SCADA, or Other Integrated Automation Link: Wi-Fi in accordance with IEEE 802.11.
   d. Provide seperate power circuit and do not power pump through boiler. Power to pump must be maintained to maintain integral vfd programming.

PART 3 EXECUTION

5.01 PREPARATION

A Verify that electric power is available and of the correct characteristics.

5.02 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

D Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

E Provide drains for bases and seals, piped to and discharging into floor drains.

F Lubricate pumps before start-up.

G Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tappings.

END OF SECTION 23 2123.20

SECTION 23 2500.10 - CHEMICAL WATER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials.
   1. System cleaner.
   2. Closed system treatment (water).

B. Glycol.

1.2 SUBMITTALS

A. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

B. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Sufficient chemicals for treatment and testing during required maintenance period.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

1.4 MAINTENANCE SERVICE

A. Furnish service and maintenance of treatment systems for one year from Date of Substantial Completion.

B. Provide semi-annual technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

C. Provide laboratory and technical assistance services during this maintenance period.

D. Include two hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.

1.5 MAINTENANCE MATERIALS

A. Supply sufficient chemicals for treatment and testing during warranty period.

PART 2 PRODUCTS

2.1 GLYCOL SYSTEM

A. Mixing Tank and Transfer Pump: 55 gallon plastic chemical drum with fittings suitable for filling. Self priming pump to transfer chemicals from drum to system. Pump shall be Dayton #2P390 or equivalent 1/2 hp, 120 volt, single phase, ODP motor with automatic reset thermal protection, provide minimum 8 foot cord and plug. Provide with hose for connection
   1. Provide with flexible hose for connection from mixing tank to system fill locations when project is complete.
   2. Mixing tank shall be left 75% full (minimum) of glycol mixture upon completion of project.

B. Glycol Solution:
   1. Manufacturers:
      a. DOW
      b. Rhomar Water Management
      c. Interstate
   2. The de-ionized water used to dilute the concentrate and the pre-mixed solutions, if necessary, shall contain less than: 100 ppm calcium carbonate hardness 40 ppm calcium plus magnesium ions 50 ppm chloride plus sulfate ions.
   3. The heat transfer fluid shall be an inhibited glycol-based industrial heat transfer fluid specifically formulated for use in HVAC SYSTEMS. The fluid must contain corrosion inhibitors and buffers and an antifoam agent, necessary for long fluid and system life.
   4. COMMERCIAL AUTOMOBILE ANTIFREEZE SOLUTIONS, UNINHIBITED GLYCOL OR FIELD INHIBITED GLYCOL IS NOT ACCEPTABLE.
   5. The system shall have a nameplate and shall contain the following information:
      a. Date of original Heat Transfer Fluid charge
      b. Description of Heat Transfer Fluid
      c. Manufacture's Name, Address and Telephone
      d. Percentage and Type of Glycol
      e. Freeze Point & Burst Point
      f. Total System Gallons
      g. Reference to Material Safety Sheet
      h. Instructions for Sampling of Fluid
      i. Month for Annual Sampling
      j. Mailing Instructions to independent testing laboratory
   6. Provide additional inhibitors as recommended by manufacturer if glycol percentage is below manufacturers recommendations.
   7. **Existing glycol hot water system mixture is different for each building. Contractor shall field verify existing glycol type and percentage. Contractor's option to reuse existing glycol mixture as well as provide additional glycol mixture for new glycol hot water system and piping. Drain down existing glycol system as required and store on site during construction. Contractor to verify existing system glycol manufacturer and match new glycol to existing if re-using glycol mixture.**

8. **Existing glycol chilled water system mixture is different for each building. Contractor shall field verify existing glycol type and percentage. Contractor's option to reuse existing glycol mixture as well as provide additional glycol mixture for new glycol hot water system and piping. Drain down existing glycol system as required and store on site during construction. Contractor to verify existing system glycol manufacturer and match new glycol to existing if re-using glycol mixture.**

2.2 MATERIALS

A. System Cleaner:
1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.

B. Closed System Treatment (Water):
1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
3. Conductivity enhancers; phosphates or phosphonates.

PART 3 EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.2 FLUSHING SEQUENCE

A. Flush all dirt and debris using potable water flowing at twice the normal operating flow rate (velocities of 8 feet per second, minimum) for a minimum of four hours or until no dirt or debris is visible, whichever is longer. If the building system pumps are used for flushing of the system, new pump seals shall be provided after system water treatment has been completed.

3.3 CLEANING SEQUENCE

A. Concentration:
1. As recommended by manufacturer.

B. Hot Water Heating Systems:
1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.

3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.

C. Chilled Water Systems:
1. Circulate for 48 hours, then drain systems as quickly as possible.
2. Refill with clean water, circulate for 24 hours, then drain.
3. Refill with clean water and repeat until system cleaner is removed.

D. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.4 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.5 CLOSED SYSTEM TREATMENT

A. Provide mimimum of one system fill location for each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. After the system is filled and the air is properly purged, allow the fluid to circulate for minimum 24 hours. Then, pull a sample using the sample kit provided by the manufacturer.

C. The analysis from the manufacturer should list the following:
1. pH, Color, Clarity
2. Reserve Alkalinity, ml
3. Inhibitors: Ferrous, Copper & Brass Corrosion Products
4. Degradation Products
5. Corrosives
6. Scale Promoters
7. Contaminants

3.6 GLYCOL SYSTEMS

A. Remodel Projects with existing systems: Prior to the start of construction, pull a sample of the existing system solution and send to a testing lab for analysis. Provide a test report to the Engineer and to the Owner. Identify any concerns about the condition of the system solution.

B. Clean and flush glycol system before adding glycol solution.

C. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

D. After the system is filled and the air is properly purged, allow the fluid to circulate for minimum 24 hours. Then, pull a sample using the sample kit provided by the manufacturer. Provide report to Engineer and Architect.

E. Contractor shall pull a second sample six months after the initial fill, and on the anniversary of the fill. Samples shall be sent to the manufacturer for analysis.

F. The flushing, filling and glycol for the entire hydronic system including the ground coupled heat exchanger shall be responsibility of section 23 2500.10 HVAC Water Treatment.

G. The analysis from the manufacturer should list the following:
1. Concentration, vol %
2. Freeze Point, Degrees F
3. pH, Color, Clarity
4. Reserve Alkalinity, ml
5. Inhibitors: Ferrous, Copper & Brass Corrosion Products
6. Degradation Products
7. Corrosives
8. Scale Promoters
9. Contaminants

H. Manufacturer report shall be submitted to the Engineer for the inclusion in the building submittal records for distribution to the Owner.

END OF SECTION

SECTION 23 2500.20
HVAC WATER TREATMENT
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

4.01 SUMMARY

A This Section includes the following HVAC water-treatment systems:

1. Chemical treatment test equipment.
2. HVAC water-treatment chemicals.

4.02 PERFORMANCE REQUIREMENTS

A Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C Closed hydronic systems, including hot-water heating chilled water dual-temperature water and glycol cooling, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
5. TDS: Maintain a maximum value of 10 ppm.
6. Ammonia: Maintain a maximum value of 20 ppm.
7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
8. Glycol % - 30% Propylene Glycol.

D Product Data: For each type of product indicated.

E Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

F Field quality-control test reports.

G Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

4.03 QUALITY ASSURANCE

A HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section. Minimum of 5 years experience.

B System will be rejected unless glycol has been tested and is clear for 2 months after substantial completion. It's the installing contractors responsibility for coordination and installation of all chemical flushing and final filling. Rejection of glycol system required complete removal and replacement of the fluid system.

C Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS

5.01 CHEMICALS

A Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

B Dow Chemical Company or approved equal.

PART 3 EXECUTION

6.01 WATER ANALYSIS

A Untreated domestic water is not approved for use. Chemical Contractor may provide own distilled or RO water to site or may provide filtration system on site to provide RO or Distilled water to glycol solution. Glycol premix is also approved in 400 gallon and larger totes if required.

B **Exiisting Systems: Complete hydronic system analysis prior to starting work. Provide test report to Engineer of record.**

1. **Provide the test report to the Engineer of record for review.**
2. **Failure to test prior to starting work will result in mechanical contractor providing 35% propylene system concentration with all appropriate chemical levels as noted above at contractor expense.**
3. **Basis of design is to remove and replace fluid with existing fluid. Additional fluid to be added to the system shall be limited to 50 gallons of premix plus 50 gallons of premix to be added to chemical feeder.**

C Complete water analysis every quarter for the first year.

6.02 INSTALLATION

A Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B Bypass Feeders: Install in closed hydronic systems, including hot-water heating chilled water dual-temperature water and glycol cooling, and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
2. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
3. Install a swing check on inlet after the isolation valve.

6.03 CONNECTIONS

A Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B Install piping adjacent to equipment to allow service and maintenance.

C Install shutoff valves on HVAC water-treatment equipment inlet and outlet.

6.04 FIELD QUALITY CONTROL

A Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Repair leaks and defects with new materials and retest piping until no leaks exist.

END OF SECTION 23 2500.20

SECTION 23 3100.10 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

1.2 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.

C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

G. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

H. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

1.3 SUBMITTALS

A. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

B. Duct Construction Report: Provide submittal detailing duct construction requirements. Provide duct fittings, duct gages, internal/external reinforcements, drives, etc. to meet SMACNA (DCS) construction criteria for each pressure class listed in this section. Provide with applicable SMACNA tables.

C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.5 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

C. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

D. Insulated Flexible Ducts:
1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
   a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
   b. Maximum Velocity: 4000 fpm.
   c. Temperature Range: -20 degrees F to 210 degrees F.
   d. Insulation: Refer to HVAC Insulation Spec Section for insualtion requirements.

E. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
2. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.

2.2 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.3 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMANCA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing and sealing for operating pressures indicated.

B. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
1. Manufacture in accordance with SMACNA (DCS).

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Duct sizes indicated are inside clear dimensions.

E. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

F. Provide turning veins in all rectangular elbows as indicated on plans and/or if either duct dimension is 12" or larger . Transfer duct elbows do not require turning veins.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

I. Use double nuts and lock washers on threaded rod supports.

J. Do not use flexible duct to change direction.

K. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

L. Connect flexible ducts to metal ducts per detail located on drawings

M. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

N. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

O. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

P. If test and balance report shows the duct traverse at the fan to be 10% or higher than the sum of the outlets, the contractor shall be required to re-seal ductwork to reduce leakage to less than 10%. Contractor shall be responsible for removing and replacing ceiling tiles, removing and replacing duct insulation and all other work required to re-seal ductwork.

3.2 SCHEDULES

A. Ductwork Pressure Class:
   1. Constant Volume Air Handling Unit Systems
      a. Supply main ducts, 2 inch w.g.
      b. Return main ducts, 1 inch w.g.
      c. Branch ductwork, 0.5 inch w.g.
      d. Outside air and relief air ductwork, 1 inch w.g.

END OF SECTION

SECTION 23 3300.10 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers.

C. Duct access doors.

D. Duct test holes.

E. Flexible duct connectors.

F. Volume control dampers.

1.2 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

1.3 SUBMITTALS

A. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

B. Project Record Drawings: Record actual locations of access doors and test holes.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.2 BACKDRAFT DAMPERS

A. Manufacturers:
1. Greenheck
2. Nailor Industries Inc: www.nailor.com.
3. Ruskin Company: www.ruskin.com.
4. Pottorff: www.pottorff.com.
5. Aire Technologies, Inc.
6. Tamco

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

A. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
1. Up to 24 inches square: Provide paired camlocks.
2. Larger than 24 inches: Provide hinge and compression latches.

B. Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.

a. Net Fabric Width: Approximately 2 inches wide.

2.6 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Single Blade Dampers:

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

E. Quadrants:
1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 3100.10 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. If there are conflicts to this minimum access for any damper, contact the Engineer for review. Refer to the drawings and details for size of panels. Where no size is indicated on the drawings, hand access shall be minimum 8" x 8" and shoulder access shall be minimum 24" x 24".

D. Provide turning veins in all rectangular elbows as indicated on plans and/or if either duct dimension is 12" or larger . Transfer duct elbows do not require turning veins.

E. Provide duct test holes where indicated and required for testing and balancing purposes.

F. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

G. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

H. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

I. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

J. Provide control dampers as indicated on the drawings.

K. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 3413.10 - AXIAL HVAC FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Propeller fans.

1.2 REFERENCE STANDARDS

A. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.

B. NEMA MG 1 - Motors and Generators; 2018.

1.3 SUBMITTALS

A. Product Data: Provide data on axial fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.6 FIELD CONDITIONS

A. Permanent fans may not be used for ventilation during construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Loren Cook Company: www.lorencook.com/#sle.

B. Greenheck

C. Twin City Fan

2.2 PROPELLER FANS

A. Performance: Refer to drawings.

B. Impeller: Shaped steel or steel reinforced aluminum blade with heavy hubs, statically and dynamically balanced, keyed and locked to shaft, directly connected to motor or provided with V-belt drive.

C. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.

D. Accessories:
1. Backdraft Damper: Multiple blade with offset hinge pin, blades linked.
2. Safety Screens: Expanded galvanized metal over inlet, motor, drive; to comply with 29 CFR 1910.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install fan restraining snubbers. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

C. Provide fixed sheaves required for final air balance.

D. Provide safety screen where inlet or outlet is exposed.

E. Provide backdraft dampers on discharge of exhaust fans and as indicated.

END OF SECTION

SECTION 23 3423.10 - HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Utility vent set.

1.2 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

B. AMCA 99 - Standards Handbook; 2016.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2005 (Reaffirmed 2012).

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.

G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.

H. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

I. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Fan Belts: One set for each individual fan.

1.4 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Greenheck / Accurex

B. Loren Cook Company: www.lorencook.com.

C. Twin City Fan & Blower: www.tcf.com/#sle.

2.2 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.

B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.

D. Fabrication: Comply with AMCA 99.

E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

G. Provide phase monitors and brown out protection on all three phase units.

H. Hood Exhaust Fans: Comply with requirements of NFPA 96.

2.3 UTILITY VENT SET

A. Belt Drive Fan:
1. Fan Wheel:
   a. Type: Non-overloading, backward inclined centrifugal.
   b. Material: Aluminum.
2. Statically and dynamically balanced.
3. Motors:
   a. Open drip-proof (ODP).
   b. Heavy duty ball bearing type.
   c. Mount on vibration isolators or resilient cradle mounts, out of air stream.
   d. Fully accessible for maintenance.
4. Housing:
   a. Rigid internal support structure.
   b. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.

c. Provide breather tube for fresh air motor cooling and wiring.

B. Shafts and Bearings:
1. Fan Shaft:
a. Ground and polished steel with anti-corrosive coating.
b. First critical speed at least 25 percent over maximum cataloged operating speed.
2. Bearings:
a. Permanently sealed or pillow block type.
b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
c. 100 percent factory tested.

C. Drive Assembly:
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
2. Belts: Static free and oil resistant.
3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. Motor pulley adjustable for final system balancing.
5. Readily accessible for maintenance.

D. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide sheaves required for final air balance.

C. Install backdraft dampers on inlet to roof and wall exhausters.

END OF SECTION

SECTION 23 3700.10 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Louvers.

1.2 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2015.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

1.3 SUBMITTALS

A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.4 QUALITY ASSURANCE

A. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 PRODUCTS

2.1 LOUVERS

A. Manufacturers:
1. Greenheck
2. Ruskin
3. Arrow
4. Louvers & Dampers
5. Nailor
6. Pottorff

B. Type: 4 inch deep with blades on 45 degree slope with heavy channel frame and birdscreen attached to the back of the louver.

C. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory baked enamel finish custom color to be selected.
1. Each louver may be selected in a different color.

D. Mounting: Furnish with interior flat flange for installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers.

E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 23 5100.20
BREECHINGS, CHIMNEYS, AND STACKS
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 SECTION INCLUDES

A Special gas venting.

3.02 RELATED REQUIREMENTS

3.03 REFERENCE STANDARDS

A NFPA 31 - Standard for the Installation of Oil-Burning Equipment; 2024.

B NFPA 54 - National Fuel Gas Code; 2024.

C NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2024.

D NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.

E SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

F UL 1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV; Current Edition, Including All Revisions.

3.04 DEFINITIONS

A Breeching: Vent connector.

B Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

C Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

D Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

3.05 SUBMITTALS

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

B Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

C Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory-built units are used.

D Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.

