

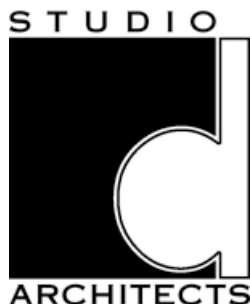
PROJECT MANUAL FOR

Genesis – A Addition & Remodel

**at
New Mexico State University
Las Cruces, New Mexico**

PROJECT MANUAL
BID NUMBER:
PROJECT NO.: 25.25
May 2026

SET NO.



Studio D Architects, PA

P.O. Box 1467

Fairacres, New Mexico 88033

(575) 521-3757

**SECTION 000102
PROJECT INFORMATION**

PART 1 GENERAL

1.01 PROJECT IDENTIFICATION

- A. Project Name: NMSU Genesis A - addition & remodel
- B. Architect's Project 25.25:
3655 Research Dr., Building A
Las Cruces, New MexicoProject
- C. The Owner, hereinafter referred to as Owner: NMSU (New Mexico State University)

1.02 PROJECT DESCRIPTION

- A. Summary Project Description: The project will consist of the interior remodel of approximately 5,000 square feet of office/lab space; the addition of 788s.f. lab expansion, and the addition of a 910 s.f. greenhouse..

1.03 PROCUREMENT TIMETABLE

- A. Procurement information as per NMSU Procurement Office.
- B. The Owner reserves the right to change the schedule or terminate the entire procurement process at any time.

1.04 PROCUREMENT DOCUMENTS

- A. Availability of Documents: Complete sets of procurement documents may be obtained:
 - 1. From Owner at the Project Manager's Office. (contact NMSU Procurement Office).
- B. Documents may be viewed at (contact NMSU Procurement Office for additional information).

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 000110
TABLE OF CONTENTS**

PROCUREMENT AND CONTRACTING REQUIREMENTS

1.01 DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

- A. 000101 - Project Title Page
- B. 000102 - Project Information
- C. 000110 - Table of Contents

SPECIFICATIONS

2.01 DIVISION 01 -- GENERAL REQUIREMENTS

- A. 012000 - Price and Payment Procedures
- B. 012300 - Alternates
- C. 012500 - Substitution Procedures
- D. 013000 - Administrative Requirements
- E. 013050 - Design Procedures and Substantiation Requirements
- F. 013114 - Facility Services Coordination
- G. 013216 - Construction Progress Schedule
- H. 014000 - Quality Requirements
- I. 015000 - Temporary Facilities and Controls
- J. 015100 - Temporary Utilities
- K. 015213 - Field Offices and Sheds
- L. 015713 - Temporary Erosion and Sediment Control
- M. 015813 - Temporary Project Signage
- N. 016000 - Product Requirements
- O. 017000 - Execution and Closeout Requirements
- P. 017800 - Closeout Submittals
- Q. 017900 - Demonstration and Training

2.02 DIVISION 03 -- CONCRETE

- A. 030500 -- Basic Concrete Materials and Methods
- B. 031000 - Concrete Forming and Accessories
- C. 032000 - Concrete Reinforcing
- D. 033000 - Cast-in-Place Concrete
- E. 033511 - Concrete Floor Finishes

2.03 DIVISION 04 -- MASONRY

- A. 040511 - Masonry Mortaring and Grouting
- B. 042000 - Unit Masonry

2.04 DIVISION 05 -- METALS

- A. 051200 - Structural Steel Framing
- B. 051213 - Architecturally-Exposed Structural Steel Framing
- C. 052100 - Steel Joist Framing
- D. 053100 - Steel Decking

2.05 DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

- A. 061000 - Rough Carpentry
- B. 062000 - Finish Carpentry
- C. 064100 - Architectural Wood Casework
- D. 068316 - Fiberglass Reinforced Paneling

2.06 DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

- A. 072100 - Thermal Insulation
- B. 072400 - Exterior Insulation and Finish Systems
- C. 075423 - Thermoplastic Polyolefin (TPO) Membrane Roofing - Carlisle
- D. 076200 - Sheet Metal Flashing and Trim
- E. 077100 - Roof Specialties
- F. 077200 - Roof Accessories
- G. 079200 - Joint Sealants

2.07 DIVISION 08 -- OPENINGS

- A. 081113 - Hollow Metal Doors and Frames
- B. 081213 - Hollow Metal Frames
- C. 081416 - Flush Wood Doors
- D. 083100 - Access Doors and Panels
- E. 087100 - Door Hardware
- F. 088000 – Glazing

2.08 DIVISION 09 -- FINISHES

- A. 092116 - Gypsum Board Assemblies
- B. 093000 - Tiling
- C. 095100 - Acoustical Ceilings
- D. 096500 - Resilient Flooring
- E. 096700 - Fluid-Applied Flooring
- F. 096813 - Tile Carpeting

2.09 DIVISION 10 -- SPECIALTIES

- A. 101400 - Signage
- B. 102113.13 - Metal Toilet Compartments
- C. 102800 - Toilet, Bath, and Laundry Accessories
- D. 104400 - Fire Protection Specialties
- E. 105617 - Wall Mounted Standards and Shelving
- F. 105723 - Closet and Utility Shelving

2.10 DIVISION 11 -- EQUIPMENT REFER TO DRAWINGS

2.11 DIVISION 12 -- FURNISHINGS

- A. 123200 - Manufactured Wood Casework
- B. 123600 – Countertops

2.12 DIVISION 21 -- FIRE SUPPRESSION REFER TO DRAWINGS

2.13 DIVISION 22 -- PLUMBING

- A. 220516 - Expansion Fittings and Loops for Plumbing Piping
- B. 220517 - Sleeves And Sleeve Seals for Plumbing Piping
- C. 220523 - General-Duty Valves for Plumbing Piping
- D. 220529 - Hangers And Supports for Plumbing Piping and Equipment
- E. 220553 - Identification For Plumbing Piping and Equipment
- F. 220719 - Plumbing Piping Insulation
- G. 221005 - Plumbing Piping
- H. 221006 - Plumbing Piping Specialties

2.14 DIVISION 23 -- HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

- A. 230517 - Sleeves And Sleeve Seals for HVAC Piping
- B. 230529 - Hangers And Supports for HVAC Piping and Equipment
- C. 230548 - Vibration And Seismic Controls For HVAC
- D. 230553 - Identification For HVAC Piping and Equipment
- E. 230593 - Testing, Adjusting, And Balancing For HVAC
- F. 230713 - Duct Insulation
- G. 232300 - Refrigerant Piping
- H. 233100 - HVAC Ducts and Casings
- I. 233300 - Air Duct Accessories

2.15 DIVISION 26 -- ELECTRICAL

- A. 260000 - Basic Electrical Requirements
- B. 260500 - Common Electrical Work Requirements
- C. 260505 - Selective Demolition for Electrical
- D. 260519 - Low-Voltage Electrical Power Conductors and Cables
- E. 260526 - Grounding And Bonding for Electrical Systems
- F. 260529 - Hangers And Supports for Electrical Systems
- G. 260533.13 - Conduit For Electrical Systems
- H. 260533.16 - Boxes For Electrical Systems
- I. 260548 - Protection For Electrical Equipment
- J. 260553 - Identification For Electrical Systems
- K. 260923 - Lighting Control Devices
- L. 262100 - Low-Voltage Electrical Service Entrance
- M. 262200 - Low-Voltage Transformers
- N. 262413 - Switchboards
- O. 262416 - Panelboards
- P. 262726 - Wiring Devices
- Q. 262816.13 - Enclosed Circuit Breakers
- R. 262816.16 - Enclosed Switches
- S. 265100 - Interior Lighting
- T. 265600 - Exterior Lighting
- U. 284600 - Fire Detection and Alarm

2.16 DIVISION 31 -- EARTHWORK

- A. 311000 - Site Clearing
- B. 312200 - Grading
- C. 312316 - Excavation
- D. 312316.13 - Trenching
- E. 312323 – Fill

2.17 DIVISION 32 -- EXTERIOR IMPROVEMENTS

- A. 328423 - Underground Sprinklers
- B. 329219 - Seeding
- C. 329223 – Sodding

2.18 DIVISION 33 -- UTILITIES REFER TO DRAWINGS

2.19 ATTACHMENTS – GEO TECHNICAL REPORT

**SECTION 011116
GENERAL REQUIREMENTS**

PART 1 GENERAL

1.01 WORK BY NMSU

- A. FS Operations personnel are the only parties authorized to operate NMSU utilities equipment. This includes all devices connected to piping and electrical distribution systems such as valves, switches, pumps, breakers, etc. Any party that requires operation of a NMSU utilities device must coordinate that operation through the NMSU Project Representative by requesting a utility outage, see F & S outage procedure OPS-015.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Provide title strip along right vertical margin with lettering at least 1/2" high
- B. Plans are to include design standards common to the architectural and engineering professions.
- C. Indexes shall match actual documents.
- D. Verify that dimensions, labeled column gridlines, room numbers, key plan, scale, and all necessary labels are indicated on the plans.
- E. New work shall be adequately differentiated from existing facilities. (line, width, symbols, etc.)
- F. Avoid duplication of information. Provide only key notes that are specific to the plan, section, and large scale drawing.

1.03 SPECIAL PROCEDURES

- A. Smoking is prohibited in NMSU buildings under construction, see NMSU policy **3.98**[if !supportNestedAnchors][endif] – Smoking.

1.04 NMSU SAFETY REQUIREMENTS

- A. It is the General Contractor's responsibility to ensure that all sub- contractors comply with all safety regulations. Also note that the Contractor is fully responsible for having an Environmental, Health and Safety compliance program for NMSU records and review.
- B. For any work areas that are posted as biohazardous, the NMSU Environmental Health and Safety Office (575) 646-3327 must be contacted for clearance prior to start of work.
- C. All persons performing mechanical, electrical, plumbing, and utility work at NMSU must coordinate with NMSU Project Representative to ensure adherence to NMSU "Lock-out/Tag-out" procedures, see Energy Lockout/Tagout Program Environmental Health Safety & Risk Management New Mexico State University.
- D. The contractor will be responsible for providing an onsite welding permit system according to OSHA 29CFR1926 and NFPA 51B.

1.05 ENVIRONMENTAL PROCEDURES

- A. Chemical Safety - All hazardous materials and wastes shall be properly labeled and stored while on site. Bulk chemical storage for drums or other containers of hazardous or otherwise regulated liquids larger than 25 gallons requires secondary containment and grounding for flammables.
- B. Contractor shall maintain on-site copies of Material Safety Data Sheets (MSDSs) for all hazardous material brought onto the site. These MSDSs must be kept readily accessible for employee use.
- C. Chemical spills shall be reported to the NMSU Project Representative.
- D. Hazardous materials that could cause illness if released or not properly used shall be kept properly stored.

- E. SWPPP: Contractor must obtain and submit for approval of a Construction Storm Water Pollution Prevention Plan (SWPPP). The approved plan must be executed and all erosion controls must be in place prior to any excavation.
- F. Disposal of liquids shall follow manufacturers' recommendations, local, state, and federal laws. At no time shall oils, solvents, paints, cleansers, etc. contaminate the soil.

1.06 CODES

- A. Design criteria must include the use of IFC standards.

1.07 LAWS

- A. All NMSU buildings shall comply with NM Executive Order 2006-001, State of New Mexico Energy Efficient Green Building Standards for State Buildings.

1.08 TEMPORARY FACILITIES AND CONTROLS

- A. Indicate construction work site limits, fencing, lay down yard, etc. in contract documents.

1.09 VEHICULAR ACCESS AND PARKING

- A. Ensure special requirements for work site entrances, handicap access, walkways to remain open, fire truck and emergency vehicle access etc., are noted and must be maintained at all times.
- B. Parking Stripes and other devices shall comply with the MUTCD standards.
- C. Prior approval is required from NMSU Project Representative.

1.10 TRAFFIC CONTROL

- A. Indicate that if traffic flow or road access must be interrupted or roads closed, the contractor shall obtain approval not less than 14 days prior. Request road closure policy from NMSU Project Representative.

1.11 TEMPORARY PARKING AREAS

- A. Temporary parking areas shall be designated for use by Contractor during construction. Contractor must purchase NMSU parking permits to allow vehicles (personal or otherwise) to be parked in existing campus parking areas, see NMSU policy 2.95.5 - NMSU Permit or Placard Issuance Requirement.

1.12 TEMPORARY BARRIERS AND ENCLOSURES

- A. The contractor will be responsible for preventing access to the building site to unauthorized persons.
- B. Do not obstruct existing streets, walkways, access corridors, etc. unless specific written permission is granted by NMSU Project Representative.

1.13 TEMPORARY DUST BARRIERS

- A. Required dust controls must be maintained over project duration, including site watering, track-out prevention, street sweeping and covering all truck loads of soil to/from site.

1.14 TEMPORARY CONTROLS

- A. For projects disturbing more than 1 acre of soil or pavement, prior to breaking ground, the Contractor must make required EPA notifications, obtain an NPDES- MS4 permit or waiver, and develop and comply with the NPDES permit and any required site-specific SWPPP. NMSU may be required to collect damages for Contractor non-compliance with the NPDES of up to \$1000 per day per violation.
- B. Any required erosion/dust controls must be regularly inspected & maintained over project duration.

1.15 SUSTAINABLE DESIGN REQUIREMENTS

- A. Refer to the NMSU LEED Policy for our sustainable design philosophy.

1. New construction larger than 15,000 square feet and/or using over 50kW peak electrical demand shall build to and achieve a minimum rating of LEED Silver. In achieving its LEED rating, the project must achieve a minimum delivered energy performance standard of one half the U.S. energy consumption for that building type as defined by the U.S. Department of Energy.
2. New construction and renovation projects of public buildings between 5,000-15,000 square feet in size shall achieve a minimum delivered energy performance standard of one half the U.S energy consumption for that building type as defined by the U.S. Department of Energy.
3. Renovations of buildings in excess of 15,000 square feet and/or use over 50 kW peak electrical demand and comprising upgrades or replacements of two of the three major systems (HVAC, lighting, and plumbing), shall achieve a minimum rating of LEED Silver and a minimum delivered energy performance standard of one half the U.S. Department of Energy.
4. All other new construction, renovations, repairs, and replacement or state buildings shall employ cost-effective, energy-efficient, green building practices to the maximum extent possible.

B. Project Name: NMSU Genesis A - addition & remodel

C. Owner's Name: New Mexico State University.

D. Architect's Name: Studio d Architects.

1.16 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of demolition and removal work is indicated on drawings.
- B. Scope of alterations work is indicated on drawings.

END OF SECTION

**SECTION 012000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Change procedures.

1.02 RELATED REQUIREMENTS

- A. Section 005000 - Contracting Forms and Supplements: Forms to be used AIA Document G702.
- B. Section 005200 - Agreement Form: Contract Sum, retainages, payment period, monetary values of unit prices.
- C. Section 007200 - General Conditions: Additional requirements for progress payments, final payment, changes in the Work.
- D. Section 007300 - Supplementary Conditions: Percentage allowances for Contractor's overhead and profit.
- E. Section 012100 - Allowances: Payment procedures relating to allowances.
- F. Section 017800 - Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. Execute certification by signature of authorized officer.
- F. Submit one electronic and _____ hard-copies of each Application for Payment.

1.05 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.

- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within ____ days.
- D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 016000.
- E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
- F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- H. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- I. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

END OF SECTION

**SECTION 012300
ALTERNATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Alternates.
- B. Procedures for pricing Alternates.

1.02 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option.
Accepted Alternates will be identified in the Owner-Contractor Agreement.

1.03 SCHEDULE OF ALTERNATES

- A. Refer to drawing for Bid Lots and Alternates. No. ____ - _____:

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 012500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 002113 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 004325 - Substitution Request Form - During Procurement: Required form for substitution requests made prior to award of contract (During procurement).
- C. Section 016000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

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 coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- C. 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.
- D. Limit each request to a single proposed substitution item.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
 - 1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.
- B. Submittal Form (before award of contract):

3.03 RESOLUTION

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

3.04 ACCEPTANCE

END OF SECTION

**SECTION 013000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Submittals for review, information, and project closeout.
- G. Number of copies of submittals.
- H. Requests for Interpretation (RFI) procedures.
- I. Submittal procedures.

1.02 REFERENCE STANDARDS

- A. AIA G716 - Request for Information; 2004.
- B. AIA G810 - Transmittal Letter; 2001.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. Contractor and Architect are required to use this service.

3. It is Contractor's responsibility to submit documents in allowable format.
 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is:
- C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor.
- C. Agenda:
1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 6. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
- D. Agenda:
1. Review minutes of previous meetings.
 2. Review of work progress.

3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Maintenance of progress schedule.
 8. Corrective measures to regain projected schedules.
 9. Planned progress during succeeding work period.
 10. Maintenance of quality and work standards.
 11. Effect of proposed changes on progress schedule and coordination.
 12. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

3.05 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 1. Prepare a separate RFI for each specific item.
 2. Prepare using software provided by the Electronic Document Submittal Service.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
- E. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.

3.06 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

3.07 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.08 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.09 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.10 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 - 2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 - 3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - 4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - 5. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - 6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 - 7. Provide space for Contractor and Architect review stamps.

8. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
- B. Product Data Procedures:
 1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Do not reproduce Contract Documents to create shop drawings.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

3.11 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- D. Architect's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 2. Not Authorizing fabrication, delivery, and installation:
- E. Architect's and consultants' actions on items submitted for information:
 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

**SECTION 013050
DESIGN PROCEDURES AND SUBSTANTIATION REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for design of the facility, based on the design criteria specified.
- B. Substantiation requirements.

1.02 RELATED REQUIREMENTS

- A. Section 007100 - Contracting Definitions: Definitions of time periods and phase names.
- B. Section 012000 - Price and Payment Procedures: Modifications procedures.