3.06 QUALITY ASSURANCE

A Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

4.01 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

A Regulatory Requirements:

1. Comply with applicable codes for installation of natural gas burning appliances and equipment.
2. Comply with NFPA 31 for installation of oil burning appliances and equipment.
3. Factory-built vents and chimneys used for venting natural draft appliances to comply with NFPA 211 and UL listed and labeled.

4.02 SPECIAL GAS VENTING (CATEGORY II, III, AND IV)

A Single-Wall Special Gas Venting:

1. Manufacturers:
    a. Heatfab Saf-T Vent: www.heatfab.com/#sle.
    b. Z-Flex U.S. Inc: www.z-flex.com/#sle.
    c. Duravent.
2. Provide single-wall metal stacks, tested to UL 1738 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 54.
3. Fabricate with 28-gauge, 0.0156-inch 29-4C stainless steel minimum.
4. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.
5. Accessories, UL Labeled:

B Polypropylene Gas Venting

1. Manufacturers
    a. CentroTherm
    b. DuraVent
2. All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, ANSI Z223.1/NFPA-54 where applicable and shall comply with and be listed to UL-1738, the US Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV and ULC-S636-95, the Canadian Standard for Type BH gas vent systems. These requirements cover venting systems intended for venting Category II or IV gas-burning appliances as defined by the Standard for Gas-Fired Central Furnaces (except Direct-Vent Central Furnaces), ANSI Z21.47 and the National Fuel Gas Code, NFPA 54. Venting systems covered by these requirements are intended to be used with Category II, III, and IV appliances that have been installed in accordance with NFPA 54, and with codes such as the BOCA National Mechanical Code, the Standard Mechanical Code, the Uniform Mechanical Code, and local codes. Components coming in direct contact with products of combustion shall carry the appropriate UL/cUL labels.
3. The manufacturer shall warrant the Positive Pressure Vent System against defects in material and workmanship for a period of 10 years from the date of the original installation. Any portion of the vent repaired or replaced under the warranty shall be warranted for the remainder of the original warranty period.
4. The vent shall be of the single wall, factory-built type, designed for use in conjunction with Category II, or IV condensing gas fired appliances, condensing oil fired appliances or as specified by the heating equipment manufacturer
5. Maximum continuous flue gas temperature shall not exceed 230 degrees F (110 degrees C).
6. Vent shall be listed for a maximum positive pressure rating of 20” w.c.
7. The vent system shall be continuous from the appliance’s flue outlet to the vent termination outside the building. All systems components shall be UL/cUL listed and supplied by the same manufacturer.
8. All systems components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings required to install the vent system shall be UL/cUL listed and provided by the vent manufacturer.
9. All systems components shall include a factory- installed gasket in their female-end to render the vent air and water tight when the male/female ends are pushed together as per manufacturer’s instructions. Vent systems requiring field installed sealants or compounds shall not be acceptable.

10. Vent layout shall be designed and installed in compliance with manufacturer’s installation instructions and all applicable local codes.

PART 3 EXECUTION

5.01 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Install in accordance with NFPA 54

C Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D Rigidly support breechings from building structure with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12-foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.

E Assemble and install stack sections in accordance with NFPA 82, UL Listings, and industry practices. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

F Level and plumb chimney and stacks.

G Clean breechings, chimneys, and stacks during installation, removing dust and debris.

5.02 SCHEDULES

A Breechings, Chimneys and Stacks.

1. Boiler: PolyProypylene intake
2. Boiler: AL29-4C vent
3. Water Heater: Polypropylene vent and intake

END OF SECTION 23 5100.20

SECTION 23 5216.20
CONDENSING BOILERS
(LONGFELLOW ELEMENTARY)
(LINCOLN ELEMENTARY)

PART 1 GENERAL

3.01 RELATED DOCUMENTS

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

3.02 SUMMARY

A Section includes gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

3.03 SUBMITTALS

A Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and mounting 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.

3.04 INFORMATIONAL SUBMITTALS

A Seismic Qualification Certificates: For boiler, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B Source quality-control reports.

C Field quality-control reports.

D Sample Warranty: For special warranty.

E Other Informational Submittals:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
2. CSA B51 pressure vessel Canadian Registration Number (CRN).

3.05 CLOSEOUT SUBMITTALS

A Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

3.06 WARRANTY

A Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fire-Tube Condensing Boilers:

a. Leakage and Materials: 10 years from date of Substantial Completion.
b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Nonprorated for 5 years from date of Substantial Completion.

PART 2 PRODUCTS

4.01 PERFORMANCE REQUIREMENTS

A Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

C ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.

E UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

F CSA Compliance: Test boilers for compliance with CSA B51.

G Mounting Base: For securing boiler to existing concrete base.

4.02 WATER-TUBE CONDENSING BOILERS

A Manufacturers: Subject to compliance with requirements, provide products by the following:
1. AERCO
2. Thermal Solutions – Amp

B Description: Factory-fabricated, -assembled, and -tested, stainless steel, water-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.

C Heat Exchanger: Stainless-steel heat exchangers.

D Combustion Chamber: Stainless steel, sealed.

E Burner: Natural gas, forced draft drawing from gas premixing valve.

F Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.
1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

G Gas Train: Combination gas valve with manual shutoff and pressure regulator.

H Ignition: Silicone carbide hot-surface ignition that includes flame safety supervision and 100 percent main-valve shutoff.

I Casing:
1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Textured epoxy.
4. Insulation: Minimum 1-inch-thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.

J Capacities and Characteristics: See Drawings

4.03 TRIM

A North Dakota Compliant Trim

B Include devices sized to comply with ASME B31.1.

C Pressure Controllers: Operating, firing rate, and high limit.

D Safety Relief Valve:

1. Size and Capacity: As required for equipment according to 2010 ASME Boiler and Pressure Vessel Code.
2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
    a. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.

E Pressure Gage: Minimum 3-1/2-inch diameter. Gage shall have normal operating pressure about 50 percent of full range.

4.04 CONTROLS

A Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.
3. Operating Pressure Control: Factory wired and mounted to cycle burner.
4. Low-Water Cutoff and Pump Control: Cycle feedwater pump(s) for makeup water control.
5. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 140; at 60 deg F outside-air temperature, set supply-water temperature at 120.
    a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

B Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

C Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.
2. Interface shall be provided by Boiler Manufacturer for staging and sequencing all high efficiency boilers along with programing to allow for control of fuel oil / natural gas boiler on a call for heat or natural gas interruption.

4.05 ELECTRICAL POWER

A Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

B Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
5. Provide each motor with overcurrent protection.

4.06 VENTING KITS

A Combustion-Air Intake: Complete system CPVC or Poylpropylene systems

B Boiler Exhaust shall be AL29. PVC Not allowed.

C Boilers shall be individually vented for both combustion and outside air. No concentric venting is allowed.

4.07 SOURCE QUALITY CONTROL

A Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

C Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 EXECUTION

5.01 EXAMINATION

A Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B Examine mechanical spaces for suitable conditions where boilers will be installed.

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

5.02 BOILER INSTALLATION

A Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment base(s).

B Install gas-fired boilers according to NFPA 54.

C Assemble and install boiler trim.

D Install electrical devices furnished with boiler but not specified to be factory mounted.

E Install control wiring to field-mounted electrical devices.

5.03 CONNECTIONS

A Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B Install piping adjacent to boiler to allow service and maintenance.

C Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 23 21 16 "Hydronic Piping Specialties."

E Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required. Regulator for boiler shall be at least 10 feet away from boiler and installed as per manufacturers recommendations.

F Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G Install piping from safety relief valves to nearest floor drain.

H Install piping from safety valves to drip-pan elbow and to nearest floor drain.

I Boiler Venting:

1. Install flue venting kit and combustion-air intake.

5.04 FIELD QUALITY CONTROL

A Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B Perform the following tests and inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C Boiler will be considered defective if it does not pass tests and inspections.

D Prepare test and inspection reports.

E Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

F Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.
    a. Test for full capacity.
    b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.
4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.

6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
7. Notify COTR 24 hours minimum in advance of test dates.
8. Document test results in a report and submit to Architect.

G The owner will be engaging a commissioning agent to verify installation and functionality of the mechanical system. Mechanical contractor shall be present and provide support as required for commissioning agent during the pre-function and functional testing phases.

END OF SECTION 23 5216.20

SECTION 23 5234.10 - FINNED MODULAR BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Controls and boiler trim.

C. Hot water connections.

D. Fuel connection.

E. Emergency Shutdown Switches.

1.2 REFERENCE STANDARDS

A. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2010.

B. ASME (BPV IV) - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers; 2007.

C. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2007.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

E. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2009.

F. UL (HCVCE) - Heating, Cooling, Ventilating and Cooking Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.3 SUBMITTALS

A. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements.

B. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

1.5 REGULATORY REQUIREMENTS

A. Conform to ASME (BPV IV) and (BPV VIII,1) for boiler construction.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.7 EXTRA MATERIALS

A. Provide one additional set of combustion air filters.

1.8 WARRANTY

A. Provide a five year warranty to include coverage for heat exchangers.

B. Provide a one year warranty on the burner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Lochinvar Corporation: www.lochinvar.com. - Knight XL

B. Burnham/Thermal Solutions - Apex

C. Fulton - Endura XE

2.2 MANUFACTURED UNITS

A. Sealed combustion hot water boiler with stainless steel finned tube heat exchanger, gas burning system, combustion chamber, controls and boiler trim.

B. Performance: See schedule on plans.

2.3 FABRICATION

A. Assembly: Stainless steel tube heat exchanger assembled within combustion chamber conforming to ASME (BPV IV) and (BPV VIII, 1) requirements, and tested for maximum working pressure of 160 psi.

B. Combustion Chamber: Stainless steel metal-mesh burner enclosed in stainless steel with a fully water-backed tube sheet heat exchanger.

C. Jacket: Galvanized steel with factory applied powder coat finish, insulated with foil faced fiberglass insulation.

2.4 FUEL BURNING SYSTEM

A. Sealed Combustion Gas Burner: Stainless steel metal-mesh burner with no moving parts, full modulation with minimum 5:1 turn down utilizing a VFD and negative pressure regulation gas valve , interrupted-type mixed fuel/air pilot system with electric spark-to-pilot ignition, pilot proving device, manual shut-off and automatic main and redundant 100% safety gas shut-off valves, high and low gas pressure switches, blower, replaceable combustion air filter and combustion air pressure switch.

B. Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven allow gas valve to open. Conform to requirements of UL 795 and CSD-1.

C. Corrosion resistant stainless steel condensate collection/evaporation components.

D. Venting: Polypropylene piping rated for venting gas fired equipment.

E. Air Intake: PVC piping.

F. Provide factory concentric vent kit. Refer to drawings for roof or wall termination.

2.5 TRIM

A. ASME rated pressure relief valve set at 50 psi.

B. Low water cut-off and inlet flow switch to automatically prevent burner operation when water falls below safe level or on low flow through boiler.

C. Provide unit mounted water pressure and temperature gauge.

2.6 CONTROLS

A. Operating Controls: Smart System control with multi -colored graphic lcd display, pre-wired, factory assembled electric control including pilot safety and thermocouple transformer, 24-volt gas valve, manual main and pilot valves, and junction box.

B. Electronic operating temperature controller:
1. NEMA 250 Type 1 enclosure installed on boiler.
2. Ambient temperature range -30 to 150 degrees F.
3. Adjustable reset ratio of outside air temperature change to discharge control point change 1:2 to 100:1.
4. Integral set point adjustment 80 to 230 degrees F.
5. Electronic primary and outdoor sensors.
6. Built-in sequencing options for lead-lag or efficiency optimzed modulation logic with rotation.
7. Two terminal strips for saftey and operating controls and integral relays for pump control.

C. High limit temperature controller with manual reset for burner to prevent boiler water temperature from exceeding safe system temperature.

2.7 EMERGENCY SHUTDOWN SWITCHES

A. ADA compliant emergency power off push button switch station. Provide with red push switch. Rated for indoor/outdoor use as required. Designed for single gang box installation.
1. Provide switch/switches for boilers at boiler rooms doors. Coordinate exact switch locations and quantity with local boiler inspector.

B. Label for use and provide with clear (lift to open) cover.

C. Provide all associated wiring and controls as required for a complete system.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.

C. Install boiler on concrete housekeeping base, sized minimum 4 inches larger than boiler base.

D. Maintain manufacturer's recommended clearances around and over equipment and as required by local code.

E. Arrange all electrical conduit, piping, exhaust vent, and air intake with clearances for burner removal and service of all equipment.

F. Connect exhaust vent and air inlet to boiler.

G. Connect gas, supply and return water connections.

H. Pipe relief valves and condensate to nearest floor drain.

3.2 SYSTEM STARTUP

A. Provide minimum of 4 hours of operation and maintenance training for owner personnel.

B. Provide the services of manufacturer's field representative for starting and testing boiler to manufacturers guidelines. Coordinate startup with all trades.

END OF SECTION

SECTION 23 5235.10 - STAINLESS STEEL MODULAR BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Controls and boiler trim.

C. Hot water connections.

D. Fuel connection.

E. Double Wall Vent

F. Emergency Shutdown Switches

1.2 REFERENCE STANDARDS

A. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2010.

B. ASME (BPV IV) - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers; 2007.

C. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2007.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

E. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2009.

F. UL (HCVCE) - Heating, Cooling, Ventilating and Cooking Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.3 SUBMITTALS

A. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements.

B. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

1.5 REGULATORY REQUIREMENTS

A. Conform to ASME (BPV IV) and (BPV VIII,1) for boiler construction.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.7 WARRANTY

A. Provide a ten year warranty to include coverage for heat exchangers.

B. Provide a five year warranty on leakage and materials.

C. Provide a two year warranty on the control panels.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Boilers
1. Aerco - Benchmark
2. Thermal Solution - Arctic
3. Lochinvar - Crest
4. Fulton - Endura
5. Laars - MagnaTherm FT

B. Double Wall Venting
1. Heatfab by Commercial Products Group of Hart & Cooley
2. Metal-fab, Inc
3. Selkirk Corporation
4. Schebler
5. Dura-Vent
6. Z-Vent

7. Enervex

2.2 MANUFACTURED UNITS

A. Sealed combustion hot water boiler with stainless steel fire tube heat exchanger, gas burning system, combustion chamber, controls and boiler trim.

B. Performance: See schedule on plans.

2.3 FABRICATION

A. Assembly: Stainless steel fire tubes and tubesheets assembled within combustion chamber conforming to ASME (BPV IV) and (BPV VIII, 1) requirements, and tested for maximum working pressure of 160 psi.

B. Heat Exchanger: The heat exchanger shall be constructed of 316L stainless steel fire tubes and tubesheets. The pressure vessel/heat exchanger shall be welded construction

C. Pressure Vessel: SA53 carbon steel.

D. Exhaust Manifold: Corrosion resistant cast aluminum with a collecting reservoir and a gravity drain for the elimination of condensation.

E. Blower. The boiler shall include a variable-speed, DC centrifugal fan to operate during the burner firing sequence and pre-purge the combustion chamber.

F. Jacket: Galvanized steel with factory applied powder coat finish, insulated with foil faced fiberglass insulation.

2.4 FUEL BURNING SYSTEM

A. Modulating Air/Fuel Valve and Burner: The boiler burner shall be capable of a 5 to 1 turndown ratio. The burner shall be metal fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage.

B. Ignition: Ignition shall be via spark ignition with 100 percent main-valve shutoff and electronic flame supervision.

C. Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven allow gas valve to open. Conform to requirements of UL 795 and CSD-1.

D. Venting: AL 29-4C, positive pressure type vent material.

E. Air Intake: PVC piping.

2.5 TRIM

A. ASME rated pressure relief valve set at 50 psi.

B. Low water cut-off and inlet flow switch to automatically prevent burner operation when water falls below safe level or on low flow through boiler.

C. Provide unit mounted water pressure and temperature gauge.

2.6 CONTROLS

A. Operating Controls: Smart System control with multi -colored graphic lcd display, pre-wired, factory assembled electric control including pilot safety and thermocouple transformer, 24-volt gas valve, manual main and pilot valves, and junction box.

B. Electronic operating temperature controller:
1. NEMA 250 Type 1 enclosure installed on boiler.
2. Ambient temperature range -30 to 150 degrees F.
3. Adjustable reset ratio of outside air temperature change to discharge control point change 1:2 to 100:1.
4. Integral set point adjustment 80 to 230 degrees F.
5. Electronic primary and outdoor sensors.
6. Built-in sequencing options for lead-lag or efficiency optimzed modulation logic with rotation.
7. Terminal strips for safety and operating controls, integral relays for pump control and relays for control valve operation.