1.03 DEFINITIONS

- A. Substantiation: All forms of evidence that are used to predict whether the design will comply with the requirements or to verify that the construction based on the design actually does comply. During Preliminary Design, Design Development, and Construction Documents, requirements to submit substantiation are primarily intended to forestall use of designs or constructions that will not comply. At any time before completion of construction, substantiation is presumed to be only a prediction and may subsequently be invalidated by actual results. The term substantiation is used to distinguish these forms of evidence from traditional submittals commonly required during the construction phase.
- B. Proven-In-Use: Proven to comply by having actually been built to the same or very similar design with the same materials as proposed (specified) and functioning as specified.
- C. Proven-by-Mock-Up: Compliance reasonably predictable by having been tested in full-scale mock-up using the same materials and design as proposed (specified) and functioning as specified. Testing need not have been accomplished specifically for this project; when published listings of independent agencies include details of testing and results, citation of test by listing number is sufficient (submittal of all test details is not required).

1.04 REFERENCE STANDARDS

- A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2021.

1.05 SUBMITTALS

- A. Substantiation Submittal Procedures:
 - 1. Time Frames: As specified. If there is a conflict between the degree of detail or completion specified and the progress of the design or construction, obtain a clarification before submitting (a clarification will be obtained before submitting).
 - 2. Recipient: Owner's project manager, at _____.
 - 3. Number of Copies: 2 copies for Owner's use and records; Owner will return not more than one additional copy.
 - 4. For time periods that constitute Milestones, all substantiation submittals required during that period must be complete and accepted before the Milestone can be considered achieved.
 - 5. Resubmissions: Clearly identified as such, with all changes made since the original submittal clearly marked.

1.06 QUALITY ASSURANCE

- A. Qualifications of Testing/Inspection Agencies Performing Substantiation:
 - 1. Qualified and equipped to perform applicable tests/inspection.
 - 2. Regularly engaged in testing and inspection activities on a commercial basis.
 - 3. Authorized to operate in the State in which the project is located.
 - 4. Substantiation: Submittal of qualifications, based on ASTM E329.

PART 2 PRODUCTS

2.01 DESIGN-BUILDER FURNISHED PRODUCTS

- A. In addition to requirements specified in other sections, provide products and elements that comply with the following.
- B. Elements Made Up of More Than One Product:
 - 1. Where an element is specified by performance criteria, use (the project will use) construction either proven-in-use or proven-by-mock-up, unless otherwise indicated.
 - a. The Design-Builder may choose whether to use elements proven-in-use or proven-by-mock-up, unless either option is indicated as specifically required.
 - b. Where test methods accompany performance requirements, use those test methods (those test methods will be used) to test the mock-up.
 - 2. Where a type of product is specified, without performance criteria specifically applicable to the element, use (the project will use) the type of product specified.
 - 3. Where more than one type of product is specified, without performance criteria specifically applicable to the element, use (the construction will use) one of the types of products specified.
 - 4. Where a type of product is specified, with applicable performance criteria, use (the construction will use) either the type of product specified or another type of product that meets the performance criteria as proven-in-use or proven-by-mock-up.
 - 5. Where more than one type of product is specified, with applicable performance criteria, use (the construction will use) either one of the types of products specified or another type of product that meets the performance criteria as proven-in-use or proven-by-mock-up.
 - 6. Where neither types of products nor performance criteria are specified, use (the construction will use) products that will perform well within the specified life span of the building.
- C. Products:
 - 1. Where a product is specified only by a manufacturer name and model number/brand name, use (the construction will use) only that model/brand product.
 - 2. Where the properties of a product are specified by description and/or with performance criteria, use (the construction will use) products that comply with the description and/or performance criteria.
 - 3. Where manufacturers are listed for a particular product, use (the construction will use) a product made by one of those manufacturers that also complies with other requirements.
- D. Reference Standards: Where products or workmanship is specified by reference to a document not included in Contract Documents, comply (the construction will comply) with the requirements of the document, except where more stringent requirements are specified.
 - 1. Date of Issue: As indicated in each instance except where a specific date is established by code.

PART 3 EXECUTION

3.01 DESIGN

- A. During Preliminary Design, the design criteria and the design itself must be (will be) refined, finalized, and documented.
- B. Owner will appoint representatives of the following departments to provide details of functional needs:
 - 1. User groups.
 - 2. Operations staff.
 - 3. Maintenance staff.
- C. Design Documentation: Record (Documentation will include) all design and performance criteria that will be of use during occupancy and operation of the project, including all items specified for maintenance manuals, below.

1. Design Criteria Documentation Included in Construction Documents: Organized logically (from the point of view of operations staff) and placed in a prominent location in drawing sets.
2. If desired, documentation may consist of annotated modifications to and amplification of the Conceptual Documents, with changes that affect Contract Times or Contract Price documented as required for modifications.
3. If required, shop drawings may be used to accomplish design documentation.
4. Owner will maintain the project program document, modified to reflect changes made during refinement of the design.
5. Drawings: Prepared using AutoCAD R14, using Owner's specified drawing and layering conventions.
6. Shop Drawings: Prepared using same CAD software.
7. Mock-Ups: Where necessary to clarify design intent and obtain approvals, construct full-scale mock-ups (full-scale mock-ups will be constructed).

3.02 PERFORMANCE OF SUBSTANTIATION

- A. In addition to the requirements stated in other sections, provide (we will provide) the following substantiation of compliance at each stage of the project:
 1. If a substantiation requirement is specified without an indication of when it is to be submitted, submit or execute (we will submit or execute) it before the end of Construction Documents.
- B. Proven-In-Use: Where elements proven-in-use are used to comply with performance requirements:
 1. In the Proposal, identify (we will identify) which elements will be accomplished using proven-in-use elements.
 2. During Design Development, identify (we will identify) proven-in-use elements proposed for use, including building name, location, date of construction, owner contact, and description of design and materials in sufficient detail to enable reproduction in this project.
- C. Proven-By-Mock-Up: Where elements proven-by-mock-up are used to comply with performance requirements:
 1. In the Proposal, identify (we will identify) which elements will be accomplished using proven-by-mock-up elements.
 2. During Design Development, identify (we will identify) proven-by-mock-up elements proposed for use, with test report including date and location of test, name of testing agency, and description of test and mock-up.
 3. Mock-up testing need (may) not have been performed specifically for this project, provided the mock-up is substantially (but the mock-up will be very) similar in design and construction to the element proposed.
- D. Design Analyses (including Engineering Calculations):
 1. Where a design analysis or calculation is specified without identifying a particular method, perform analysis (analysis will be performed) in accordance with accepted engineering or scientific principles to show compliance with specified requirements, and submit (with) report that includes analysis methods used and the name and qualifications of the designer.
 2. Where engineering design is allowed to be completed after commencement of construction, substantiation may be in the form of shop drawings or other data.
 3. Submit design analyses (Design analyses will be submitted) at the end of Design Development unless otherwise indicated.
 4. Where design analysis is specified to be performed by licensed design professional, use (we will use) a design professional licensed in the State in which the Project is located.
- E. Substantiation for Products:

1. Where actual brand name products are not identified by either the Owner or the Design-Builder, identify (we will identify) the products to be used.
 2. In the Proposal:
 - a. Identify (We will identify) one or more product types for each system, assembly, or element.
 - b. For each product type, provide (we will provide) brief descriptive or performance specifications.
 - c. For major manufactured products that are commonly purchased by brand name, and any other products so indicated, identify (we will identify) at least one manufacturer that will be used.
 3. During Preliminary Design or Design Development:
 - a. Where more than one product type is identified for a particular system, assembly, or element, identify (we will identify) exactly which type will be used.
 - b. For each product type, provide (we will provide) descriptive or performance specifications; early submittals may (will) be brief specifications, but complete specifications are required (will be provided) prior to completion of construction documents.
 - c. For each product type, identify (we will identify) at least one manufacturer that will be used.
 - d. For major manufactured products that are commonly purchased by brand name, and any other products so indicated, provide (we will provide) manufacturer's product literature on at least one actual brand name product that meets the specifications, including performance data and sample warranty.
 4. During Construction:
 - a. Identify (We will identify) actual brand name products used for every product, except commodity products specified by performance or description.
 - b. Where a product is specified by performance requirements with test methods, and if so specified, provide (we will provide) test reports showing compliance.
 - c. Provide (We will provide) manufacturer's product literature for each brand name product.
 - d. Provide (We will provide) the manufacturer's certification that the product used on the project complies with Contract Documents.
 5. Before End of Closeout:
 - a. Provide (We will provide) copies of all manufacturer warranties that extend for more than one year after completion.
- F. Regardless of whether substantiation is specified or not, the actual construction must (will) comply with the specified requirements and may, at the Owner's discretion, be examined, inspected, or tested to determine compliance.
1. Substantiation submittals will not be approved or accepted, except to the extent that they are part of documents required to be approved or accepted in order to proceed to the next stage of design or construction. However, approval or acceptance of substantiation will not constitute approval or acceptance of deviations from the specified requirements unless those deviations are specifically identified as such on the submittal.
 2. The Owner accepts the responsibility to review substantiation submittals in a timely manner and to respond if they are unacceptable.

3.03 FIELD TESTING AND INSPECTION AS SUBSTANTIATION

- A. Perform (Construction operations will include) all testing , observation, and inspection required by code and as specified.
- B. Reports: Written report of each test/inspection; including complete details of conditions, methods, and results, signed by responsible individual.