C. High limit temperature controller with manual reset for burner to prevent boiler water temperature from exceeding safe system temperature.

D. Controller shall integrate to Automatic Temperature Controls system.
1. Boiler manufacturer to provide, integral to boiler, a BACnet MS/TP communication interface as required to connect the Johnson Controls Automatic Temperature Controls building Management System. Boiler status, Boiler On/Off set points, alarm points, and boiler control parameters shall be available on the Building Management System. Provide controls contractor with mapping instructions.

2.7 DOUBLE WALL VENT FOR CATEGORY I, II, III, OR IV APPLIANCES (AS REQUIRED BY MANUFACTURER)

A. Provide double wall metal stacks, tested and listed to UL 1738 and UL 641 for use with listed oil and gas burning equipment which produce continuous flue-gas temperatures not above 570 deg. F.

B. Fabricate with 1 inch minimum air space between walls. Construct inner jacket of AL29-4C stainless steel. Construct outer jacket of 430 stainless steel.

C. All joints shall be fastened with a closure system in accordance with the vent listing providing a gas tight system at two and a half times the listed pressure rating of 15 in. water column.

D. Refer to the drawings for venting configuration and field verify dimensions. Provide accessories as required for the arrangement on the drawings including ventilated roof thimble, flashing, storm collar, stack cap or wall cap, and drip tee.

E. Boilers: Fabricate with 2 inches minimum ceramic fiber insulation between walls and construct inner liner of 304 stainless steel and outer jacket of aluminum coated steel.

F. All supports, drains, terminations, flange adaports, fittings and lined bellows expansion joists required to install the exhaust pipe shall be included.

G. Inner pipe joints shall be held together by means of formed vee bands and sealed with P071, high temperature sealant or as recommended by manufacturer.

H. Outer pipe bands shall be sealed to prevent rainwater from entering space between inner and outer walls.

I. Refer to drawings and details for arrangement.

J. Accessories:
1. Drip tee with drain piped to the floor drain.

2.8 CONDENSATE NEUTRALIZATION TANK

A. Provide condensate neutralization tank equal to Axiom Industries Model NT20.

2.9 EMERGENCY SHUTDOWN SWITCHES

A. ADA compliant emergency power off push button switch station. Provide with red push switch. Rated for indoor/outdoor use as required. Designed for single gang box installation.
1. Provide switch/switches for boilers at boiler rooms doors. Coordinate exact switch locations and quantity with local boiler inspector.

B. Label for use and provide with clear (lift to open) cover.

C. Provide all associated wiring and controls as required for a complete system.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.

C. Install boiler on concrete housekeeping base, sized minimum 4 inches larger than boiler base.

D. Maintain manufacturer's recommended clearances around and over equipment and as required by local code.

E. Arrange all electrical conduit, piping, exhaust vent, and air intake with clearances for burner removal and service of all equipment.

F. Connect exhaust vent and air inlet to boiler.

G. Connect gas, supply and return water connections.

H. Pipe relief valves and condensate to nearest floor drain.

3.2 SYSTEM STARTUP

A. Provide minimum of 4 hours of operation and maintenance training for owner personnel.

B. Provide the services of manufacturer's field representative for starting and testing boiler to manufacturers guidelines. Coordinate startup with all trades.

END OF SECTION

SECTION 23 7313.10 - AIR-HANDLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Casing construction.

B. Fan section.

C. Coil section.

D. Filter and air cleaner section.

E. Access section.

1.2 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).

C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

D. AMCA 99 - Standards Handbook; 2016.

E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.

F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.

G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.

H. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2015.

I. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

1.3 SUBMITTALS

A. Product Data:

1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
2. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
3. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.

B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.5 EXTRA MATERIALS

A. Supply one set for each unit of filters.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Daikin Applied: www.daikinapplied.com/#sle.

B. Trane Inc: www.trane.com/#sle.

C. York International Corporation / Johnson Controls Inc: www.york.com/#sle.

2.2 CASING CONSTRUCTION

A. Full Perimeter Base Rail:
1. Construct of galvanized steel.
2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.

B. Drain Pan Construction:
1. Provide cooling coil and humidifier sections with an insulated, double wall, stainless steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.

3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.

C. Construction: Fabricate on channel base and drain pan of welded stainless steel. Assemble sections with gaskets and bolts. Outside and inside casing shall be solid galvanized steel. Insulation between the casings shall be foam with minimum R-13.

D. Access Doors: galvanized steel insulated sandwich construction, for flush mounting, with hinges, gasket, latch, and handle assemblies,

E. Drain Pans: Construct from double thickness stainless steel with insulation between layers with welded corners. Cross break and pitch to drain connection. Provide drain pans under cooling coil section .

F. Strength: Provide structure to brace casings for suction pressure of 2.5 inch wg, with maximum deflection of 1 in 200.

G. Performace: Case leakage rates shall not exceed 1% of supply air volume at design static pressure up to +- 8" w.c.

H. Louvers: Stationary, of galvanized steel, 4 inch deep with plenum, nylon bearings, 1/2 inch mesh, 0.04 inch galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-L. Furnish adjustable louvers with hollow vinyl bulb edging on blades and foam side stops to limit leakage to maximum 2 percent at 4 inch wg differential pressure when sized for 2000 fpm face velocity.

I. Finish:
1. Indoor Units
   a. Baked Enamel Finish

2.3 FAN SECTION

A. Type: Refer to the drawings for fan type.

B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.

E. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.

F. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted starter-disconnect, variable frequency drive, and external motor junction box.

G. Drives:
1. Comply with AMCA 99.
2. Bearings: Heavy duty pillow block type, ball bearings with ABMA STD 9 L-10 life at 50 000 hours.

H. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

I. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

J. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.4 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.

C. Eliminators: Three break of galvanized steel, mounted over drain pan.

D. Air Coils:
1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

E. Fabrication:
1. Tubes: 1/2 inch or 5/8 inch OD seamless copper expanded into fins, brazed joints.
2. Fins: Aluminum.
3. Casing: Die formed channel frame of galvanized steel.

2.5 FILTER AND AIR CLEANER SECTION

A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.

B. Refer to plans for filter requirements.

C. Filter Gages:
1. 3-1/2 inch diameter diapgragm actuated dial in metal case with static pressure tips.

2.6 ACCESS SECTION

A. Provide as required and where indicated on drawings and of sufficient size to allow for inspection, cleaning, and maintenance of field-installed components.

B. Construct access doors same as previously specified within this Section.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Bolt sections together with gaskets.

C. Install flexible duct connections between fan inlet and discharge ductwork and air handling unit sections. Ensure that metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

D. Install neoprene vibrations isolation pads under air handling unit.

E. Provide fixed sheaves required for final air balance.

F. Make connections to coils with unions or flanges.

G. Route condensate line from unit to nearest floor drain or condensate pump.

H. Hydronic Coils:
1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
3. Locate water supply at bottom of supply header and return water connection at top.
4. Provide manual air vents at high points complete with stop valve.
5. Ensure water coils are drainable and provide drain connection at low points.

I. Field-wire each factory provided control for field installation.

3.2 FIELD QUALITY CONTROL

A. Final Acceptance Requirements:
1. Use dial indicator gauges to demonstrate fan and motor are aligned.
2. Verify compliance with specifications using vibration analysis.

3.3 SYSTEM STARTUP

A. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.

B. Adjust for proper operation within manufacturer's published tolerances.

3.4 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation of system to Owner's personnel.
1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.

B. Training: Train Owner's personnel on operation and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Location: At project site.

3.5 DEMONSTRATION

A. Provide on-site training course of 4 hours shall be provided by a representative of the unit manufacturer to plant and/or maintenance personnel.

END OF SECTION

SECTION 23 8101.10 - TERMINAL HEAT TRANSFER UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unit heaters.

1.2 SUBMITTALS

A. Product Data: Provide typical catalog of information including arrangements.

B. Shop Drawings:
1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
3. Indicate mechanical and electrical service locations and requirements.,

C. Manufacturer's Instructions: Indicate installation instructions and recommendations.

D. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.3 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 UNIT HEATERS

A. Manufacturers:
1. Slant/Fin Corporation: www.slantfin.com.
2. Sterling Hydronics/Mestek Technology, Inc: www.sterlingheat.com.
3. Sigma
4. Trane Inc: www.trane.com.
5. Modine
6. Rittling
7. McQuay
8. Airtherm
9. Reznor
10. Vulcan

B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

C. Casing: 18-gauge steel with threaded pipe connections for hanger rods.

D. Finish: Factory applied powder coat.

E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

F. Air Outlet: Adjustable pattern diffuser on projection models and two way louvers on horizontal throw models.

G. Motor: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models.

H. Capacity: See schedule.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Do not damage equipment or finishes.

C. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

D. Hydronic Units: Refer to plans for piping requirements.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 26 00 00

ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical General Requirements specifically applicable to Division 26 Sections, in addition to Division 01 - General Requirements.

B. Definitions common to Division 26 specification sections.

1.02 RELATED DOCUMENTS

A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26.

B. This section is related to all other sections of Division 26.

1.03 DEFINITIONS

A. Words "Architect" where written in Division 26 specifications and drawings refer to commissioned Design Professional, whose name appears on contract documents.

B. Word "Engineer" where written in Division 26 specifications and drawings refers to Consulting Electrical Engineer, CMTA, Inc.; (877) 380-0501; https://www.cmta.com/contact.

C. Word "Contractor" where written in Division 26 specifications and drawings refers to Electrical Contractor and any and all of his subcontractors.

D. Word "Furnish" where written in Division 26 specifications and drawings shall mean Contractor shall deliver to the site item(s) specified, as well as additional specialized materials and/or accessories necessary for the use and operation of item or items specified.

E. Word "Install" where written in Division 26 specifications and drawings shall mean Contractor shall set in position, connect (including sub-assemblies furnished), and adjust for use. Contractor shall furnish miscellaneous specialty items such as fittings, hangers, fastening devices, etc., as obviously necessary for a complete and operating installation.

F. Word "Material" where written in Division 26 specifications and drawings shall mean any and all apparatus, equipment, devices, fixtures, components, products, assemblies, items, parts, things, and any other pieces specified or shown or required.

G. Word "Labor" where written in Division 26 specifications and drawings shall mean any and all physical effort, manpower, time, expertise, tools, equipment and services to carefully assemble, install and affix all material in a proper, complete and acceptable manner.

H. Word “Low Voltage” where written in Division 26 specifications and drawings shall mean 0 to 1,000 Volts (IEEE).

I. Word "Provide" where written in Division 26 specifications and drawings shall mean Contractor shall perform all labor and furnish all materials and equipment necessary to that specified item or system will be complete and operational in every respect.

J. Performance Verification Testing refers to test performed in the field to ensure proper operation and / or installation of service or products.

1. Unless noted otherwise Performance Verification Testing is not required to be provided by a 3rd party testing firm.
2. Unless noted otherwise Performance Verification Testing is not required to be witnessed by the Electrical Engineer, Owner, Architect, and / or (if applicable) Commissioning Agent

K. Acceptance Testing refers to formal testing process required prior to acceptance by the Owner.

1. Unless noted otherwise Acceptance Testing is required to be provided by a 3rd party testing firm.
2. Unless noted otherwise Acceptance Testing is required to be witnessed by the Electrical Engineer, Owner, Architect, and / or (if applicable) Commissioning Agent.

L. As-built drawings are prepared by the contractor. They show, in red ink, on-site changes to the original construction documents.

M. Record drawings are prepared by the Architect or Engineer and reflect on-site changes the contractor noted in the as-built drawings.

N. Quality Assurance includes all the planned and systematic activities implemented that can be demonstrated to provide confidence that a product or service will fulfill requirements for quality. Typically, quality assurance procedures are performed before and while the work is being performed. As such in the Division 26 specifications Quality Assurance procedures are specified in Part 1.

O. Quality Control includes all the planned activities required to verify quality after the work has been performed. This can include testing and inspections along with other procedures. As such in the Division 26 specifications Quality Assurance procedures are specified in Part 3.

1.04 SCOPE OF WORK

A. All Specifications, corresponding Drawings and all Addenda form a complete set of documents for electrical work for this project, and no part shall be considered complete without the other.

B. The Specifications, Drawings, and all Addenda describe both the design characteristics and functional performance criteria that the completed electrical and telecommunications and electronic safety and security systems shall include.

C. Contractor shall obtain all required licenses, permits, plan reviews, inspections and pay all fees, costs and all other charges for this project. All sales, use and any other taxes shall be paid by Contractor.

D. Electrical Work shall comply with all ordinances, laws, regulations and codes applicable to the work involved. If, in any instance, the plans and specifications conflict with such laws, the stricter requirement shall take preference.

1. If Contractor is aware of conflicts between drawings or specifications and such codes or regulations, they shall be brought to the Engineer's attention prior to commencing work. If Contractor performs work in violation of such codes or regulations, Contractor shall correct the violation at his expense.

E. Work under Division 26 includes providing all labor and materials necessary for satisfactory completion of all electrical work shown on all drawings and in all specification divisions.

1.05 Site Investigation

A. Prior to submitting bids, visit the work site to become familiar with existing conditions which may affect the cost of the project. This includes measurements for lengths, quantities, clearances and all other field verifiable conditions.

B. No extra charges will be allowed because of failure of Contractor to become familiar with all existing conditions.

C. Where work under this project requires extension, relocation, or modifications to existing equipment, systems or installations the existing equipment, system or installations shall be restored to their original condition, with exception to the work under this project, before completion.

D. Existing equipment, systems and installations which are not detailed on the drawings must still be restored to their original condition.

1.06 DRAWINGS

A. Drawings indicate the extent and general layout of the electrical systems.

B. The electrical drawings are diagrammatic (that is, designed to demonstrate or explain the scope of work), they are intended to be as accurate as planning can determine.

C. The scales are shown for estimating purposes only. Field verification of dimensions, locations, and construction details is required. Review appropriate drawings (for example: shop drawings), make field measurements and adjust work to suit the conditions encountered. Although electrical drawings are diagrammatic, they shall be followed as closely as actual construction permits.

D. Contractor shall coordinate with civil, architectural, structural, and mechanical construction drawings for locations of partitions, walls, beams, shafts, equipment, etc.

E. In general, the drawings of the Electrical Systems and Equipment are to scale, however, to determine exact locations of walls and partitions, the Contractor shall consult the Architectural and/or Structural Drawings which are dimensioned. Drawings shall not take precedence over field measurements. Plans showing circuiting or conduit routing, although shown on scale drawings, are diagrammatic only. They are intended to indicate the size and/or capacity where stipulated, approximate location and/or direction, and approximate general arrangement of one phase of work to another, but not the exact detail or exact arrangement of construction

1. **DO NOT SCALE LOCATIONS OF ELECTRICAL OUTLETS, LIGHT FIXTURES, OR OTHER DEVICES FROM ELECTRICAL DRAWINGS**.
2. Because the drawings are to a relatively small scale to show as large a portion as is practical, the fact that only certain features of the system are indicated does not mean that other similar or different features or details will not be required. The Contractor shall furnish all incidental labor, materials, or equipment for the systems under their control, so that each system is a complete and operating one unless otherwise specifically stipulated in the detailed body of the Specifications.

F. The Contractor shall be responsible for determining all field measurements before commencing construction, giving due consideration to building design and other equipment to be installed. Electrical equipment not dimensioned on the drawings shall be field located, giving due consideration to the work of other trades. The Contractor shall verify all dimensions before proceeding with the work. Where cutting and patching is required, each Subcontractor shall be responsible for their own work, unless otherwise determined by the Contractor.

1. If the Contractor discovers any discrepancy between actual measurements and those shown on the drawings which prevents good practice, good arrangement, or which is contrary to the intent of the drawings and specifications, they shall notify the Engineer before proceeding with the work

G. Standard electrical symbols along with special symbols are used on all drawings.

1.07 Coordination

A. If it is found before installation of any or all construction phases, that a more convenient, suitable or workable arrangement of any or all phases of the project would result by varying or altering the arrangement indicated on the drawings, the Engineer may require any or all Contractors to change the location or arrangement of their work without additional cost to the Owner. Such rearrangement shall be in accordance with directions from the Engineer, Architect, Owner, or Consruction Manager.