END OF SECTION

SECTION 013114
FACILITY SERVICES COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Services of a coordinator for facility services construction.

1.02 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Responsibilities of separate contractors.
- B. Section 013000 - Administrative Requirements: Additional requirements for coordination.
- C. Section 016000 - Product Requirements: Spare parts and maintenance materials.
- D. Section 017000 - Execution and Closeout Requirements: Starting of Systems. Systems Demonstration.
- E. Section 017800 - Closeout Submittals: Project record documents.

1.03 MECHANICAL AND ELECTRICAL COORDINATOR

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 COORDINATION REQUIRED

3.02 COORDINATION OF SUBMITTALS

- A. Review shop drawings, product data, and samples for compliance with Contract Documents and for coordination with related work. Transmit copies of reviewed documents to Architect.
- B. Check field dimensions and clearances and relationship to available space and anchors.
- C. Check compatibility with equipment and work of other sections, electrical characteristics, and operational control requirements.

3.03 OBSERVATION OF WORK

- A. Observe work for compliance with Contract Documents.

3.04 DOCUMENTATION

- A. Observe and maintain a record of tests. Record:
 - 1. Specification section number and product name.
 - 2. Name of Contractor, subcontractor, and _____.
 - 3. Name of testing agency and name of inspector.
 - 4. Retesting required.
- B. Submit copies of documentation to Architect upon request.

3.05 EQUIPMENT START-UP

- A. Verify utilities, connections, and controls are complete and equipment is in operable condition as required by Section 017000.
- B. Observe start-up and adjustments, test run, record time and date of start-up, and results.
- C. Observe equipment demonstrations made to Owner; record times and additional information required for operation and maintenance manuals.

END OF SECTION

**SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.02 RELATED SECTIONS

- A. Section 011000 - Summary: Work sequence.

1.03 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Submit updated schedule with each Application for Payment.
- D. Submit in PDF format.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- D. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

3.05 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

**SECTION 014000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. Testing and inspection agencies and services.
- D. Contractor's construction-related professional design services.
- E. Contractor's design-related professional design services.
- F. Control of installation.
- G. Mock-ups.
- H. Tolerances.
- I. Defect Assessment.

1.02 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2026.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2025.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2021.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2026.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.

1.03 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.

1.04 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.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
 - 1. Concrete Mix Design: As described in Section 033000 - Cast-in-Place Concrete. No specific designer qualifications are required.
 - 2. Sprinkler Layout: Coordinate with ceiling installation, detailed pipe layout, and hydraulic calculations as described required by New Mexico Code.

1.05 SUBMITTALS

- A. See Section 013000 - 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 required product data and shop drawings.
 2. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
- 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.

1.06 QUALITY ASSURANCE

- A. 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.

1.07 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Contractor shall be responsible for the selection of all testing agencies and shall include in his bid all costs associated with all tests to be performed under this project and as outlined in the General conditions
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM C1077, ASTM C1093, ASTM D3740, and _____.

PART 3 EXECUTION

2.01 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.

2.02 MOCK-UPS

- A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- D. 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.

2.03 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.

2.04 TESTING AND INSPECTION

- A. 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.
- B. 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.
- C. 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.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.05 DEFECT ASSESSMENT

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

END OF SECTION

**SECTION 015000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Waste removal facilities and services.
- G. Project identification sign.

1.02 RELATED REQUIREMENTS

- A. Section 015100 - Temporary Utilities.
- B. Section 015213 - Field Offices and Sheds.

1.03 TEMPORARY UTILITIES - SEE SECTION 015100

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

1.04 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:

1.05 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

- A. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.09 SECURITY - SEE SECTION 013553

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.10 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.11 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on drawings.
- B. Erect on site at location indicated. Coordinate with Owner/Architect.
- C. No other signs are allowed without Owner permission except those required by law.

1.12 FIELD OFFICES - SEE SECTION 015213

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 015100
TEMPORARY UTILITIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.02 RELATED REQUIREMENTS

- A. Section 015000 - Temporary Facilities and Controls:
 - 1. Temporary telecommunications services for administrative purposes.
 - 2. Temporary sanitary facilities required by law.

1.03 REFERENCE STANDARDS

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

1.04 TEMPORARY ELECTRICITY

- A. Cost: By Contractor.
- B. Provide power service required from utility source.
- C. Power Service Characteristics: as required by construction, three phase, four wire.
- D. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.
- E. Provide main service disconnect and over-current protection at convenient location and meter.
- F. Permanent convenience receptacles may be utilized during construction.
- G. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.05 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs.

1.06 TEMPORARY HEATING

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.

1.07 TEMPORARY COOLING

- A. Cost of Energy: By Contractor.
- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
- C. Maintain maximum ambient temperature of 80 degrees F (26 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.

1.08 TEMPORARY VENTILATION

1.09 TEMPORARY WATER SERVICE

- A. Cost of Water Used: By Contractor.

- B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 015213
FIELD OFFICES AND SHEDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary field offices for use of Architect.
- B. Temporary field offices for use of Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 015000 - Temporary Facilities and Controls:
 - 1. Temporary telecommunications services for administrative purposes.
 - 2. Temporary sanitary facilities required by law.

PART 2 PRODUCTS

2.01 CONSTRUCTION

- A. Construction: Structurally sound, secure, weather tight enclosures for office. Maintain during progress of Work; remove when no longer needed.

2.02 CONTRACTOR OFFICE AND FACILITIES

- A. Size: For Contractor's needs and to provide space for project meetings.

2.03 OWNER AND ARCHITECT/ENGINEER OFFICE (NOT REUIQ

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.

3.02 REMOVAL

- A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

**SECTION 015713
TEMPORARY EROSION AND SEDIMENT CONTROL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 321123 - Aggregate Base Courses: Temporary and permanent roadways.

1.03 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.
- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2021.
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
 - 1. Submit within 2 weeks after Notice to Proceed.
 - 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - f. Format required by law is acceptable, provided any additional information specified is also included.
 - 3. Obtain the approval of the Plan by authorities having jurisdiction.
 - 4. Obtain the approval of the Plan by Owner.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 - 1. Average Opening Size: 30 U.S. Std. Sieve (0.600 mm), maximum, when tested in accordance with ASTM D4751.
 - 2. Permittivity: 0.05 sec⁻¹, minimum, when tested in accordance with ASTM D4491/D4491M.
 - 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 - 4. Tensile Strength: 100 pounds-force (450 N), minimum, in cross-machine direction; 124 pounds-force (550 N), minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 - 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 - 6. Tear Strength: 55 pounds-force (245 N), minimum, when tested in accordance with ASTM D4533/D4533M.
 - 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- B. Silt Fence Posts: One of the following, minimum 5 feet (1500 mm) long:
- C. Gravel: See Section 321123 for aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 - 1. Width: As required; 20 feet (7 m), minimum.
 - 2. Length: 50 feet (16 m), minimum.
 - 3. Provide at each construction entrance from public right-of-way.
 - 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
 - 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
- D. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- E. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
 - 2. Cover with mulch at least 4 inches (100 mm) thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches (150 mm) of straw or hay.
- F. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:

1. Excavate minimum of 6 inches (150 mm).
 2. Place geotextile fabric full width and length, with minimum 12 inch (300 mm) overlap at joints.
 3. Place and compact at least 6 inches (150 mm) of 1 1/2 to 3 1/2 inch (40 to 90 mm) diameter stone.
- B. Silt Fences:
1. Store and handle fabric in accordance with ASTM D4873/D4873M.
 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch (405 mm) high barriers with minimum 36 inch (905 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 4 inches (100 mm) in ground.
 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch (710 mm) high barriers, minimum 48 inch (1220 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet (6 m), use nominal 32 inch (810 mm) high barriers with woven wire reinforcement and steel posts spaced at 4 feet (1220 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
 5. Install with top of fabric at nominal height and embedment as specified.
 6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches (460 mm), with extra post.
 7. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches (300 mm) high with post spacing not more than 4 feet (1220 mm).

3.05 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

**SECTION 015813
TEMPORARY PROJECT SIGNAGE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project identification sign.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

- A. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch (19 mm) thick, standard large sizes to minimize joints.

2.02 PROJECT IDENTIFICATION SIGN

- A. Graphic Design, Colors, Style of Lettering: Designated by Architect. 4'X8' sign

END OF SECTION

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Procedures for Owner-supplied products.
- G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- C. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Containing lead, cadmium, or asbestos.
- C. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 016116.
 - 2. If wet-applied, have lower VOC content, as defined in Section 016116.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 012500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

- A. Owner's Responsibilities:
 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 2. Arrange and pay for product delivery to site.
 3. On delivery, inspect products jointly with Contractor.
 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
 1. Review Owner reviewed shop drawings, product data, and samples.
 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 3. Handle, store, install and finish products.
 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.
- B. Store and protect products in accordance with manufacturers' instructions.

- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

**SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- B. Section 014000 - Quality Requirements: Testing and inspection procedures.
- C. Section 015100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
- D. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

1.02 QUALIFICATIONS

- A. 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,

1.03 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. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. 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.
- F. 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. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

1.04 COORDINATION

- A. 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.
- B. Notify affected utility companies and comply with their requirements.
- C. 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.
- D. 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.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

- F. Coordinate completion and clean-up of work of separate sections.
- G. 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 016000 - 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 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. 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; and _____.
 2. Grid or axis for structures.
 3. Building foundation, column locations, ground floor elevations, and _____.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 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.

3.05 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. 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.
- C. 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.
- D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.
- I. 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.

3.06 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.

3.07 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. 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.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.08 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. 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.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 ADJUSTING

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

3.10 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. 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.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.

- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.11 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 Notice of Substantial Completion.
- 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. 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.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

**SECTION 017800
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 007200 - General Conditions and 007300 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. 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 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
- 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. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Changes made by Addenda and modifications.
- F. 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.

3.02 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.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. 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.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. 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.

3.05 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 (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) 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.

3.06 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.

END OF SECTION

**SECTION 017900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 SUMMARY

- A. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Electrical systems and equipment.

1.02 RELATED REQUIREMENTS

- A. Section 017800 - Closeout Submittals: Operation and maintenance manuals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- D. Provide training in minimum two hour segments.
- E. 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.
- F. 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.
- G. 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.

- H. 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

**SECTION 020100
EXISTING CONDITIONS**

PART 1 GENERAL

1.01 MAINTENANCE OF EXISTING CONDITIONS

- A. Photographs and/or videotapes of existing conditions including adjacent structures shall be taken and submitted. Existing conditions before the start of work shall be documented.
- B. Support and protect existing structures & utilities.
- C. Promptly repair damages to adjacent structures and facilities if incurred.

1.02 SURVEYS

- A. Require that a professional surveyor document the existing conditions of adjacent structures prior to start of work. Establish benchmarks including elevations and maintain a project log to become part of the as-built records. Survey/resurvey to verify no adverse project impact. Notify the Architect and NMSU of changes in elevations, cracks, sags, or other damage in adjacent structures.

1.03 GEOTECHNICAL INVESTIGATIONS

- A. Soils testing laboratory and other required specialty testing to be retained by NMSU.
- B. Concrete testing laboratory to be retained by NMSU. Specifications shall indicate required testing; i.e. number of cylinders, maximum fill lifts, etc.

1.04 CONTAMINATED SITE REMOVAL

- A. Prior to start of work; verify that there are no hazardous materials at the site with NMSU Environmental Health & Safety department through the NMSU Project Representative. If hazardous materials are found during the performance of work, stop work and contact NMSU and the Architect for direction.

1.05 FACILITY REMEDIATION

- A. It is the Contractor's responsibility to ensure that workers comply with all safety regulations. Also note that the Contractor is fully responsible for having an Environmental, Health and Safety compliance program for NMSU records and review.
- B. Prior to start of work; verify that there are no hazardous materials at the site with NMSU Environmental Health & Safety department through the NMSU Project Representative. If hazardous materials are found during the performance of work, stop work and contact NMSU and the Design Professional for direction.
- C. Ozone Depleting Substances (e.g., Freons & related refrigerants) - Follow all regulatory requirements.
- D. Prior to demolition or removal of equipment containing hazardous or otherwise regulated materials, those regulated materials must be abated/removed.
- E. Installation and/or application of lead-based paint and asbestos-containing materials during renovation are prohibited.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL PROCEDURES

- A. Drawings indicating existing construction, building services, and site utilities are based on casual field observation and existing record documents only.
 - 1. Report discrepancies to Architect before disturbing existing historic elements.
 - 2. Beginning of work constitutes acceptance of existing conditions that are apparent upon examination at that time.

- B. Separate spaces in which removals and salvage operations are conducted from occupied spaces.
 - 1. Provide, erect, and maintain temporary dustproof partitions; see Section 015000.

3.02 MATERIALS TO BE REMOVED

- A. Services: Remove existing systems and equipment to extent indicated, including but not limited to Fire Protection, Plumbing, HVAC, Electrical, and Telecommunications elements:
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and other 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 switchover.
 - 3. Verify that abandoned services serve only abandoned facilities prior to commencing removals.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stubs and tag with identification.

3.03 CLEANING

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

END OF SECTION

SECTION 03 05 00

BASIC CONCRETE MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes formwork, reinforcement, accessories, cast-in-place concrete, transporting, placing, finishing, curing, and other pertinent items of construction.
- B. Concrete and Standards - Except as noted or modified in this section, all concrete materials, transporting, placing, finishing, curing, and sealing shall conform to requirements as follows:
 - 1. American Institute of Concrete (ACI)
 - a. 301 - Specifications for Structural Concrete.
 - b. 302.1R - Guide to Concrete Floor and Slab Construction.
 - c. 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - d. 305.1 - Specification for Hot Weather Concreting.
 - e. 306.1 - Standard Specification for Cold Weather Concreting.
 - f. 308.1 - Standard Specification for Curing Concrete.
 - g. 318 - Building Code Requirements for Structural Concrete.
 - h. 347R - Guide to Formwork for Concrete.
 - i. SP-66 - ACI Detailing Manual.
 - 2. ASTM International (ASTM)
 - a. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - c. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - d. ASTM C33 - Specifications for Concrete Aggregates.
 - e. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - f. ASTM C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - g. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - h. ASTM C94 - Specification for Ready-Mixed Concrete.
 - i. ASTM C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 - j. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - k. ASTM C150 - Standard Specification for Portland Cement.
 - l. ASTM C156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete.
 - m. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

- n. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - o. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - p. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - q. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 - r. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - s. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
 - t. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
 - u. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
 - v. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
 - w. ASTM C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
 - x. ASTM C1550 - Standard Test Method for Flexural Toughness of Fiber Reinforced Concrete (Using Centrally Loaded Round Panel).
 - y. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
 - z. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
 - aa. ASTM C1609 - Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading).
 - bb. ASTM C1778 - Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
3. American Association of State Highway & Transportation Officials (AASHTO):
- a. PP 65 - Standard Practice for Determining the Reactivity of Concrete Aggregates and Selecting Appropriate Measures for Preventing Deleterious Expansion in New Concrete Construction.

1.2 QUALITY ASSURANCE

- A. Inform Engineer at least 48 hours in advance of time at which Contractor intends to place concrete.
- B. When required by any applicable permits, such as CID permits, Contractor shall have reinforcement inspected by the agency with jurisdiction prior to placement of concrete.
- C. Construct and erect concrete formwork in accordance with ACI 301 and ACI 347R.
- D. Concrete tests shall be in accordance with requirements of ACI 301, except as noted or modified in this Section.
 - 1. Strength test:
 - a. Mold and cure 5 cylinders from each sample.

- b. Test one at 7 days and one at 14 days for information and two at 28 days for acceptance.

E. Samples:

- 1. Collect the following minimum samples for each 28-day strength concrete used in the work for each days placing:

<u>Quantity</u>	<u>Number of Samples</u>
50 cubic yards or less	1
50 to 100 cubic yards	2
100 cubic yards or more	2 plus 1 sample for each additional 100 cubic yards

- 2. Sampling should be in accordance with ASTM C172.
- 3. Forming cylinders in accordance with ASTM C31.
- 4. No sample shall be required for thrust blocks nor fence posts.
- 5. Hold fifth cylinder for future considerations. Deliver to Owner upon determination of substantial completion and prior to final payment.
- 6. Sample marking.
 - a. Mark or tag each sample of compression test cylinders with date and time of day cylinders were made.
 - b. Identify location in work where concrete represented by cylinders was placed.
 - c. Identify delivery truck or batch number, air content and slump.
- 7. Slump test:
 - a. Conduct test for each strength test sample and whenever consistency of concrete appears to vary, in accordance with ASTM C143.
- 8. Air content:
 - a. Conduct test from 1 of first 3 batches mixed each day and for each strength test sample, in accordance with ASTM C231, 138 or 173.
- 9. Temperature:
 - a. Conduct test in accordance with ASTM C1064.

- F. Coordinate concrete placement with the Engineer to ensure proper testing in compliance with the Drawings and Specifications. The cost of all tests shall be covered by the Testing Allowance provided for in the bid schedule, except for failed tests, or new analyses required due to failed tests.

- G. The Contractor is free to take additional specimens for his own information, at his own expense, not reimbursable from the Testing Allowance.

- H. Acceptance of Concrete: Strength level of concrete will be considered satisfactory so long as average of all sets of 3 consecutive strength test results equal or exceeds specified 28-day strength and no individual strength test result falls below specified strength (f_c') by more than 500 psi when specified compressive strength is 5000 psi or less; or by more than **0.10 f_c'** when specified compressive strength is more than 5000 psi.

- I. Failure of Test Cylinder Results: Upon failure of test cylinder results, Engineer may require Contractor, at his expense, to test remaining cylinder after curing for a period of time specified by Engineer. If strength level of this cylinder is not greater than specified

28-day strength, Engineer may require Contractor to obtain and test at least three 2-inch diameter cored samples from an area in question.