B. Where discrepancies are discovered after certain portions or phases of any Contract have been installed, the Engineer, Architect, Owner, or Construction Manager may direct the Contractor make minor changes in conduit or duct, outlet, fixture or equipment locations or arrangements to avoid conflict with other work at no additional cost to the Owner. It shall be the responsibility of the Contractor to provide written notification prior to making any changes or performing any additional work described in the plans and specifications. The Contractor may not be compensated for work done before providing notification.

1.08 QUALITY ASSURANCE

A. Notify the Architect or Engineer of any discrepancies in or omissions from the drawings and documents. Interpretations and clarifications during bidding will be made only by written Addenda. If discrepancies are not reported, the contractor shall bid the greater quantity or better quality, and appropriate adjustment will be made after contract award.

B. Any work not clear to Contractor shall be referred to Architect or Engineer for clarification before bid is submitted. If no question is raised prior to opening of bid, Contractor shall be required to provide work, in question, as directed by Architect or Engineer, whose decision shall be final, without additional charges.

C. By virtue of submitting a bid, Contractor agrees that he is skilled and experienced in use of and in interpretation of drawings and specifications. Contractor further agrees that he has carefully reviewed all drawings, all specifications and all addenda, which constitute bid documents for this contract, and finds them free of ambiguities and good and sufficient for bidding and construction purposes.

D. Should major changes from drawings and specification be necessary, Contractor shall provide notification and secure written approval and agreement concerning such changes before work is started.

1.09 REGULATORY REQUIREMENTS

A. Work provided shall comply with the following partial list of governing codes and regulations:
   1. International Building Code (IBC).
   2. International Fire Code. (IFC).
   3. State Fire Codes.
   4. State and Local Electric Codes.
   5. State Building Code.
   6. Serving Utility Regulations.
   7. National Fire Protection Association (NFPA) National Fire Codes.
      a. NFPA 70 - National Electrical Code.
      b. NFPA 72 - National Fire Alarm and Signaling Code.
      c. NFPA 101 - Life Safety Code.
   8. Williams-Steiger (OSHA) Regulations.
   9. Americans with Disabilities Act (ADA) requirements.

1.10 WARRANTY

A. TThe Contractor shall be held responsible for any and all defects in equipment and workmanship which appear for one (1) full year after the date of Substantial Completion. All such defects must be repaired or defective equipment promptly replaced by the Contractor at no expense to the Owner..

B. The warranty guarantee shall extend one year minimum from the date of final acceptance of the work or for as long as normal equipment manufacturer warranties are in effect from the date of final acceptance of the work.

C. During the warranty period, the Electrical Contractor shall respond by making appropriate corrections or repairs required to correct defect within one week of notification. Notification shall be made by telephone, fax, email, or letter.

D. The Electrical Contractor shall provide 24-hour service in case of emergency.

1.11 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement (contract).

B. Coordinate related work and modify surrounding work as required.

C. Schedule of Alternates: See Division 00 and Division 01.

1.12 SUBSTITUTIONS

A. Where substitute materials or prior approved materials are provided, Contractor shall assume all responsibility and pay for all necessary changes resulting from such substitution. This responsibility shall also include any extra costs required by other trades.
   1. Provide Products as specified unless substitutions are submitted in this manner and subsequently accepted.

B. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any price quotations received and submittals made are for equipment which meet or exceed the specifications included herein.

C. Required where specifically noted or where materials are specifically identified by a manufacturer's name, model or catalog number. In these cases only such material may be included in base bid. Prior approval of substitute materials shall be required.

D. When a product is considered discontinued by the manufacturer, an equal or better product shall be used instead of the discontinued product, pending engineering approval.

E. Prior approved substitutions:

1. Requests for prior approval shall be made in accordance with Division 01, as specified below, and indicated in specific specification section.
2. If Contractor desires to furnish materials other than that named, Contractor or supplier shall apply in writing, to Architect, for prior approval of such material at least ten (10) days prior to bid opening date.
3. Requests for prior approved substitution shall indicate specific proposed materials in lieu of those specified together with complete technical data for all such proposed material.
4. All prior approved substitutions will be clearly identified in addenda which will be sent to all bidders well in advance of bid opening. Only material listed on drawings, specifications and addenda shall be provided.

F. Substitutions after execution of contract: Substitution of materials other than those specifically named in contract documents will be approved, by Architect or Engineer, for following reason only:

1. That material proposed for substitution is equal to or superior, in Engineer and Architect's opinion, to that specified in construction, efficiency, appearance, and utility.
2. That material named in the documents cannot be delivered to project in time to complete work due to conditions beyond control of Contractor.

G. Equal To and Or Equal: Where materials are specifically identified as “equal to” an identified manufacturer’s name, model, or catalogue numbers or where noted as “or equal” manufacturer’s complying with the requirements of these specifications not listed may be incorporated in the Work. Such materials must be equal to or superior, in Engineer’s opinion, to that specified in construction, efficiency, appearance, and utility.

1.13 Drawing Plan Backgrounds Available

A. Electronic drawing files may be available to the contractor for the purpose of preparing shop drawings or submittals. Files generally available after signing a waiver.

1.14 GENERAL REQUIREMENTS FOR SUBMITTALS

A. Submit according to the requirements of Division 01.

B. General requirements for Submittals for Review

1. Submittal format, general information, and requirements for all submittals:
   a. At the front of the submittal on a dedicated page(s): name, address, and phone number of equipment vendor, engineer, and contractor.

   b. At the front of the submittal on dedicated page(s): Any deviation from contract requirements shall be called to attention. No deviation will be permitted without written approval of Architect or Engineer.

   c. At the front of the submittal on dedicated page(s): Any requests for clarification, selections that must be made, etc. shall be called to attention.

   d. At the front of the submittal on a dedicated page(s): Include a complete list of equipment included with manufacturer and model number or catalog number.

   e. Submittals shall be grouped to include complete information for related systems, products, and accessories in a single submittal with tabs, dividers, or other means of separating each different component within the submittal from the next.

   f. Mark dimensions and values in units to match those specified.

g. Drawings and brochures shall be clearly marked as to item to be supplied and shall have designation corresponding to designation on Drawings (for example: enclosed switch data shall indicate for which equipment they are provided).

2. Contractor Review of Submittals
   a. The Contractor shall thoroughly review each item for compliance with these Specifications making any necessary corrections prior to issuing submittal. Each submittal set shall be stamped, signed and dated indicating Contractor review. If the Contractor fails to properly review submittals, the Contractor shall reimburse the Engineer for all additional reviews on a time and material basis.

   b. Should the contractor fail to comply with any of the requirements of the specified submittal requirements; then the right is reserved by the Architect or Engineer to select any or all items in the material schedule, with that selection to be final and binding upon the contractor. The materials selected or reviewed, as the case may be, by the Architect and / or Engineer, shall be used in the work at no additional cost to the Owner.

3. Architect / Engineer Review of Submittals
   a. The submittal will be reviewed with reasonable promptness, and returned to the Contractor (with copies retained by the Engineer and the Architect). No equipment should be released for shipment until submittals have been approved.

   b. Submittal review is to verify general conformance with the design concept of the Project and substantial compliance with the information provided in the Contract Documents. This review does not in any way relieve the Contractor or their suppliers of their responsibility to provide all materials and equipment as specified, in quantities, quality and dimensions required.

   c. Approval Stamp: Submittals will be reviewed with the following actions noted:

      1) “No Exception Taken” indicates that the Submittal appears to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation.

      2) “Reviewed as Noted” indicates that the Submittal, after noted corrections are made, appears to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.

      3) “Revise and Resubmit” indicates that the noted revisions are such that a corrected copy of the Submittal is required for review to confirm that the noted revisions have been understood and made. The Contractor, at his discretion, may proceed with fabrication and/or procurement and installation after submitting a corrected copy and verifying with the reviewer that the corrected copy is acceptable, if the corrections are accepted by the Contractor without an increase in the Contract Sum or Time.

      4) “Rejected” indicates that the Submittal does not appear to conform to the specifications, a resubmission is required and fabrication or procurement is not authorized.

4. If the Architect or Engineer rejects (Revise and Resubmit or Rejected) the same section two times the engineer shall be compensated for additional reviews (beyond the first two) at a rate of $500 per review. Compensation will be incorporated by Change Order and will be deducted from the Contractor's application for payment. Contractor is responsible for all delays caused by the resubmittal process

C. General Requirements for Submittals For Information
   1. Information submittals shall include the information noted in the specifications and information requested by the Architect, Engineer, and / or Owner.
   2. Coordination Drawings: Where this and other specification sections require Coordination Drawings to be submitted meet the requirements defined in Division 01 and as indicated below.
      a. Prepare documents using software program required by Division 01. If no requirements are listed utilize a software compatible with AutoDesk's AutoCAD.
      b. Submit hardcopies and / or electronic copies as required by Division 01. Drawings and files shall be uniquely labeled.
      c. Scale shall not be less than 1/8" equal 1 foot.

D. General Requirements for Submittals for Closeout:
   1. As specified in Division 01 and Section 26 0100.

E. General Requirements for Product Data. The following are minimum requirements.
   1. Catalog sheets showing ratings, settings, performance curves and rated capacities.
   2. Dimensions, knockout sizes and locations, materials, fabrication details, finish.
   3. Outline and support point dimensions, voltage, ampacity, integrated short circuit ampere rating, arrangement and sizes, roughing-in data, and accessories.
   4. Operational Characteristics.

F. General Requirements for Shop Drawings. The following are minimum requirements.
   1. Electrical ratings of equipment; how the components of the equipment are assembled and function together; and how they will be installed on the project.
   2. Dimensioned plans, elevations, sections, and details. Show quantities of installed devices, features, and ratings.
   3. Detail enclosure types.
   4. Detail configuration, current, and voltage ratings.
   5. Detail features, characteristics, ratings, and factory settings devices and auxiliary components.
   6. Include wiring diagrams for power, signal, and control wiring.

G. General Requirements for Manufacturer's Instructions. The following are minimum requirements.
   1. Application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.
   2. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
   3. Instructions for placing each piece of equipment and system into operation.

1.15 PROJECT SUBCONTRACTOR AND VALUES LISTING

A. The Contractor shall submit a list of suppliers, Subcontractors, and manufacturers for equipment installed under Division 26, 27 and 28 for approval. Contractor shall make such submittal within 16 days after Notice to Proceed, prior to ordering any equipment. Approval of such list does not relieve the Contractor from submittal of shop drawings, nor shall it constitute final approval should the shop drawings be found not in agreement with the Specifications.

B. Before submittal of the first Request for Payment, the Contractor shall submit to the Engineer, an itemized cost breakdown, including separation of labor and material, for work under Division 26, 27 and 28. The breakdown shall be divided in such detail as requested to aid in approval of Payment Requests based on work completed. Breakdown shall include, but not be limited to:

1. Special Electrical Conditions (Bonds, Fees, Mobilization, etc.)Conduit, boxes, wire, etc.Panelboards, Switchboard, circuit breakers and disconnects.DevicesLuminaires
2. Conduit, boxes, wire, etc.
3. Panelboards, Switchboard, circuit breakers and disconnects.
4. Wiring Devices
5. Luminaires and Lightiing Controls
6. Motor connections and controls.
7. Structured cabling for voice / data systems.
8. Other Division 27 systems (for example: audio-video systems, paging systems).
9. Fire Alarm System.
10. Electronic Security Systems (for example: access control, video surveillane).

PART 2 PRODUCTS

2.01 Not Used.

PART 3 EXECUTION

3.01 Jobsite Inspections

A. Periodic job site observations will be made throughout the construction to review applications for payment, observe methods and materials of construction, and review requirements of the Bid Documents.

B. Contractor shall notify the Engineer, or authority having jurisdiction, and arrange for observation of installation prior to backfill or concealing of systems. Contractor shall, to the maximum practical extent, schedule work to allow for the observation of systems' installation in groups rather than individually.

C. Upon completion of all work, and submittal and approval of Test Reports, Maintenance Manuals and Record Drawings, Contractor shall notify the A/E and shall make arrangements for a Substantial Completion inspection.

D. After the inspection is made, the Contractor will receive a list of items requiring adjustment, correction, replacement or completion.

E. The Contractor shall promptly comply completely with all the listed requirements. Should the Contractor fail to perform promptly, the Engineer reserves the right to have the work completed by others and the cost deducted from the contract price.

F. The Contractor will be billed for projects which are not complete enough for a Substantial Completion Report (Punch List) by the Engineer when one is previously scheduled.

END OF SECTION

SECTION 26 01 00

ELECTRICAL SYSTEMS CLOSE OUT DOCUMENTATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Operations and Maintenance Manuals.
B. Warranty Documentation.
C. Maintenance Materials.
D. As-Built Drawings.

1.02 RELATED DOCUMENTS

A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26.
B. This section is related to all other sections of Division 26.

1.03 SUBMITTALS FOR REVIEW

A. Submit under provisions of Division 01 and Section - Electrical General Requirements.
B. Provide operations and maintenance manuals and As-Built drawings.

1.04 SUBMITTALS FOR CLOSEOUT

A. Provide all documents as described below and in each specification section according to the requirements of Division 01 upon reaching substantial completion of the project unless noted otherwise.

PART 2 PRODUCTS

2.01 OPERATIONS AND MAINTENANCE MANUALS

A. Provide operations and maintenance manual for electrical system as a bookmarked PDF on a USB flash drive. Refer to Division 01 for additional requirements.
B. Provide dedicated manuals for the following:
    1. Division 26 systems and equipment unless noted otherwise.
    2. Division 26 lighting and lighting control.
    3. Division 26 low voltage generator and transfer equipment.
C. Common Results for Operation and Maintenance Manuals. The following information shall apply to all manuals.
    1. Provide a master index at the beginning of manual indicating items included.
    2. The first section of each manual shall list the name, address, and phone number of Architect, Electrical Engineer, Contractor, and all associated Subcontractors.
    3. Each section shall include an approved and edited copy of submittals for review with review comments.
    4. Warranty information shall be provided with each piece and / or type of equipment include Manufacturer’s Warranty Statement.
    5. Testing Reports shall comply with the requirements of section - Testing of Electrical Systems.
    6. Each section shall be digitally bookmarked with the section title as listed below, and each device/cutsheet shall be bookmarked with the device type/name.
D. The Division 26 systems and equipment manual shall include the following sections. See the applicable sections of the Division 26 specifications for additional information.
    1. Distribution Panelboards.
    2. Branch Circuit Panelboards.
    3. Enclosed Switches and Circuit Breakers.
    4. Enclosed Motor Controllers.

5. Wiring devices.
6. Surge protective devices.
7. Receipts for Spare Materials, Owner Training / Demonstrations.
8. Test Reports and Certificates.
9. Operation and Maintenance Guidelines.
10. Contractor's Warranty Statement according to the requirements of specification "Electrical General Requirements."

E. The Division 26 Lighting and lighting control manual shall include the following sections. See the applicable sections of the Division 26 specifications for additional information.

1. Luminaires (including specific lamp and ballast information).
2. Lighting control devices.
3. Receipts for Spare Materials, Owner Training / Demonstrations.
4. Test Reports and Certificates.
5. Operation and Maintenance Guidelines.
6. Contractor's Warranty Statement according to the requirements of specification "Electrical General Requirements."

F. The Division 28 Fire Alarm Systems shall include the approved product data, shop darwings, test reports, and as-built drawings.

2.02 AS-BUILT DRAWINGS

A. The contractor shall maintain one set of drawings at the job site to be used as a master copy. All changes and deviations shall be clearly marked and noted by colored pencil. These drawings shall be used for no other purpose.

1. Where any material, equipment or system components are installed different from that shown on the Drawings, such differences shall be clearly and neatly shown on this set of drawings using ink, or indelible pencil. The change notations shall be kept up-to-date on a daily basis.
2. This set of drawings shall be transmitted to the Architect as directed, and after having been examined, the set will be returned to the Contractor for further use.
3. At the completion of the project, the set of drawings shall be turned over to the Architect for approval and delivery to the Owner.

B. As-Built Drawings shall include the following information in addition to specific information indicated in individual specification sections:

1. Actual locations / configurations of components and circuits.
2. Indication of route of all feeders and branch circuits 100-amps and larger.
3. Indicate route and location of all underground circuits, raceways, pull boxes, etc.
4. Indicate actual locations and mounting heights of outlet boxes, pull boxes, junction boxes, surface metal raceway, and wireway.
5. Final locations of all lighting control devices and diagrams showing circuiting / control wiring arrangements.
6. Provide table indicating final setting of all automatic lighting control sensors.
7. Provide document indicating final programming of relay panel.
8. Panel and Switchboard Directories: Provide revised typed directories with As-Built documents.