1. Conform to ASTM C42.
2. Concrete will be considered adequate if average of 3 cores is at least 85 percent of, and if no single core is less than 75 percent of, specified 28-day strength.
3. Upon failure of core test results, Engineer may require Contractor, at his expense, to perform load tests as specified in ACI 318.
4. Fill all core holes as specified for repairing defective concrete.

J. Completed Work

1. Completed concrete work which fails to meet 1 or more requirements, but which has been repaired to bring it into compliance, will be accepted without qualification.
2. Completed concrete work which fails to meet 1 or more requirements and which cannot be brought into compliance shall be rejected as provided in these Contract Documents. In this event, modifications shall be required to assure that concrete work complies with requirements. Modifications, as directed by Engineer, to be made at no additional cost to Owner.

K. Perform concrete reinforcing and cast-in-place concrete work in accordance with ACI 301.

L. The maximum deviation of the top surface of curb and gutter shall not exceed 1/8" in 10' nor shall the inside face deviate more than 1/4" in 10' from a straight line. Prior to or during final inspection, curb and gutter shall be water flow tested as directed by the Engineer. All areas with standing water will be rejected.

PART 2 PRODUCTS

2.1 FORM MATERIALS AND ACCESSORIES

- A. Steel Forms: Symons "Steel-Ply", Simplex "Industrial Steel Frame Forms", Universal "Uniform". Forms shall be clean, straight and true, without surface defects.
- B. Plywood Forms: Product standard PS-1, waterproof, resin-bonded exterior type Douglas Fir or Larch. Forms shall be clean, straight and true, without surface defects.
- C. Lumber: Douglas Fir or Larch, straight, uniform width and thickness, clean and free from offsets, holes, dents and other surface defects.
- D. Chamfer Strips: Clean white pine, surface against concrete planed.
- E. Form Release Agent: Colorless mineral oil not capable of staining concrete or impairing natural bonding characteristics of coating intended for use on concrete.

2.2 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615, deformed. Reinforcement bar, size and spacing as indicated on the Drawings.

- B. Welded wire fabric reinforcement shall conform to the requirements of ASTM A1064 and the details shown; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.
- C. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing; plastic tipped or non-corroding for supports in slabs where supports are exposed to weather.
- D. Concrete blocks used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.
- E. Fabricate concrete reinforcing in accordance with ACI SP-66.

2.3 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C150 Type I.
 - 2. Fly Ash: ASTM C618, Class F or C.
 - 3. Slag Cement: ASTM C989, Grade 100 or 120.
 - 4. Silica Fume: ASTM C1240.
 - 5. Metakaolin: ASTM C618, Class N.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: ASTM C1602/C1602M, Clean and not detrimental to concrete.
- D. Chemical Admixtures (when applicable): Compatible with each other and free of intentionally-added chlorides.
 - 1. Air Entraining Admixture: ASTM C260.
 - 2. Water-Reducing Admixture: ASTM C494, Type A.
 - 3. Mid-Range Water-Reducing Admixture: ASTM C494, Type A.
 - 4. High-Range Water-Reducing Admixture: ASTM C494, Type F.
 - 5. Accelerating Admixture: ASTM C494, Type C or E.
 - 6. Retarding Admixture: ASTM C494, Type B or D.
 - 7. Workability-Retaining Admixture: ASTM C 494, Type S.
 - a. Shall retain concrete workability without affecting time of setting or early-age strength development.
 - 8. Alkali-Silica Reaction Inhibiting Admixture: ASTM C494, Type S
 - a. Shall contain a nominal lithium nitrate content of 30 percent.

2.4 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C94.
- B. Re-tempering of prepared concrete will not be permitted.
- C. Furnish concrete of the following strength:

Type of Work	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (in.)	Min. Cement W/C per CY (94# sacks)	Maximum w/cm (by wt.)
Slabs on grade, footings floor slabs, and all other concrete items not specified elsewhere.	4,000	1	6.0	0.50
Site work concrete such as fence posts, thrust blocks, valve collars, etc.	3,000	1	5.0	0.50

D. Proportioning:

1. Proportion ingredients to produce a well-graded mix of high-density maximum workability consistent with approved mix design.
2. Entrained air - all concrete exposed to freeze-thaw cycles under saturated conditions:
 - a. Four point five (4.5) percent, plus or minus one point five (1.5) percent, for concrete in the forms. Concrete samples for air content tests shall be taken at the end of the concrete truck chute or the output of the concrete pump, whichever applies. A reduction in air content of pumped concrete should be expected. Contractor shall be responsible to coordinate with the concrete supplier to provide the specified air content of the in-place concrete.
 - b. Refer to ACI 301 for further requirements.
3. Fly ash, silica fume, and slag cement:
 - a. Fly ash: The mineral admixture Class F fly ash shall be proportioned by weight of cement to provide a fly ash to portland cement ratio not less than 1:4 and not less than 25 per cent of the total cementitious material. Portland cement concrete submitted under this specification shall be proportioned with Class F fly ash, unless a variance is authorized by the Engineer. Alternatively, lithium-based admixture can be used in lieu of Class F fly ash to mitigate ASR. The Contractor shall provide the Engineer with chemical and physical analysis of the fly ash.
 - b. Silica fume: Silica fume may be added to the mix and shall be proportioned by weight of cement to provide a silica fume to Portland cement ratio not less than 1:25 and no greater than 1:7. Portland cement concrete using silica fume shall follow ASTM C1240 standards.
 - c. Slag cement: Slag cement may be added to the mix and shall be proportioned by weight of cement to provide a slag cement to Portland cement ratio of no greater than 80 percent. Slag cement can consist of Grade 100 or grade 120. Portland cement concrete using slag cement shall follow ASTM C989 standards.
4. Aggregates supplied under this Specification shall be assumed to be "alkali-silica reactive", ASR. Mitigation measures, such as the use of supplementary cementitious materials or lithium nitrate based admixtures or the combination of both, shall be utilized in the concrete mixtures to mitigate alkali-silica reaction, when the aggregates are known to be alkali-silica reactive. Replacement levels of

supplementary cementitious materials and the dosage of lithium nitrate based admixtures shall be determined in accordance with the performance-based approach provided in ASTM C1778. Variance from this position for a particular aggregate source may be authorized by the Engineer. Application for a variance may be made to the Engineer.

- a. Portland cement concrete design mixes using non alkali-silica reactive aggregates will not be required to be proportioned with Class F fly ash.

E. Batching and Mixing Equipment: Conform to ACI 304R.

F. Slump:

1. Keep as low as possible consistent with proper handling and thorough compaction.
2. Shall not exceed 4 inches unless otherwise authorized by Engineer.

2.5 CEMENT GROUT

A. Portland Cement: ASTM C150, Type I and II.

B. Water:

1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts.

C. Fine Aggregate:

1. Washed natural sand.
2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
3. Free from injurious amounts of organic impurities as determined by ASTM C40.

D. Mix:

1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.
2. Water content shall be such that the grout can be readily spread, yet not wet enough to cause trouble with surface water or laitance, or failure to stay in place after screeding. All grout mixes and mixing procedures shall be submitted in accordance with submittal requirements, and shall be subject to review and approval by the Engineer prior to commencing the grouting operations.

E. The minimum compressive strength at 28 days shall be 4000 psi.

F. Procedures for Grout placement shall be approved by the equipment supplier, to insure that no equipment is overstressed, as well as proper placement tolerances. Equipment Supplier shall have final say on grouting procedures and final tolerances.

PART 3 EXECUTION

3.1 FORMWORK ERECTION

A. Erect formwork, shoring and bracing to achieve design requirements.

- B. Erect forms substantially and sufficiently tight to prevent leakage of mortar and braced or tied to maintain desired position, shape and alignment before, during, and after concrete placement.
- C. Carefully remove forms only after concrete is able to support all dead and live loads and curing requirements are met. Apply curing compound to all formed surfaces immediately after form removal.
- D. Camber slabs and framing to achieve ACI 301 tolerances.
- E. Provide bracing to ensure stability of formwork.
- F. Clean forms as erection proceeds, to remove foreign matter.

3.2 INSERTS, EMBEDDED COMPONENTS, AND OPENINGS

- A. Provide formed openings where required for work to be embedded in and passing through concrete members.
- B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install concrete accessories straight, level, and plumb.
- D. Install water stops continuous without displacing reinforcement.

3.3 REINFORCEMENT PLACEMENT

- A. Place reinforcement, supported and secured against displacement.
- B. Ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings.

3.4 PLACING CONCRETE

- A. Do not place concrete during rain, sleet, or snow unless adequate protection is provided and Construction Observer approval is obtained. Do not allow rainwater to increase mixing water or damage surface finish.
- B. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
- C. Convey concrete from mixer to final position as rapidly as practicable without segregation or loss of material. Limit chute length to less than 20 feet with maximum slope of 1 vertical to 2 horizontal.
- D. Maximum height of concrete free fall is 4 feet.
- E. Place concrete continuously between predetermined expansion, control and construction joints. Do not break or interrupt successive pours creating cold joints.

- F. On large volume pours, concrete shall be placed with the aid of approved mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faces in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes or other shapes built into the work.
- G. Where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack with non-shrink grout.
- H. Screed slabs-on-grade and concrete base for toppings level.

3.5 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Remove formwork progressively and in accordance with code requirements.