C. Indicate other information specifically noted in other Division 26 specification sections.

2.03 MAINTENANCE MATERIALS

A. Turn over to owner and obtain signed receipt for all maintenance materials, spare parts, touched up parts and loose items.

PART 3 EXECUTION

3.01 Not Used.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes limited scope general construction materials and methods for application with electrical, communications, and electronic safety and security systems installations.

B. Materials specified herein include:

1. Miscellaneous for support of electrical materials and equipment.
2. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in walls, floors, ceilings, roofs, foundations for moisture, water, smoke, fire and acoustic control.

C. General electric construction methods and requirements specified herein include:

1. Material and workmanship.
2. Product manufacturer requirements.
3. Coordination.
4. Safety.
5. Material handling, storage protection, cleaning and painting.
6. Cutting, patching and finishing.
7. Penetrations.
8. Wiring Methods.
9. Balancing Loads.
10. System Interruptions.
11. Outlet mounting heights.

D. Owner Instruction and Demonstration.

1.02 RELATED DOCUMENTS

A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26.

B. Division 03 Section Concrete Boring (Concrete Core Drilling).

C. Section 26 01 00 Electrical Systems Close Out Documentation.

1.03 REGULATORY REQUIREMENTS

A. See Section 26 0000.

1.04 COMMON REQUIREMENTS FOR QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years experience.

B. Installer Qualifications: Engage experienced Installers for Work.

C. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide UL Labeled and listed access door assembly with flush door, frame, hinge, and latch from manufacturer listing in the UL "Building Materials Directory" for rating shown.

D. Standardization of Product Manufacturer:

1. When two or more items of same material or equipment are required they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work, except as otherwise indicated.
2. Except as noted, all switchboard, panelboards, safety switches, and equipment or wiring cabinets shall be manufactured by the same company, all finishes shall be the same color, and all equipment shall fit the space designated.

3. Except as noted, all magnetic starters, manual starters and motor control centers shall be manufactured by the same company, all finishes shall be the same color, and all equipment shall fit the space designated.
4. Wiring devices and other items covered under a single specification section, with the exception of light fixtures, shall be of the same manufacturer and style whenever practical or where failure to do so is visibly noticeable.

E. Material and Workmanship:
1. All materials provided shall be new and shall be approved by the Underwriters Laboratories, Inc., NFPA, NEMA, and ANSI as conforming to its standards in every case where such a standard has been established for such material.
2. Materials shall be standard products of manufacturer's regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design.
3. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
4. All workmanship shall be neat and complete in both effectiveness and appearance and shall be executed by persons licensed and skilled in the trade. Engineer reserves the right to reject any material or workmanship before, during or after construction.
5. Materials and Finishes: Provide adequate corrosion resistance to eliminate staining of exposed surfaces.
6. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

F. Equipment
1. All equipment shall be new and in first-class condition. Equipment shall not be used for purposes other than intended by the manufacturer.
2. Manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this Specification. Nameplate of Subcontractor or distributor will not be acceptable. Nameplate shall be masked prior to any painting. Remove masking after completion.
3. Equipment specified and furnished shall be of a type and manufacturer that has a local representative and a local replacement and service outlet to give complete coverage on parts and service at all times.

G. Coordination:
1. See also "Quality Assurance" paragraph of Section 26 0000.
2. Refer to drawings and specifications of all other divisions and trades for correlating information, location and details of work, dimensions, etc. Coordinate location of all outlets with equipment and architectural, structural, mechanical, heating, ventilation element. If conflicts develop Architect or Engineer's decision will govern. No additional compensation will be allowed for moving of un-coordinated, misplaced or poorly located outlets, material, equipment or work
3. Discrepancies and omissions discovered during construction shall immediately be called to the attention of the Architect or Engineer for clarification.
4. Installation of materials shall be coordinated with other trades and installed at such time and manner as to not delay or interfere with the work of other trades.
5. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections. Determine connection locations and requirements.
6. Sequence and coordinate work with other trades so as to avoid conflict of space and time sequence. If interference develops, the matter shall be brought to the attention of the Architect for decision.
7. Organize the work so that progress of work will conform to the progress of other trades. Give particular attention to large equipment requiring positioning prior to closing the building.
8. Complete the entire installation as soon as building conditions permit.
9. This Contractor shall be held solely responsible for coordinating proper size and location of hangers, slots, chases, openings, etc., required for proper installation of his work and shall arrange with the proper building contractors for inserts, chases, and openings.
10. Interferences between the work of different divisions which cannot be resolved by the parties involved shall be submitted to the Engineer who shall decide upon final location and arrangement without respect to which work was installed first.

H. Pre-installation meetings are required as noted in this and other specification sections and are intended to help coordination efforts. Electrical Contractor shall schedule and convene a pre-installation meeting with all affected trades as noted in specifications and on Drawings.

I. Provide competent representative(s) on site constantly to supervise work from beginning through completion and final acceptance. So far as possible contractor shall keep same foreman and workmen throughout project duration.

J. During its progress, the work shall be subject to observation by representatives of Owner, Architect and Engineer at which times Contractor shall furnish all required information and cooperation

1.05 SAFETY

A. Comply with the requirements of Division 01 and this specification.

B. Perform work in accordance with NFPA 70E and in compliance with OSHA requirements.

C. Do not perform work on exposed live electrical equipment. If work is required (as defined by OSHA 29 CFR 1910.333) to be performed on exposed live electrical equipment an energized work permit must be must be prepared (see NFPA 70E for energized work permit requirements) and a Hazard/Risk Analysis in accordance with NFPA 70E and provide appropriate levels of personal protective equipment according to NFPA 70E.

D. Only Qualified Persons as defined by NFPA 70E shall be allowed to work on exposed live electrical equipment. Observe the safety boundaries defined in NFPA 70E.

E. Prior to performing work on exposed live electrical equipment convene a safety meeting to address safety hazards specific to the task.

F. Safety Program: the electrical contractor shall implement and document an electrical safety program in accordance with NFPA 70E and a workplace safety program that complies with the requirements OSHA and NFPA 70E.

1.06 SUBMITTALS

A. Submit according to the requirements of Division 01 and Section 26 0100.

B. Provide manufacturers installation instructions and product data for:

1. Fire-Resistant Joint Sealers.
2. Sleeves.

C. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this section.

D. Submit written requests for System Interruptions and Outages as specified herein.

E. Include product information and installation details with O & M manuals for fire resistant joint sealers and fire resistant sleeves.

F. As-built drawings. Submit as-built drawings showing final locations of eqiupment, locations and sizes of sleeves, and rated penetrations.

PART 2 PRODUCTS

2.01 JOINT SEALERS

A. General: Joint sealers, joint fill material, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Project engineer from manufacturer's standard colors.

C. Provide fire resistant joint sealers as specified in Division 07.

D. Fire-Resistant Joint Sealers: One-part or two-part, foamed-in-place, sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, ducts and through penetrations through fire-rated walls, ceilings, roofs and floors. Sealants and accessories shall have required fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

2.02 SLEEVES

A. Sleeves for Raceways and Cables
   1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized Steel.
   2. Rectangular Sleeves: Galvanized Sheet Steel. 16 Gauge for less than 50 square inches and not side longer than 16 inches. 8 gauge for greater than 16 inches or one side more than 16 inches.

B. Sleeve Seals
   1. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
      e. Link Seal.
   3. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   4. Pressure Plates: Carbon steel. Include two for each sealing element.
   5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element
   6. Provide fire rated seals as required. See Division 07.

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR EXAMINATION PRIOR TO ELECTRICAL INSTALLATIONS

A. Verify conditions and constructions types prior to installation.

B. Verify that surfaces that support Product(s) are ready to receive them.

C. Examine location of equipment installation for compliance with installation tolerances and other conditions affecting performance of Work
   1. Prepare drawings showing proposed rearrangement of work to meet Project conditions, including changes to work specified in other Divisions. Obtain permission of Architect before proceeding.

D. Review all Drawings including architectural, mechanical, structural, civil, and electrical drawings for extent of Work.
   1. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

E. Examine Architectural drawings and elevations to verify device locations and mounting heights.
   1. In finished spaces, where mounting heights are not detailed or dimensioned coordinate mounting height with Architect.
   2. Do not rough-in for any wall mounted equipment without verifying mounting height with Architect unless equipment is specifically noted on Architectural Drawings.
   3. Do not scale dimensions from Electrical Drawings and verify all mounting heights noted on Electrical Drawings.
   4. See preparation, quality assurance, and coordination requirements in section Raceways and Boxes for Electrical Systems for additional information and requirements.

F. Site Investigation
   1. Prior to beginning work, examine the work site to become familiar with existing conditions which may affect the cost of the project. This includes measurements for lengths, quantities, clearances

and all other field verifiable conditions.

2. No extra charges will be allowed because of failure of Contractor to become familiar with all existing conditions prior to beginning work.
3. Existing equipment, systems and installations whether or not they are not detailed on the drawings must be restored to their original condition.

3.02 COMMON REQUIREMENTS FOR PREPARATION TO INSTALLATION

A. Equipment Wiring preparation
   1. Obtain and review shop drawings, product catalog data, etc. prior to roughing-in for electrical connections.
   2. Verify dimensions and final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
   3. Refer to equipment drawings and specifications in all specification Divisions for rough-in requirements.

B. Concrete Housekeeping pad preparation: After the concrete is fully cured remove all laitance and defective or weak concret

3.03 COMMON INSTALLATION REQUIRMENTS FOR ELECTRICAL WORK

A. Description Of Wiring Methods:
   1. All wiring shall be installed in accordance with applicable codes and as noted in section 26 0519, unless otherwise indicated.
   2. Multi-wire branch circuits shall not be allowed unless specifically noted. Provide separate neutral conductor for each circuit.
   3. See Section Low Voltage Electrical Power Conductors and Cables for conductor and cable requirements.
   4. See Section Raceways and Boxes for Electrical Systems for box and raceway requirements.

B. Workmanship shall be first-class in every respect. Standard accepted practice in the various trades shall be considered as minimum. The Engineer reserves the right to reject any workmanship not in accordance with the specifications, either before or after installation of equipment.

C. Install work in locations shown on drawings, unless prevented by Project conditions. Refer to architectural drawings for exact devices locations.

D. Conform to arrangements indicated by Contract Documents, recognizing that the Work is shown only in diagrammatic form.

E. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

F. Install materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.

G. Core drilling of concrete is required, where possible, in lieu of hammer drilling. Hammer drilling is generally to be limited to small holes for anchors.

H. Install access door assembly where units are concealed behind finished surfaces. Access doors are specified in Division 08 and this section.

I. Concrete housekeeping pads shall be installed with chamfered edges.

J. Floor, Wall And Ceiling Penetrations
   1. Effectively seal penetrations in exterior walls, roofs, and rated interior walls in accordance with Division 07.
   2. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access door units. Do not proceed with installation until unsatisfactory conditions have been corrected.
   3. Conduits and cables passing through floors, walls, and ceilings at the following locations shall be sealed for the purpose of sound, heat, smoke and / or moisture control.
      a. Acoustically rated walls.

b. Fire and / or smoke resistant walls and floors.

c. All electrical rooms.

d. All mechanical rooms.

e. Penthouse.

f. All exterior walls.

g. All vertical and horizontal shafts.

h. All walls around janitor rooms, receiving rooms, and other facility maintenance and management rooms.

i. Food service areas.

4. Where conduits and raceways pass through interior walls and ceilings (not requiring water proofing) provide suitable sealing material complying with Division 07 for the wall construction; examples:
   a. Plaster for plaster walls.

   b. Joint compound for gypsum board walls.

   c. Mortar for masonry block and brick walls.

   d. Grout for concrete walls.

5. Place sealing material around each conduit and raceway for the full thickness of the wall.
6. Where conduits and raceways pass through exterior walls and ceilings below grade, provide installation to meet the details noted on the Drawings.
7. Where interior walls require waterproof conduit and raceway seals, provide silicone sealant generally installed as specified above for exterior walls.
8. Where conduits and raceways pass through exterior walls above grade, provide matching wall material inside (see examples above) and provide waterproof seal of silicone sealant or other approved sealant on outside.
9. At the nearest point of access to wires (inside conduit or raceway) passing through exterior walls and roof; provide "Ductseal" between wires and conduit or raceway as a wind barrier.
10. Where cables pass through walls, ceilings and floors, generally use same sealing method as for conduits.
11. "Ductseal" type material is generally not acceptable except as noted above.
12. Utilize fire rated cabling pathways where cabling must be routed through fire-rated floor and wall assemblies.

K. Roof Penetrations

1. Electrical Contractor shall be responsible for providing roof seals for each raceway, mast, tower leg, guy wire, etc., which pass through roof, rest on roof or attach to roof. Avoid roof penetrations where possible. This work shall be performed by the Roofing Contractor. Electrical Contractor shall coordinate work as needed.

L. Cutting, Patching, and Finishing

1. General: Perform cutting, patching and finishing in accordance with Division 01.
   a. Cut, remove, and legally dispose of material including but not limited to construction material, and other indicated material made obsolete by the new work.

b. Protect the structure, furnishings, finishes, and adjacent materials and installations not indicated or scheduled to be cut or removed.

c. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt into adjacent areas.

d. The Contractor shall not endanger the stability of the structure by cutting, excavation or otherwise.

e. Do not cut or alter work of any other trade without trade and Architect / Engineer's consent.

2. Perform cutting, patching and finishing of walls, floors, ceilings, roofs required to:
   a. Uncover work to provide for installation of new or ill-timed work.

   b. Remove and replace defective work.

   c. Remove samples of installed work as specified for testing.

3. Upon written instructions from the Architect / Engineer, uncover and restore work to provide for Engineer's observation of concealed work.
4. Should any cutting be required for proper installation of electrical work because of failure to give the General Contractor the proper information at the time required, such cutting shall be done at the Electrical Contractors expense.

3.04 INTERRUPTIONS, ENERGIZATIONS, AND OUTAGES

A. Coordinate utility service connections / disconnections with Utility Company.

B. Provide temporary wiring, connections, and protection as required to maintain all existing systems to remain in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

C. Owner approval is required prior to electric service outages or energizations and shall be scheduled at the convenience of the Owner.
   1. A written request must be submitted to the Owner / Architect / Engineer for approval a minimum of 15 days prior to outage or energization.
   2. Cancellation of the planned interruption by the Owner for any reason, at any time up to 24 hours before planned interruption shall bear no additional cost to the Owner.

D. Outages and / or energizations may require the Contractor to work at other than regular normal working hours. No extra compensation will be allowed for such times.

3.05 EQUIPMENT AND DEVICE MOUNTING HEIGHTS

A. Coordinate final mounting heights as directed under Part 3 paragraph “Preparation”.

B. Interior mounting heights indicated on drawings are from finished floors (interior) or final grade (exterior). Mounting heights for items indicated on exterior walls are from the interior finished floor below.

C. Mounting heights indicated are to the top of the device plate unless noted otherwise. Mounting heights are nominal and shall be adjusted to fit block joints.

D. Typical mounting heights are detailed on the Drawings.

E. Handicapped counter and lavatory locations: meet ADA requirements for receptacle and switch locations and elevations.

F. Contractor shall verify mounting heights of all outlets to assure installation above top of radiation covers, mirrors, counters, vanity, cabinets, and any other obstruction that may alter indicated mounting heights. ADA accessible controls must be mounted at 48”.

3.06 OWNER INSTRUCTION AND DEMONSTRATION

A. Furnish, without additional expense to the Owner, the services of competent instructors, who will give full instructions in the care, adjustment and operation of all parts of the electrical equipment to the Owner's employees who are to have charge of the equipment. Including but not limited to the following:
   1. Demonstrate the proper operation of systems per the operational and function requirements of the Contract Documents and as outlined in any sequence of operation.
   2. Instruct personnel, in all phases of operation, location of components and use of all systems.
   3. Review manufacturer Warranty information for all equipment included in the manual.

B. Number of hours of instruction shall be specified in other sections of this specification.

C. An operating and maintenance manual shall be made available to the Owner's operating personnel during the instruction and left with the Owner upon completion of the instruction.