3.6 FLOOR FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1R.
- B. Uniformly spread, screed, and float concrete.
- C. In areas with floor drains, maintain floor level at walls and slope surfaces uniformly to drains.
- D. Provide surface conforming to proper elevation and contour with all aggregates completely embedded in mortar by screening.
- E. Provide an initial float as soon as concrete has stiffened sufficiently for proper working.
- F. Provide a second floating at time of initial set.
- G. Apply a broom finish.

3.7 CURING

- A. Immediately after placement, protect concrete from premature drying.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete, for not less than ten (10) days in warm to hot weather (per ACI 305.1), and fourteen (14) days in cold weather (per ACI 306.1) after placing, unless otherwise indicated by the Engineer, in accordance with the methods specified herein for the different parts of the Work.
 - 1. Cold weather is defined as when the temperature reaches or goes below 35 degrees F for one (1) hour during any 24-hour period during the curing period.

- C. Use a pre-approved concrete curing method. Acceptable curing methods, as detailed in ACI 308.1, are as follows:
 - 1. Water Curing Methods:
 - a. Ponding/Immersion.
 - b. Fogging/Sprinkler.
 - c. Burlap/Cotton Mats/Absorbent Material.
 - d. Wet Sand Curing.
 - e. Straw/Hay.
 - f. Plastic Film.
 - g. Reinforced Paper.
 - 2. Liquid Membrane-Forming Compounds.
- D. The covering used, if applicable, must be overlapped adequately to ensure 100% coverage, and must not be allowed to become dry at any point during the curing period. Place and anchor covers, mats, and/or sheeting to ensure continuous contact with the concrete surfaces.
- E. When using one of the water curing methods, keep the concrete structures thoroughly and continuously moist and covered during the entire curing period.

3.8 FIELD QUALITY CONTROL

- A. Three (3) Concrete Test Cylinders: Taken for every 75 or less cubic yards of each class of concrete placed.
- B. One (1) Additional Test Cylinder: Taken during cold weather concreting, and cured on job site under same conditions as concrete incorporated into the Work.
- C. One (1) Slump Test: Taken for each set of test cylinders taken and whenever consistency of concrete appears to vary.
- D. One (1) Air Content Test: Taken for each set of test cylinders taken.
- E. One (1) Concrete Temperature Measurement: Taken for each set of test cylinders taken.
- F. One (1) Ambient Air Temperature Measurement: Taken for each set of test cylinders taken and at the beginning of each day that concrete is being placed.

3.9 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required lines, details and elevations, as directed by Engineer.

END OF SECTION

SECTION 030516
UNDERSLAB VAPOR BARRIER - STEGO

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

- A. Section 031000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 033000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Samples: Submit samples of underslab vapor barrier to be used.
- D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Underslab Vapor Barrier:
 - 1. Water Vapor Permeance: Not more than 0.010 perms (0.6 ng/(s m² Pa)), maximum.
 - 2. Thickness: 15 mils (0.4 mm).
 - 3. Basis of Design:
 - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil):
www.stegoindustries.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches (150 mm).
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.

F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

**SECTION 031000
CONCRETE FORMING AND ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Form accessories.
- C. Form stripping.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 301 - Specifications for Concrete Construction; 2020.
- C. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
- D. ACI 347R - Guide to Formwork for Concrete; 2014, with Errata (2017).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

2.02 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor.

2.03 FORMWORK ACCESSORIES

- A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, ____ inch back break dimension, (____ mm back break dimension,) free of defects that could leave holes larger than 1 inch (25 mm) in concrete surface. Provide _____ manufactured by _____.
- B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
- C. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

- A. Earth forms are not permitted.

3.03 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.06 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.07 FORM REMOVAL

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

END OF SECTION

**SECTION 032000
CONCRETE REINFORCING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 031000 - Concrete Forming and Accessories.
- B. Section 033000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Concrete Construction; 2020.
- B. ACI SP-66 - ACI Detailing Manual; 2004.
- C. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2024.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- F. CRSI (DA4) - Manual of Standard Practice; 2009.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
 - 1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: See Structural drawings for requirements and additional information.
- B. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.02 RE-BAR SPLICING:

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full steel reinforcing design strength in tension and compression.

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.

END OF SECTION

**SECTION 033000
CAST-IN-PLACE CONCRETE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Floors and slabs on grade.
- C. Concrete reinforcement.
- D. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
- E. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 031000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 032000 - Concrete Reinforcing.
- C. Section 079200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 301 - Specifications for Concrete Construction; 2020.
- D. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- F. ACI 305R - Guide to Hot Weather Concreting; 2010.
- G. ACI 306R - Guide to Cold Weather Concreting; 2016.
- H. ACI 308R - Guide to External Curing of Concrete; 2016.
- I. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
- J. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.
- M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
- N. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.
- O. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2017a.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

- C. Mix Design: Submit proposed concrete mix design.
- D. Samples for Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.
- E. Samples: Submit samples of underslab vapor retarder to be used.
- F. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Comply with requirements of Section 031000.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
 - 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
 - 2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
 - 3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches (38 mm) of concrete surface.

2.02 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
 - 1. Form: Coiled Rolls.
 - 2. WWR Style: 4 x 8-W6 x W10 (102 x 203-MW39 x MW65).
- C. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch (1.29 mm).
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
 - 1. Acquire cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
 - 1. Acquire aggregates for entire project from same source.
- C. Lightweight Aggregate: ASTM C330/C330M.
- D. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
 - 1. Installation: Comply with ASTM E1643.
 - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

3. Manufacturers:
 - a. Stego Industries, LLC; ____: www.stegoindustries.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.05 BONDING AND JOINTING PRODUCTS

- A. Slab Isolation Joint Filler: 1/2 inch (13 mm) thick, height equal to slab thickness, with removable top section that will form 1/2 inch (13 mm) deep sealant pocket after removal.

2.06 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- D. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard (0.89 kg per cu m), or as recommended by manufacturer for specific project conditions.
- E. Normal Weight Concrete:
 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 pounds per square inch (20.7 MPa).
 2. Water-Cement Ratio: Maximum 40 percent by weight.
 3. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
 4. Maximum Slump: 3 inches (75 mm).
 5. Maximum Aggregate Size: 5/8 inch (16 mm).
- F. Structural Lightweight Concrete:
 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 pounds per square inch (20.7 MPa).
 2. Water-Cement Ratio: Maximum 40 percent by weight.
 3. Total Air Content: 3 percent, determined in accordance with ASTM C173/C173M.
 4. Maximum Slump: 3 inches (75 mm).
 5. Maximum Aggregate Size: 5/8 inch (16 mm).

2.07 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
 1. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
- B. Transit Mixers: Comply with ASTM C94/C94M.
- C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 PREPARATION

- A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with

manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.02 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- F. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.04 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Maximum Variation of Surface Flatness:
 - 1. Exposed Concrete Floors: 1/4 inch (6 mm) in 10 feet (3 m).
 - 2. Under Seamless Resilient Flooring: 1/4 inch (6 mm) in 10 feet (3 m).
 - 3. Under Carpeting: 1/4 inch (6 mm) in 10 feet (3 m).
- B. Correct the slab surface if tolerances are less than specified.
- C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.
- C. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 - 1. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.
 - 2. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

- D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.07 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Surfaces Not in Contact with Forms:
 - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
 - 2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
 - 3. Final Curing: Begin after initial curing but before surface is dry.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.09 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

**SECTION 033511
CONCRETE FLOOR FINISHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.

1.02 RELATED REQUIREMENTS

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

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

1.05 MOCK-UP

- A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- B. Mock-Up Size: 10 feet (3 m) square.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

- A. Penetrating Clear Sealer:
 - 1. Use at following locations: as indicated on drawings.

2.02 COATINGS

- A. Concrete Stain or Dye: Translucent, penetrating compound for interior or exterior use; must be finished with a topical sealer.
 - 1. Composition: Water-based, non-reactive.
 - 2. Number of Coats: Minimum of two.
 - 3. Application:
 - a. Primary Color: Spray applied.
 - b. Secondary Color: Spray applied.
- B. High Gloss Clear Coating: Transparent, non-yellowing, water- or solvent-based coating.
 - 1. Composition: Acrylic polymer-based.
- C. Low Gloss Clear Coating: Transparent, non-yellowing, water- or solvent-based coating.
 - 1. Composition: Acrylic polymer-based.
- D. Clear Coating: Clear coating recommended by manufacturer for finishing concrete floors and slabs.
 - 1. Gloss: High gloss.
- E. Penetrating Sealer: Transparent, non-yellowing, water- or solvent-based coating.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

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

3.03 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

**SECTION 040511
MASONRY MORTARING AND GROUTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.02 RELATED REQUIREMENTS

- A. Section 040100 - Maintenance of Masonry: Bedding and pointing mortar for masonry restoration work.
- B. Section 042000 - Unit Masonry: Installation of mortar and grout.
- C. Section 081113 - Hollow Metal Doors and Frames: Products and execution for grouting steel door frames installed in masonry.