D. Owner instruction / demonstration shall be provided as noted below and as noted in specification sections (see individual specification section for additional requirements):
   1. Lighting Control Devices - see specification section.
   2. Electrical Distribution Equipment - provide overview of system, highlight major components and distribution equipment. Review suggested maintenance schedules.
   3. Wiring Devices - review maintenance requirements (e.g. GFCI monthly test requirements).
   4. Lighting Fixtures and Luminaires - review lamp changing requirements for all fixture types.

E. Documentation: Upon completion of Owner Instruction and Demonstration provide a certificate signed and dated by the attendees indicating information covered, amount of instruction / demonstration time provided, and applicable specification sections. Provide certificate for all Owner Instruction and Demonstration sessions. Include copy with O & M Manual. A sample certificate is attached for reference.

3.07 FIELD QUALITY CONTROL

A. So far as possible contractor shall keep same foreman and workmen throughout project duration. Keep enough workmen on job to insure keeping up with or ahead of other trades so that no delays occur.

B. Delivery, Storage, and Handling
   1. Deliver, store, protect and handle products on site under provisions of Division 01 according to manufacturer’s recommendations and as specified herein.
   2. This Contractor shall make provisions for delivery and safe storage of materials.
   3. Accept Products on site. Inspect for damage
   4. Protect Products from corrosion and entrance of debris. Provide appropriate covering. During construction, it shall be the responsibility of this Contractor to protect the surface of equipment and material furnished.
   5. See individual specifications sections for specific delivery, storage, handling and protection requirements.

3.08 CLEAN-UP, KEY CONTROL, AND PAINTING

A. Remove all packing materials, rubbish, debris, etc. from the site each day.

B. String all furnished keys on split metal key ring and turn same over to Owner at project completion.

END OF SECTION

SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 RELATED REQUIREMENTS

A. Section 01 70 00 - Execution and Closeout Requirements: Additional requirements for alterations work.

B. Section 02 84 00 - Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

B. Materials taken out of service: The owner shall have the first right of refusal for any materials. EC to clean and store where directed by owner. Materials that the owner does not want become the property of the contractor to be removed from the site and disposed of properly.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Engineer or Engineer before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:

1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
2. PCB- and DEHP-containing lighting ballasts.

3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

K. Maintain fire ratings where raceway is to be removed or modified that pass through a fire rated structure, floor, ceiling, wall, etc.

3.04 CLEANING AND REPAIR

A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Metal-clad cable.
C. Variable-frequency drive cable.
D. Wiring connectors.
E. Electrical tape.
F. Wire pulling lubricant.
G. Cable ties.

1.02 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
G. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.
I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
J. NFPA 79 - Electrical Standard for Industrial Machinery; 2018.
K. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
L. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
M. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
R. UL 1479 - Standard for Fire Tests of Through-Penetration Firestops
S. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.
T. UL 2277 - Outline of Investigation for Flexible Motor Supply Cable and Wind Turbine Tray Cable; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for

voltage drop.

2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 Description of System

A. Conductor and conduit sizes noted are based on type THHN copper unless noted otherwise.

B. Conductor material applications:
   1. Feeders for panelboards, switchboards, and other distribution equipment: Copper. Aluminum Conductors are not acceptable.
   2. Motor Feeders: Copper. Aluminum Conductors are not acceptable.
   3. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
      a. Use stranded conductors for control circuits.
      b. Use conductor not smaller than 12 AWG for power and lighting circuits.
      c. Use conductor not smaller than 16 AWG for control circuits.

C. Wiring Methods
   1. See Section 26 0533 for raceway system requirements.
   2. Service Entrance: Type THHN-THWN single conductors in raceway or Type XHHW-2, single conductors in raceway.
   3. Feeders for panelboards, switchboards, and other distribution equipment: Type THHN-THWN or XHHW-2 single conductors in raceway.
   4. Motor Feeders: Type THHN-THWN or XHHW-2 single conductors in raceway.
   5. Branch Circuits:
      a. Multi-wire branch circuits shall not be acceptable. Provide dedicated neutral conductor for each circuit.
      b. Home Runs (from circuit breaker to junction box at accessible location adjacent to first wiring device): Type THHN-THWN single conductors in raceway.
      c. Exposed (including in crawl spaces, electrical rooms, mechanical rooms, and above accessible ceilings): Type THHN-THWN single conductors in raceway.

d. Concealed (e.g. in ceilings, walls, partitions): Type THHN-THWN single conductors in raceway.

e. Direct Burial (Outdoors): Direct buried cables are not acceptable.

6. Wiring for Variable Frequency Drives:
   a. Input to the VFD: Copper, 600V, 90 degree C, THHN, THWN-2, XHHW2, RHH, or RHW-2. Single conductors in conduit.

   b. Output from VFD to equipment: variable-frequency drive cable.

7. Cord Drops and Portable Appliance Connections:
   a. Indoors kitchen and similar environments: Type SO, hard service cord.

   b. Indoors shop and similar environments Type STO, thermoplastic, hard service cord.

   c. Outdoors Type STOW-A, thermoplastic, hard service, weather resistant cord.

   d. Include stainless, wire-mesh, strain relief device at terminations to suit applications.

8. Class 1 Control Circuits: Type THHN-THWN single conductors in raceway.
9. Class 2 Control Circuits:
   a. For lighting control devices (occupancy sensors, low-voltage switches, etc.), exposed multi-conductor cable, plenum rated shall be acceptable in concealed locations. Install cabling in accordance with Section 27 0528.

   b. Unless otherwise noted all other locations use type THHN-THWN single conductors in raceway.

2.02 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
   1. Exceptions:
      a. Use variable-frequency drive cable for connection between variable-frequency motor controllers and associated motors.

C. Metal-clad cable is not permitted.
   1. Metal-clad Luminary Cable is permitted only as follows:
      a. Where not otherwise restricted, may be used:

         1) Where concealed above accessible ceilings for final connections from junction boxes to luminaires.

         2) Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.

D. CONDUCTOR AND CABLE GENERAL REQUIREMENTS
   1. Provide products that comply with requirements of NFPA 70.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended.
   3. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

4. Comply with NEMA WC 70.
5. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
6. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
7. Conductor Material:
   a. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.

   b. Tinned Copper Conductors: Comply with ASTM B33.

8. Minimum Conductor Size:
   a. Branch Circuits: 12 AWG.

      1) Upsizing for voltage drop: voltage drop is not to exceed 5% total drop as measured at the furthest device on a circuit. The values indicated below are based on installed circuit lengths; contractors must account for circuit routing used in the field:

         a) For 20A, 120V branch circuits serving only convenience receptacles:

            1 Use 10 AWG conductors for circuits longer than 100ft.

            2 Use 8 AWG conductors for circuits longer than 175ft.

         b) For 20A, 120V branch circuits serving anything other than convenience receptacles:

            1 Use 10 AWG conductors for circuits longer than 60ft.

            2 Use 8 AWG conductors for circuits longer than 115ft.

         c) For 20A, 277V branch circuits:

            1 Use 10 AWG conductors for circuits longer than 150ft.

            2 Use 8 AWG conductors for circuits longer than 245ft.

9. Conductor Color Coding:
   a. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.

   b. Color Coding Method: Integrally colored insulation.

   c. Color Code:

      1) 480Y/277 V, 3 Phase, 4 Wire System:

         a) Phase A: Brown.

         b) Phase B: Orange.

         c) Phase C: Yellow.

         d) Neutral/Grounded: Gray.

2) 208Y/120 V, 3 Phase, 4 Wire System:

a) Phase A: Black.

b) Phase B: Red.

c) Phase C: Blue.

d) Neutral/Grounded: White.

3) Equipment Ground, All Systems: Green.

E. SINGLE CONDUCTOR BUILDING WIRE

1. Description: Single conductor insulated wire.
2. Conductor Stranding:
   a. Feeders and Branch Circuits:

      1) Size 10 AWG and Smaller: Solid.

      2) Size 8 AWG and Larger: Stranded.

3. Insulation Voltage Rating: 600 V.
4. Insulation:
   a. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

F. METAL-CLAD CABLE

1. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
2. Conductor Stranding:
   a. Size 10 AWG and Smaller: Solid.

   b. Size 8 AWG and Larger: Stranded.

3. Insulation Voltage Rating: 600 V.
4. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
5. Grounding: Full-size integral equipment grounding conductor.
6. Armor: Steel, interlocked tape.

G. VARIABLE-FREQUENCY DRIVE CABLE

1. Description: Flexible motor supply cable listed and labeled as complying with UL 2277 in accordance with NFPA 79; specifically designed for use with variable frequency drives and associated nonlinear power distortions.
2. Conductor Stranding: Stranded.
3. Insulation Voltage Rating: 1000 V.
4. Insulation: Use only thermoset insulation types; thermoplastic insulation types are not permitted.
5. Grounding: Full-size integral equipment grounding conductor or symmetrical arrangement of multiple conductors of equivalent size.
6. Provide metallic shielding.
7. Jacket: PVC or Chlorinated Polyethylene (CPE).

H. WIRING CONNECTORS

1. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
2. Wiring Connectors for Splices and Taps:

a. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.

b. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

3. Wiring Connectors for Terminations:
   a. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

   b. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

   c. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.

   d. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

4. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
5. Mechanical Connectors: Provide bolted type or set-screw type.
6. Compression Connectors: Provide circumferential type or hex type crimp configuration.

I. ACCESSORIES

1. Electrical Tape:
   a. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.

   b. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

2. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
3. Cable Ties: Material and tensile strength rating suitable for application.
4. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
   5. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
   6. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Exposed Cable Installation (only where specifically permitted):
   1. Route cables parallel or perpendicular to building structural members and surfaces.
   2. Protect cables from physical damage.

G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

I. Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.

      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

J. Variable-Frequency Drive Cable: Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.

K. Install conductors with a minimum of 12 inches of slack at each outlet.

L. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

M. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

N. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

O. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

P. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

Q. Insulate ends of spare conductors using vinyl insulating electrical tape.

R. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

U. Connection of 0-10V fixtures: 0-10V dimming circuit shall not be run in same conduit as 120/277V connection for fixture.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.
B. Conductors for grounding and bonding.
C. Connectors for grounding and bonding.
D. Ground bars.
E. Ground rod electrodes.

1.02 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
D. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.

2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

E. Grounding Electrode System:
1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
   a. Provide continuous grounding electrode conductors without splice or joint.
   b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Concrete-Encased Electrode:
   a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
3. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
4. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
   b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.

F. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

G. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
   1. Use insulated copper conductors unless otherwise indicated.
      a. Exceptions:
         1) Use bare copper conductors where installed underground in direct contact with earth.
         2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
      a. Exceptions:
         1) Use mechanical connectors for connections to electrodes at ground access wells.
   3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
      a. Exceptions:
         1) Use exothermic welded connections for connections to metal building frame.

D. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 05 53.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
6. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
   a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

1. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
2. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2 inch diameter.
   b. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
   c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
   d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
   e. Outlet Boxes: 1/4 inch diameter.
2. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
5. Hollow Masonry: Use toggle bolts.
6. Hollow Stud Walls: Use toggle bolts.
7. Steel: Use beam clamps, machine bolts, or welded threaded studs.
8. Sheet Metal: Use sheet metal screws.
9. Plastic and lead anchors are not permitted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Do not install hangers or supports to the bottom chord of joists.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: Also comply with Section 26 05 33.16.

I. Box Support and Attachment: Also comply with Section 26 05 33.16.

J. Exterior Luminaire Support and Attachment: Also comply with Section {\id\#913}.

K. Secure fasteners according to manufacturer's recommended torque settings.

L. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

END OF SECTION

SECTION 26 05 33.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Aluminum rigid metal conduit (RMC).
C. Intermediate metal conduit (IMC).
D. PVC-coated galvanized steel rigid metal conduit (RMC).
E. Flexible metal conduit (FMC).
F. Liquidtight flexible metal conduit (LFMC).
G. Electrical metallic tubing (EMT).
H. Rigid polyvinyl chloride (PVC) conduit.
I. Reinforced thermosetting resin conduit (RTRC).
J. Conduit fittings.

1.02 REFERENCE STANDARDS

A. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2020.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
D. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
E. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
F. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
G. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
H. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
I. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
J. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
K. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Shop Drawings:

1. Indicate proposed arrangement for conduits to be installed at fuel island.
2. Include proposed locations of roof penetrations and proposed methods for sealing.

C. Project Record Documents: Record actual routing for conduits installed underground and conduits 2 inch (53 mm) trade size and larger.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
4. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
5. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
6. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

1. Locations subject to physical damage include, but are not limited to:
   a. Where exposed below 8 feet, except within electrical and communication rooms or closets.

J. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

K. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit, aluminum rigid metal conduit, or reinforced thermosetting resin conduit (RTRC).

L. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, or PVC-coated galvanized steel rigid metal conduit.

M. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet.

N. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

2.02 CONDUIT REQUIREMENTS

A. Electrical Service Conduits: Also comply with Section 26 21 00.

B. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.

C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 1/2 inch (16 mm) trade size.
   2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   3. Underground, Interior: 3/4 inch (21 mm) trade size.
   4. Underground, Exterior: 1 inch (27 mm) trade size.

F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:
   1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   3. Material: Use steel or malleable iron.
   4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

B. Fittings:
   1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   3. Material: Use aluminum.

4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

C. PVC-Coated Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

2.09 ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use compression (gland) or set-screw type.
   a. Do not use indenter type connectors and couplings.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

2.11 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).

B. Supports: Per manufacturer's recommendations.

C. Fittings: Same type and manufacturer as conduit to be connected.
   1. Cement-Tight Joints: Use bonded coupling or bell and spigot.
   2. Cement- and Water-Tight Joints: Use adhesive and manufacturer's standard gaskets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.

E. Install intermediate metal conduit (IMC) in accordance with NECA 101.

F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

H. A cable, raceway or box, installed in exposed or concealed locations under roof decking, shall be installed more that 1.5 inches from the lowest point of the roof decking to the top of the cable, raceway or box.

I. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   5. Unless otherwise approved, do not route conduits exposed:
      a. Across floors.
      b. Across roofs.
      c. Across top of parapet walls.

d. Across building exterior surfaces.

6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
14. Group parallel conduits in the same area together on a common rack.

J. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
    a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use of wire for support of conduits is not permitted.

K. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

L. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.

4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

M. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
4. Where conduits are subject to earth movement by settlement or frost.
5. Any runs over 200 feet.

N. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:

1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

O. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

P. Provide grounding and bonding in accordance with Section 26 05 26.

3.03 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.04 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 05 33.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
C. Floor boxes.
D. Underground boxes/enclosures.
E. Accessories.
F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
G. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
I. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
L. SCTE 77 - Specification for Underground Enclosure Integrity; 2017.
M. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.03 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use suitable concrete type boxes where flush-mounted in concrete.
4. Use suitable masonry type boxes where flush-mounted in masonry walls.
5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Use shallow boxes where required by the type of wall construction.
7. Do not use "through-wall" boxes designed for access from both sides of wall.
8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
12. Wall Plates: Comply with Section 26 27 26.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
3. Junction and Pull Boxes Larger Than 100 cubic inches:
   a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

D. Underground Boxes/Enclosures:

1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Provide logo on cover to indicate type of service.
5. Applications:
   a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
   b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
   a. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

2.02 ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.

1. Manufacturers:
   a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

G. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes as required for devices installed under other sections or by others.
   a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.16.
10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

H. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70.

Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

K. Install boxes as required to preserve insulation integrity.

L. Underground Boxes/Enclosures:

1. Install enclosure on gravel base, minimum 6 inches deep.
2. Flush-mount enclosures located in concrete or paved areas.
3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
4. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

O. Close unused box openings.

P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

Q. Provide grounding and bonding in accordance with Section 26 05 26.

R. Identify boxes in accordance with Section 26 05 53.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Underground warning tape.
F. Warning signs and labels.

1.02 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Motor Control Centers:
         1) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      b. Panelboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.

3) Identify power source and circuit number. Include location when not within sight of equipment.

4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.

5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil. Where room names/numbers are referenced, use the most up-to-date architectural drawings and schedules as a reference, not engineering plans.

6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

c. Enclosed switches, circuit breakers, and motor controllers:

1) Identify voltage and phase.

2) Identify power source and circuit number. Include location when not within sight of equipment.

3) Identify load(s) served. Include location when not within sight of equipment.

2. Service Equipment:
   a. Use identification nameplate to identify each service disconnecting means.

3. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
4. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
5. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations indicated.
6. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
   a. Fuel island: at each source and load connection.

4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
5. Use underground warning tape to identify direct buried cables.

C. Identification for Raceways:
1. Use identification labels or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.

2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
3. Use underground warning tape to identify underground raceways.

D. Identification for Cable Tray: Comply with Section 26 05 36.

E. Identification for Boxes:

1. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
   a. For exposed boxes in public areas, use only identification labels.

F. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
2. Use identification label to identify fire alarm system devices.
3. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
4. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
   a. Indoor Clean, Dry Locations: Use plastic nameplates.
   b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. Equipment Designation: 1/2 inch.
5. Color:
   a. Normal Power System: White text on black background.

D. Format for Receptacle Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.

5. Color: Black text on clear background.

E. Format for Fire Alarm Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Minimum Size:

1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

B. Legend:

1. Markers for System Identification:
   a. Emergency Power System: Text "EMERGENCY".

C. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:

1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 Identify conduit and boxes as follows:

A. Accessible Raceways 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A: Identify with orange snap-around label or stenciled legend adjacent to each junction box, pull box, and electrical enclosure. Indicate type of system and circuits located within (i.e. Normal or Emergency, 208/120 volt or 480/277 volt, panel ID and circuit number).

B. Use the following color code for conduit and junction box covers:

1. Fire Alarm - Red.
2. Voice and Data and other communication or security systems - Blue

C.

2.07 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

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

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Boxes: Outside face of cover.
   9. Conductors and Cables: Legible from the point of access.
   10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors
B. Outdoor motion sensors
C. Manual control components
D. Outdoor photo controls

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
C. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
D. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
E. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.03 Administrative Requirements

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch/dimmer occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   5. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

1.04 Submittals

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.

1.05 Submittals for Closeout

A. Submit according to the requirements of Division 01 and Section 26 0100.

B. As-Built Drawings: include as-built drawings showing final locations, settings, and circuit arrangements of all devices included in this section.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

D. Operation and Maintenance Manuals:

1. Approved and edited copy of Submittals for Review shall be included in the Operation and Maintenance Manuals.
2. Include copies of all documentation required by part 3 of this specification with the Operation and Maintenance Manual.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.07 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 Warranty

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

D. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 DESCRIPTION OF LIGHTING CONTROLS

A. Provide a full lighting control system. General system types to be used on this project are:

1. Basic Manual Lighting controls: lighting controls designed for manual-only control of individual spaces in buildings.
2. Standalone automatic lighting controls:low-voltage automatic lighting controls designed for economical control of individual spaces.
3. Wireless lighting controls are not allowed.

2.02 MANUFACTURERS

A. Acuity Brands Lighting:

1. SensorSwitch

B. Leviton:

C. Legrand Wattstopper

D. Cooper Controls

2.03 Low-Temperature / HIgh-Humidity Components

A. Where indicated on drawings, provide components with electronics coated for corrosion resistance and operable down to -40°F/-40°C.

2.04 Manual Control Components

A. Single Pole Single Throw (SPST) Switches: refer to Section 26 27 26.

B. Wall Dimmers and Scene Controllers

1. General Requirements:

a. Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

b. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.

2. Control Type:
   a. Basic: Decorator rocker control type with preset slide adjustment.

   b. Standalone: Digital fade type with tap on/off, dimming, and preset scene control where indicated. Laser-engraved legends. Unmarked buttons are not acceptable.

2.05 Occupancy Sensors

A. General Requirements
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technologies:
   a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.

   b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.

   c. Microphonic Occupancy Sensors: Designed to detect occupancy by passively sensing frequencies associated with human activity.

3. Connection/Communication Technologies:
   a. Standalone low-voltage sensors: low voltage units, for use with separate compatible accessory power packs or fixtures with integrated control modules.

4. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
5. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
6. Turn-Off Delay: Field adjustable, with time delay settings up to 20 minutes.
7. Sensitivity: Field adjustable.
8. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
9. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
10. Furnish sensors with a set of contacts for connection to mechanical control systems, when these contacts are not provided by other components within each area.
11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
13. Load Rating for Line Voltage Occupancy Sensors:
    a. Motor Load: Not less than 1/6 HP.

B. Wall Switch/Dimmer Occupancy Sensors
   1. Description: Decorator-style occupancy sensors designed for installation in standard single-gang wall box at standard wall switch mounting height with a field of view of 180 degrees, integral manual controls, and no leakage current to load in off mode.
   2. Provide vandal resistant lenses for wall switch occupancy sensors where indicated.
   3. Dimmer Type:
      a. Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.

      b. Provide field adjustable dimming preset for occupied state.

      c. Provide fade-to-off operation to notify occupant of impending load turn-off.

C. Ceiling Mounted Occupancy Sensors
   1. Description: Low profile occupancy sensors designed for ceiling installation.
   2. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
   3. Finish: White, unless otherwise indicated.
   4. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
   5. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: As indicated on the drawings.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.

3. Locate wall controls on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Engineer to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.

G. Provide required supports in accordance with Section 26 05 29.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Program controls in each room and verify that they function correctly. Failure of the programming will require a call back to correct the program.

J. Program the lighting controls once each area is ready for occupancy or after each phase has been completed.

K. Identify lighting control devices in accordance with Section 26 05 53.

L. Occupancy Sensor Locations:

1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

P. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 05 33.16 for mounting of lighting control device system components.

3.04 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Engineer.

C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

D. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Engineer.

E. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Engineer.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

C. Demonstration: Once each area is ready for occupancy or after each phase has been completed, demonstrate proper operation of lighting control devices to Owner and Engineer, and correct deficiencies or make adjustments as directed.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.
B. Lighting and appliance panelboards.
C. Overcurrent protective devices for panelboards.

1.02 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
E. NEMA PB 1 - Panelboards; 2011.
F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less; 2023.
G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
J. UL 67 - Panelboards; Current Edition, Including All Revisions.
K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
L. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
M. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
N. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
   2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Panelboard Keys: Two of each different key.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. Schneider Electric; Square D Products: www.schneider-electric.us.

C. Siemens Industry, Inc: www.usa.siemens.com.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
   1. For service entrance boards rated 1000A and higher, provide GFCI protection for the main breaker.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
      c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list and label panelboards as a complete assembly including surge protective device.

L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

M. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

N. Load centers are not acceptable unless noted otherwise.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Aluminum or copper.
   3. Ground Bus Material: Aluminum or copper.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.

3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:

         1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.

         2) 20,000 rms symmetrical amperes at 480 VAC.

      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

   3. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.

      b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

   4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
   6. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time per NEC 240.87.
   7. Provide the following circuit breaker types where indicated:
      a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.

   8. Do not use tandem circuit breakers.
   9. Do not use handle ties in lieu of multi-pole circuit breakers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 05 29.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 26 05 26.

1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

K. Install all field-installed branch devices, components, and accessories.

L. Set field-adjustable circuit breaker tripping function settings as indicated.

M. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

N. Provide filler plates to cover unused spaces in panelboards.

O. Identify panelboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

C. Test GFCI circuit breakers to verify proper operation.

D. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 24 19

MOTOR-CONTROL CENTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Motor control center units:
   1. Feeder units.
B. Overcurrent protective devices for motor control centers and associated units, including overload relays.
C. Motor control accessories:
   1. Control and timing relays.

1.02 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NECA 402 - Standard for Installing and Maintaining Motor Control Centers; 2014.
D. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers; 1995 (R2008).
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor control centers overcurrent protective devices, and other installed components and accessories.
C. Project Record Documents: Record actual installed locations of motor control centers and final equipment settings.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store motor control centers in accordance with manufacturer's instructions, NECA 402, and NEMA ICS 2.3.
B. Store in a clean, dry space having a uniform temperature to prevent condensation. Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
D. Handle carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MOTOR CONTROL CENTER UNITS

A. Feeder Units: Circuit breaker type.

2.02 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:

1. Interrupting Capacity (not applicable to motor circuit protectors):
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.

   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

2. Molded Case Circuit Breakers:
   a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

   b. Minimum Interrupting Capacity:

      1) 22,000 rms symmetrical amperes at 240 VAC or 208 VAC.

   c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the motor control centers and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive motor control centers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install motor control centers in accordance with NECA 1 (general workmanship), NECA 402, and NEMA ICS 2.3.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Provide grounding and bonding in accordance with Section 26 05 26.

F. Install all field-installed devices, components, and accessories.

G. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

H. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

I. Provide filler plates to cover unused spaces.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of motor control center covers and doors.

3.04 CLEANING

A. Clean dirt and debris from motor control center enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.
B. Receptacles.
   1. Straight blade receptacles.
   2. GFCI type receptacles.
   3. Twist-locking receptacles.
C. Wall plates.
D. Floor box service fittings.
E. Device plates and decorative box covers
F. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
G. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
I. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
J. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).
K. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
N. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
O. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
P. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
   4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   5. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
B. Sequencing:
   1. Do not install wiring devices until final surface finishes and painting are complete.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
C. Project Record Documents: Record actual installed locations of wiring devices.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.05 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

C. Provide GFCI protection for receptacles installed within 6 feet of sinks.

D. Provide GFCI protection for receptacles installed in kitchens.

E. Provide GFCI protection for receptacles serving electric drinking fountains.

F. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Wiring Devices, Unless Otherwise Indicated: Standard finish selected by Architect.

2.03 WALL SWITCHES

A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.04 RECEPTACLES

A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

B. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

C. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL

498 Supplement SD suitable for installation in damp or wet locations.

2.05 WALL PLATES

A. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard.
   3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

C. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

D. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switches: 46 inches above finished floor to centerline of device.
      b. Wall Dimmers: 46 inches above finished floor to centerline of device.
      c. Fan Speed Controllers: 46 inches above finished floor to centerline of device.
      d. Receptacles: 18 inches above finished floor to centerline of device, 6 inches above countertop, or 4 inches above backsplash. Modify receptacle installation height to accomodate hydronic baseboard heat where installed.
   2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Engineer to obtain direction prior to proceeding with work.

5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on right.

L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Engineer.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

1.02 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Fuses: One set(s) of three for each type and size installed.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Individual Motor Branch Circuits: Class RK1, time-delay.

2.02 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

1. Class RK1, Time-Delay Fuses:

H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 28 16.16

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

G. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Project Record Documents: Record actual locations of enclosed switches.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. Schneider Electric; Square D Products: www.schneider-electric.us.

C. Siemens Industry, Inc: www.usa.siemens.com.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
2. Minimum Ratings:
   a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
   b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

N. Heavy Duty Switches:

1. Comply with NEMA KS 1.
2. Conductor Terminations:

a. Provide mechanical lugs unless otherwise indicated.

b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 05 26.

H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Identify enclosed switches in accordance with Section 26 05 53.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.04 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Poles and accessories.

C. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals; 2013 (Revised 2019).

D. IEEE C2 - National Electrical Safety Code; 2012.

E. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.

F. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015, with Errata (2017).

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

H. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.

I. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 1598 - Luminaires; Current Edition, Including All Revisions.

L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
2. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:
   a. Include estimated useful life, calculated based on IES LM-80 test data.

D. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.

I. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 ACCESSORIES

A. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires in accordance with NECA/IESNA 501.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.

G. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

H. Pole-Mounted Luminaires:

1. Maintain the following minimum clearances:
   a. Comply with IEEE C2.
   b. Comply with utility company requirements.
2. Grounding:
   a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
3. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
4. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 26 27 26 in designated poles.

I. Install accessories furnished with each luminaire.

J. Bond products and metal accessories to branch circuit equipment grounding conductor.

K. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.

3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 32 0519
GEOSYNTHETICS FOR EXTERIOR IMPROVEMENTS
(TROLLWOOD PERFORMING ARTS)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Geogrid for stabilization.

1.02 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing.

B. Section 31 2316 - Excavation.

C. Section 31 2323 - Fill.

1.03 REFERENCE STANDARDS

A. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).

B. ASTM D6637/D6637M - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method; 2015.

C. ASTM D7737/D7737M - Standard Test Method for Individual Geogrid Junction Strength; 2015.

1.04 SUBMITTALS

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

B. Product Data: Manufacturer's data on each product used, including physical properties, seaming materials, and installation instructions.

C. Shop Drawings:
   1. Indicate overall layout, dimensions, geotextile sheet, and seam layout.
   2. Indicate anchorage, penetration, and seaming details.

D. Certificate: Certify that products of this section meet or exceed specified requirements.

E. Manufacturer's Instructions: Indicate seaming method.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Identify, store, and handle geosynthetic rolls and samples in accordance with ASTM D4873/D4873M.

B. Protect materials from sunlight and other ultraviolet light sources during storage.

1.06 FIELD CONDITIONS

A. Temperature Requirements: Do not place geosynthetic when ambient air or base surface temperature is less than 40 degrees F or above 140 degrees F.

B. Surface Requirements: Do not place geosynthetic when receiving surface is saturated or has ponded water.

C. Follow recommendations of geosynthetic manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. SKAPS Industries: www.skaps.com/#sle.

B. Solmax: www.solmax.com/#sle.

C. US Fabrics Inc: www.usfabricsinc.com/#sle.

D. GrassMats .https://grassmatsusa.com

E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GEOGRID

A. General:
   1. Material: Polyethylene consisting of 5 percent maximum regrind and free of contaminants.

B. Products:
   1. Tensar, a division of CMC; InterAx Geogrids: www.tensarcorp.com/#sle.
   2. GrassMats.https://grassmatsusa.com/product/grass-protection-mesh/
   3. Substitutions: See Section 01 6000 - Product Requirements.

C. Geogrid for Stabilization: Capable of reducing deformation of unbound granular materials.
   1. Seams: Loose laid.
      a. Overlap: 12 inches.
   2. Ultimate Tensile Strength: 1,300 lbf/ft, minimum, when tested in accordance with ASTM D6637/D6637M.
   3. Junction Strength: 25 lbf, minimum, when tested in accordance with ASTM D7737/D7737M.

D. Geogrid Accessories:
   1. Anchoring Staples: As recommended by manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove vegetation, boulders, and rocks larger than 3/4 inch in size and other sharp objects.

B. Remove unsuitable materials.

C. Fill in holes, including stake holes, backfill, and fill.

3.02 INSTALLATION

A. General:
   1. Notify Architect minimum of 24 hours before geosynthetic installation.
   2. Prevent surface drainage from eroding under geosynthetic. Repair undermined areas before backfill.
   3. Position geosynthetic smooth and wrinkle-free on prepared surface; unroll or unfold carefully, avoiding stretching.

B. Separation:
   1. Install geotextile according to manufacturer's recommendations.
   2. Lay sheets in direction of construction.
   3. Repairs: Remove damaged portion of geotextile and seam additional layer to cover affected area.

C. Filtration:
   1. Install geotextile according to manufacturer's recommendations.
   2. Lay sheets in direction of construction.
   3. Repairs: Remove damaged portion of geotextile and seam additional layer to cover affected area. Replace geotextile where surface runoff contamination has occurred.

D. Stabilization:
   1. Install geogrid according to manufacturer's recommendations.
   2. Lay sheets in direction of construction.
   3. Allow geogrid to lie in relaxed state 1/2 hour, minimum before attachments.
   4. Repairs: Remove damaged portion of geogrid, and seam additional layer to cover affected area.

E. Drainage:
   1. Install geocomposite according to manufacturer's recommendations.
   2. Lay sheets in direction of incline.
   3. Allow geocomposite to lie in relaxed state 1/2 hour, minimum before attachments.
   4. Repairs:

a. Remove damaged portion of geonet and seam additional layer to cover affected area.
b. Remove damaged portion of geotextile and seam additional layer to cover affected area.

3.03 BACKFILL

A. Obtain approval for geosynthetic sheet installation from Architect before placing fill.

B. Backfill in manner to prevent damage to geosynthetic. Repair geosynthetic damaged during backfill operations.

C. Cover geosynthetic in installed direction, see Section 31 2323.

3.04 PROTECTION

A. Do not exceed geosynthetic manufacturer's recommended exposure to UV radiation.

B. Prevent surface water runoff from contaminating geosynthetic.

C. Do not use pins or staples where risk of damaging underlying geosynthetic layer is present.

D. Erect barricades preventing traffic over unfilled geosynthetic.

END OF SECTION 32 0519

SECTION 32 1816.13
PLAYGROUND PROTECTIVE SURFACING
(LONGFELLOW ELEMENTARY)
(EAGLES ELEMENTARY)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of existing protective surfacing and correction of grades as necessary.

B. Protective surfacing for playground area.

1.02 RELATED REQUIREMENTS

A. Section 11 6813 - Playground Equipment: Playground layout (staking).

1.03 REFERENCE STANDARDS

A. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine; 2017.

B. ASTM F1292 - Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment; 2022.

C. ASTM F1487 - Standard Consumer Safety Performance Specification for Playground Equipment for Public Use; 2021.

D. CPSC Pub. No. 325 - Public Playground Safety Handbook; 2015.

1.04 DEFINITIONS

A. Use Zone: The area beneath and immediately adjacent to a play structure or equipment (play event) that is designated for unrestricted circulation around equipment, and on whose surface it is predicted that a user would land when falling from or exiting the equipment.

B. Critical Fall Height: The maximum fall height at which the protective surfacing meets the requirements of ASTM F1292.

C. Fall Height: The vertical distance between the finished elevation of the designated play surface and the finished elevation of the protective surfacing beneath it as defined by ASTM F1487.

D. Protective Surfacing: Resilient ground surfacing. The characteristics of the protective surfacing are based on the fall height of the playground equipment. Changes in either the surfacing or the fall height, particularly reducing the resilience of the protective surfacing or increasing the fall height, will reduce safety-related performance.

E. Subbase: A layer under the resilient layer of the protective surfacing but over the subgrade; may be rigid, as in concrete or bituminous, or aggregate.

F. Subgrade: The surface of the ground on which the protective surfacing is installed.

1.05 SUBMITTALS

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

B. Product Data: For all manufactured surfacing products, provide manufacturer's product data showing materials of construction, compliance with specified standards, installation procedures, and safety limitations.

C. Product Data: For natural surfacing materials, provide supplier's certification or mill certificate showing compliance with specified requirements.

D. Shop Drawings: Detailed scale drawings showing locations of existing playground equipment and exposed footings, bases, and anchorage points.

1. Clearly identify footing and base elevations in relation to a fixed survey point on site and to subgrade elevation and depth of protective surfacing, surveyed by land surveyor licensed in the State in which the Project is located.
2. Show locations of underground utilities, storm-drainage system and irrigation system.
3. Show locations of related construction such as walkways and roadways, fences, site furnishings, and plantings.
4. Show measured fall height for each playground equipment item, determined in accordance with ASTM F1487.
5. Show Use Zone perimeters, determined in accordance with ASTM F1487.

E. Samples: For each product for which color must be selected provide color chart showing full range of colors.

1.06 QUALITY ASSURANCE

A. Maintain one copy of the latest edition of ASTM F1487 and CPSC Pub. No. 325 at project site.

B. Manufacturer Qualifications: Company regularly engaged in manufacturing products specified in this section, with not less than three years of documented experience.

C. Installer Qualifications: Company certified by manufacturer for training and experience installing the protective surfacing; provide installer's company name and address, and training and experience certificate.

1.07 PRE-INSTALLATION MEETING

A. Coordinate with Section 11 6813.

B. Convene a meeting one week before starting earthwork for playground to discuss coordination between various installers.
1. Require attendance by personnel responsible for grading and installers of playground equipment, protective surfacing, footings, and adjacent work.
2. Include representatives of Contractor.
3. Notify Architect at least 2 weeks prior to meeting.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store protective surfacing to project site in accordance with manufacturer's recommendations.

B. Store materials in a dry, covered area, elevated above grade.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals - Closeout Submittals, for additional warranty requirements.

B. Provide minimum ____ year warranty for playground surfacing.

PART 2 PRODUCTS

2.01 PERFORMANCE CRITERIA

A. Because the safety of the playground depends on strict compliance with the performance criteria, this information is provided for Contractor's information.
1. The top elevation of the protective surfacing is intended to be flush with adjacent grades.
2. Use Zone: The protective surfacing has been designed to provide acceptable impact attenuation as defined in ASTM F1292 for Critical Height of 12 feet at Longfellow and 10 feet at Eagles.

B. If deviation from specified depth is required, it is the Contractor's responsibility to make all changes required to maintain specified top elevation and required impact attenuation at no extra cost to Owner; obtain approval prior to proceeding; follow approval request procedure as specified for substitutions.

2.02 MATERIALS

A. Poured-In-Place Membrane Surfacing: Weather-resistant wear layer over impact attenuating substrate over rigid subbase.

1. Wear Layer: Ethylene propylene diene monomer (EPDM) particles adhered with a ultraviolet-stabilized polyurethane binder to produce an even, uniformly colored surface.
2. Wear Layer Thickness: 3/8 inch, minimum.
3. Coefficient of Friction, when wet: 0.8, minimum, when tested in accordance with ASTM D2047.
4. Wear Layer Color(s): As selected from manufacturer's full range of bright colors.
5. Impact Attenuating Substrate: 100 percent recycled shredded styrene butadiene rubber (SBR) shreds or granules with 100 percent solids polyurethane binder to form a resilient material; do not use foam rubber.
6. Manufacturers:
   a. GameTime, Inc: www.gametime.com/#sle.
   b. No Fault Sport Group; No Fault Safety Surface for Playgrounds: www.nofault.com/#sle.
   c. Play Safe Surfacing, Inc: www.playsafesurfacing.com/#sle.
   d. Hanover Specialties Inc: www.vitriturf.com/#sle.
   e. Landscape Structures.www.playlsi.com
   f. Substitutions: See Section 01 6000 - Product Requirements.
7. Accessories: Provide manufacturer's standard containment curbs and tapered transition elements to support surfacing between changes of surface grade.

PART 3 EXECUTION

3.01 PREPARATION FOR REPLACEMENT OF EXISTING LOOSE FILL SURFACING

A. Remove existing loose fill.

B. Measure the location of all playground elements, including perimeter of existing protective surfacing, access and egress points, hard surfaces, walls, fences, and structures, and planting locations.

C. Stake the layout of the entire Use Zone perimeter before starting any work, based on Contract Documents.
   1. Verify that Use Zone perimeters do not overlap hard surfaces, whether currently installed or not.
   2. Do not proceed until revised drawings have been provided, showing corrected layout.

D. Inside Use Zones remove all obstructions that would extend into the resilient protective surfacing.

E. After subgrade is correct, mark intended depth of surfacing on the base supports of each item of playground equipment using paint or tape in a manner that will be easily verifiable during installation of surfacing.

F. Perform percolation test at the lowest elevation of the subgrade in the areas to be covered by protective surfacing.
   1. Report results to Architect.
   2. If percolation is less than 1 inch in a 3 hour period, do not proceed.

3.02 EXAMINATION

A. Playground equipment installer will perform playground layout prior to installation of footings; verify correctness of layout before starting this work.

B. Verify that playground equipment and site furnishings and irrigation system located within playground area are complete.

C. Verify location of underground utilities and facilities in the playground area. Damage to underground utilities and facilities will be repaired at Contractor's expense.

D. Verify that subgrades are at proper elevations and that smooth grading is complete.

E. Verify that proper depth of surfacing is marked on base supports of playground equipment.

3.03 PREPARATION

A. Correct subgrade irregularities to ensure that required depth of protective surfacing can be installed, and subgrade elevation is in accordance with manufacturer's requirements.

B. Inside Use Zones remove all obstructions that would extend into the resilient protective surfacing.

C. Remove rocks, debris, and other similar items.

D. Install containment curbs with top surface flush with intended elevation of top surface of protective surfacing.

3.04 SUBBASE

A. Install concrete subbase as indicated on drawings.
   1. Remove curing compounds and other substances that will adversely affect adhesion.

B. Install with top surface of subbase no higher than grades and levels indicated and not more than 1/4 inch lower than grades and levels indicated.

C. Install in true, even plane, sloped to provide positive drainage.

D. Flatness Tolerance: 1/4 inch in 10 feet, maximum.

E. Cure subbase at least 7 days but not less than required by manufacturer of resilient surfacing.

3.05 RESILIENT SURFACING LAYER

A. Install in accordance with CPSC Pub. No. 325, ASTM F1487, manufacturer's instructions, and requirements of authorities having jurisdiction (AHJ).

B. Install proper thickness throughout Use Zone(s).

C. Clean and dry surface of subbase.

D. Poured In Place Surfacing:
   1. Mix components mechanically on-site in accordance with manufacturer's directions; do not mix by hand.
   2. Install seamlessly; ensure complete bond to subbase.
   3. Cover footings and foundations and adhere tightly around penetrating elements.
   4. Maintain full thickness of resilient layers within Use Zone; cover or abut containment curbs as indicated on drawings; completely cover tapered transition edges.
   5. Hand trowel exposed surface to smooth, even finish.
   6. Impact Attenuation Layer: Install entire layer in one continuous pour on the same day.
   7. Wear Surface: Bond wear surface to substrate with adhesive. Apply adhesive in small quantities so that wear surface can be applied before adhesive dries.
      a. Install surfacing seamlessly. When wear surface is composed of different color patterns, pour surface continuously and seamlessly.
      b. When seams are required due to color change or field conditions, place adjacent wear surface as soon as possible, before initial pour has cured. Coat edge of initial pour with adhesive and apply wear surface mixture immediately.
      c. Add a minimum of 1/16 inch depth to specified surfacing depth to ensure required impact attenuation performance is met.
      d. Install wear surface to cover foundations and adhere tightly around elements penetrating the surface.

3.06 FIELD QUALITY CONTROL

A. Owner or Owner's representative will inspect playground surfacing after installation to verify that surfacing is of proper type and depth and that playground meets specified design safety and accessibility requirements.

B. Repair or replace rejected work until compliance is achieved.

3.07 CLEANING AND PROTECTION

A. Restore adjacent existing areas that have been damaged from the construction.

B. Clean playground equipment of construction materials, dirt, stains, filings, and blemishes due to shipment or installation. Clean in accordance with manufacturer's instructions, using cleaning agents as recommended by manufacturer.

C. Clean playground area of excess construction materials, debris, and waste.

D. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.

E. Protect installed products until Date of Substantial Completion.

F. Replace damaged products before Date of Substantial Completion.

END OF SECTION 32 1816.13

SECTION 32 1823.39
SYNTHETIC RUNNING TRACK SURFACING
(DAVIES HIGH SCHOOL)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Synthetic running track surfaces.

B. Line markings.

1.02 REFERENCE STANDARDS

A. IAAF/NCAA - Performance Specification for Synthetic-Surfaced Athletics Tracks (Outdoor); 1999.

B. DIN 18035-6 - Sports Ground - Part 6: Synthetic Surfaces; 2021.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

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

B. Product Data: Manufacturer's product data including standard specifications, installation guidelines and maintenance instructions.
   1. Submit documentation that synthetic running track surfacing material is free of toxic or hazardous substances that exceed the limits set forth by the U.S. Environmental Protection Agency.

C. Shop Drawings: Show location and color of lane lines, start lines, finish lines, and related markings for Owner to review a minimum of 4 weeks prior to application.

D. Samples: Three, 12 inch by 12 inch samples in the color(s) indicated on Contract Documents.

E. Manufacturer's Instructions: Submit copies of manufacturer's written installation instructions and other recommendations

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Maintenance Data.

I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company that has produced surfacing materials for not less than ten years with not less than five similar projects that have been in successful use for more than five years.

B. Installer Qualifications: Minimum five years experience in successful installation of surfacing systems of type specified herein.
   1. Submit manufacturer's certification that installer is qualified to install the products specified.

1.06 DELIVERY STORAGE AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store in weathertight location and protect from damage during delivery, storage and handling.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after date of Substantial Completion.

C. Provide five year manufacturer warranty for synthetic running track surface system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Synthetic Running Track Surfacing:
1. Beynon Sports Surfaces: www.beynonsports.com/#sle.
2. Conica: www.conica.com/#sle.
3. United Sport Systems: www.unitedsportsystems.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SYNTHETIC RUNNING TRACK SURFACING

A. Synthetic Running Track Surfacing System: Permeable; paved-in-place.
1. Finish Layer: Structural spray coating of colored polyurethane and Type 2 top layer EPDM rubber granule mixture, sprayed onto base system.
2. Comply with the following as described in IAAF/NCAA Performance Specification for Synthetic-Surfaced Athletics Tracks (Outdoor):
a. Force Reduction: 35 to 50 percent.
b. Modified Vertical Deformation: 0.23 inch to 0.07 inch.
c. Friction (TRRL Skid Resistance): 47.
d. Tensile Strength:
1) Porous surface: 72.5 pound per square inch.
2) Non-porous surface: 58 pounds per square inch.
e. Elongation at Break: 40 percent.
f. Maximum Rubber Content in Force Reduction Layer: 20 percent.
3. Comply with the following as described in DIN 18035-6:
a. Spike Resistance: Class 1.
b. Ball Rebound: 99 percent.
c. Abrasion Resistance: 1.30.
d. Maximum Indentation: 7/32 inch.
e. Sliding Coefficient:
1) Dry: 0.68.
2) Wet: 0.50.
4. Flammability Behavior: Class 1 in accordance with DIN 4102-1.

2.03 MATERIALS

A. Structural Spray Coat: 2-component polyurethane spray coating.

B. Aliphatic Top Coating: 2-component, high elongation, UV resistant sealer.

2.04 ACCESSORIES

A. Track and Event Line Marking Paint: Polyurethane paint formulated for exterior service environments in striping applications in color as specified for line markings.
1. Thickness: 12 mils dry film thickness (DFT).
2. Multiple coats to achieve thickness as required by paint manufacturer.
3. Prime surface to achieve adhesion characteristics of paint.

B. Striping/Marking Paint: UV-resistant, waterborne acrylic paint finish, for use on athletic fields.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
1. Do not proceed until unsatisfactory conditions have been corrected.

2. Substrate tolerances:
   a. Concrete Curbs: Ensure top elevations of continuous concrete curbs are at constant elevation.

B. Flood Test: Flood substrate immediately after substrate is capable of supporting foot traffic. Allow to dry for 20 minutes.
   1. If any areas of ponded water ("birdbaths") are visible at the end of the 20 minute drying time, correct areas of substrate that allow water to pond.
   2. Obtain Architect's written approval of method of correction prior to proceeding with corrective work.
   3. Cold tar patching, skim-coat patching and sand-mix patching are not acceptable methods of correction.

3.02 PREPARATION

A. Protection: Protect surfaces adjacent to track surfacing operations from polyurethane liquids.

B. Surface Preparation: Verify substrate is fully cured and free from excess surface oils and chemicals that would impair track surface installation.

3.03 INSTALLATION

A. General:
   1. Comply with manufacturer's recommendations.
   2. Prime areas to be surfaced.
   3. Make substrate surface repairs and minor planarity corrections with repair compound.
   4. Install track surface as specified to achieve track surface performance and physical dimensions within tolerances.

3.04 INSTALLATION OF PAVED-IN-PLACE SYNTHETIC TRACK SURFACE

A. Priming: Prime only area to be covered within working day to ensure good bond to base. Apply primer at manufacturer's recommended rate.

B. Base Layer: Mix base layer granules with polyurethane binder at manufacturer's recommended rate until homogeneous. Pave mixture in place using heated mechanical screed paver specially designed for this work. Apply to recommended depth at recommended application rate.

C. Spray Coat: Apply spray coat with air and volume controlled spray equipment in even surfaces without streaking. Apply second coat in opposite direction to first application. Achieve uniform finish. Apply at manufacturer's recommended rate.

3.05 TRACK AND EVENT LINE MARKING

A. Track and Event Line Markings, General: Comply with the requirements of the referenced IAAF / NCAA standards. **Match Existing**.

3.06 TOLERANCES

A. Surface Thickness, variation: Variation of minus 0.0 inch to plus 1/8 inch.

B. Color Deviation: 5 Delta E (Hunter) units maximum allowed.

3.07 FIELD QUALITY CONTROL

A. Tests: Perform thickness, hardness and deformation tests.

B. Layout:
   1. Employ registered surveyor to document compliance of in-place work with the Contract Documents and the referenced standards.
   2. Submit reports.

3.08 CLEANING

A. Leave surfacing in clean condition and free of surface defects.

B. Reapply and touch up paint striping once during the warranty period.

3.09 PROTECTION

A. Protect installed surfacing from damage during the balance of construction activity.

END OF SECTION 32 1823.39