1.03 REFERENCE STANDARDS

- A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.
- B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2018.
- C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- D. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- E. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- F. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2017.
- G. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.06 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. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
- B. Mortar Color: Natural gray unless otherwise indicated.
- C. Mortar Mix Designs: ASTM C270, Property Specification.
 - 1. Exterior, Loadbearing Masonry: Type S.
 - 2. Exterior, Non-loadbearing Masonry: Type N.
 - 3. Interior, Loadbearing Masonry: Type S.

2.02 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - 1. Color: color to match C.M.U..
- B. Portland Cement: ASTM C150/C150M.
 - 1. Type: Type I - Normal; ASTM C150/C150M.
 - 2. Color: color to match C.M.U..
- C. Masonry Cement: ASTM C91/C91M.
 - 1. Type: Type N; ASTM C91/C91M.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Quicklime: ASTM C5, non-hydraulic type.
- F. Mortar Aggregate: ASTM C144.
- G. Water: Clean and potable.

PART 3 EXECUTION

3.01 INSTALLATION

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

3.02 GROUTING

- A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.
- B. Low-Lift Grouting:
 - 1. Limit height of pours to 12 inches (300 mm).
 - 2. Limit height of masonry to 16 inches (400 mm) above each pour.
 - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- C. High-Lift Grouting:
 - 1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
 - 2. Place grout for spanning elements in single, continuous pour.

END OF SECTION

**SECTION 042000
UNIT MASONRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Lintels.
- F. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 032000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 040511 - Masonry Mortaring and Grouting.
- C. Section 072123 - Loose-Fill Insulation: Granular insulation for masonry unit cores.
- D. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016, with Editorial Revision (2018).
- D. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.
- E. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2017.
- F. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- G. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- I. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2025.
- J. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- K. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Fire Rated Assemblies: Comply with applicable code for UL (FRD) Assembly No. ____.

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.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth of 8 inches (200 mm).
 - 2. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.
 - b. Exposed Faces: Manufacturer's standard color and texture where indicated.
 - c. Exposed Faces: Special color and texture where indicated, as follows:
_____.
 - d. Pattern: Split-face and standard as indicated on drawings..
 - e. Manufacturers:
 - 1) Featherlite Building Products or Equal.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - 3. Nonloadbearing Units: ASTM C129.

2.02 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 040511.
- B. Water: Clean and potable.
- C. Packaged Dry Material for Mortar for Unit Masonry: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - 1. Color: as selected by Architect.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

2.04 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.05 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Exterior, loadbearing masonry: Type S.
 - 2. Exterior, non-loadbearing masonry: Type N.
 - 3. Interior, loadbearing masonry: Type S.
 - 4. Interior, non-loadbearing masonry: Type O.

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.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.
- B. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.

3.04 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. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.06 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.07 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.

3.08 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.

END OF SECTION

**SECTION 051200
STRUCTURAL STEEL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel framing members.
- B. Grouting under base plates.

1.02 RELATED REQUIREMENTS

- A. Section 051213 - Architecturally-Exposed Structural Steel Framing: Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).
- B. Section 052100 - Steel Joist Framing.
- C. Section 053100 - Steel Decking: Support framing for small openings in deck.

1.03 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; 2017.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel; 2024.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2020.
- G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- I. SSPC-SP 3 - Power Tool Cleaning; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 051213.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Rolled Steel Structural Shapes: ASTM A992/A992M.
- D. Steel Shapes, Plates, and Bars: ASTM A242/A242M high-strength, corrosion-resistant structural steel.

- E. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).
- F. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.
- D. Develop required camber for members.

2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Do not field cut or alter structural members without approval of Architect.
- D. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- E. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

END OF SECTION

SECTION 051213
ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

1.02 RELATED REQUIREMENTS

- A. Section 051200 - Structural Steel Framing: General requirements for structural steel members, including AESS framing specified in this section.
- B. Section 052100 - Steel Joist Framing: Alignment and location of bridging where joists are visible.
- C. Section 053100 - Steel Decking: Erection requirements relating to exposed steel decking and its connections.
- D. Section 099113 - Exterior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- E. Section 099123 - Interior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- F. Section 099600 - High-Performance Coatings: Finish coat requirements and coordination with primer and surface preparation specified in this section.

1.03 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- B. AISC 360 - Specification for Structural Steel Buildings; 2016 (Revised 2021).
- C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2019.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
- E. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS); 2015.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Detailing for fabrication of AESS components.
 - 1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
 - 2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
 - 3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle finished pieces in accordance with Section 10 of AISC 303, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Comply with Section 051200, except as amended in this section for aesthetic purposes.

2.02 FABRICATION

- A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.
- B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.
- C. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.
- D. Bolted Connections:
- E. Welded Connections:
 - 1. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding tolerances of this section.
- F. Fabricate AESS in accordance with categories defined in AISC 303, as follows:
 - 1. AESS 1: Basic elements.
 - 2. AESS 2: Feature elements viewed at a distance greater than 20 feet (6 m) (feature elements not in close view).

2.03 PAINT SYSTEM

- A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Sections 099113, 099123, and 099600. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.

2.04 SHOP PRIMING

- A. Surface Preparation:
 - 1. Remove weld spatter, slivers and similar surface discontinuities.
 - 2. Ease sharp corners resulting from shearing, flame cutting or grinding.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.

3.02 PREPARATION

- A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.
- B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.03 ERECTION

- A. AESS 1 and 2: Basic elements; feature elements not in close view:
 - 1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.

2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AEES members prior to erection.
3. AEES Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
4. Set AEES accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
6. Remove all backing and run out tabs.
7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.
8. Bolted Connections: Align bolt heads on same side of connection as indicated on approved fabrication or erection documents.
9. Welded Connections: Comply with AWS D1.1/D1.1M and Section 051200. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
10. Remove weld spatter exposed to view.
11. Grind off projections larger than 1/16 inch (1.5875 mm) at field butt and plug welds.
12. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.
13. Do not enlarge holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.
14. Obtain permission for any torch cutting or field fabrication from Architect. Finish sections thermally cut during erection to a surface appearance consistent with mock-up.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Structural Requirements:
 1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 051200 for additional requirements.
- C. AEES 1 and 2 Acceptance: Architect to observe AEES in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

3.05 CLEANING

- A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AEES. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 099113, 099123, and 099600.

END OF SECTION

SECTION 052100 STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Open web steel joists, with bridging, attached seats and anchors.

1.02 RELATED REQUIREMENTS

- A. Section 051200 - Structural Steel Framing: Grouting base plates and bearing plates. Superstructure framing.
- B. Section 053100 - Steel Decking: Bearing plates and angles.
- C. Section 053100 - Steel Decking: Support framing for openings less than 18 inches (450 mm) in decking.
- D. Section 055000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- D. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
- E. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019, with Editorial Revision (2020).
- F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- G. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2018.
- H. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- I. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Open Web Joists: SJI Type K Joists:
 - 1. Provide bottom chord extensions as indicated.

2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.
 3. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
 4. Finish: Shop primed.
- B. Anchor Bolts, Nuts and Washers: ASTM A307 hot-dip galvanized per ASTM A153/A153M Class C.
 - C. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
 - D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
 - E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 FINISH

- A. Shop prime joists as specified.
- B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 ERECTION

- A. Erect joists with correct bearing on supports.
- B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
- C. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
- D. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- E. Do not field cut or alter structural members without approval of joist manufacturer.

END OF SECTION

SECTION 053100 STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof deck.
- B. Supplementary framing for openings up to and including 18 inches (450 mm).
- C. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

- A. Section 052100 - Steel Joist Framing: Placement of embedded steel anchors for bearing plates and joist seats in cast-in-place concrete.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- E. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

1.05 QUALITY ASSURANCE

- A. Design deck layout, spans, fastening, and joints 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.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 STEEL DECK

- A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
 - 1. Calculate to structural working stress design and structural properties specified.
- B. Roof Deck: Non-composite type, fluted steel sheet:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
 - a. Grade as required to meet performance criteria.
 - 2. Minimum Base Metal Thickness: 22 gauge, 0.0299 inch (0.76 mm). unless indicated otherwise on Structural Drawings.
 - 3. Nominal Height: 1-1/2 inch (38 mm).
 - 4. Profile: Fluted; SDI NR.

5. Formed Sheet Width: 24 inch (600 mm).

2.02 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
- B. Welding Materials: AWS D1.1/D1.1M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On steel supports provide minimum 1-1/2 inch (38 mm) bearing.
- C. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

END OF SECTION

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonstructural dimension lumber framing.
- B. Sheathing.
- C. Roof-mounted curbs.
- D. Roofing nailers.
- E. Miscellaneous framing and sheathing.
- F. Communications and electrical room mounting boards.
- G. Concealed wood blocking, nailers, and supports.
- H. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 051200 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- B. Section 061500 - Wood Decking.
- C. Section 061733 - Wood I-Joists.
- D. Section 061753 - Shop-Fabricated Wood Trusses.
- E. Section 077200 - Roof Accessories: Prefabricated roof curbs.
- F. Section 313116 - Termite Control: Field-applied termiticide and mildewcide for wood materials.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ICC-ES AC308 - Acceptance Criteria for Termite Physical Barrier Systems; 2014, with Editorial Revision (2017).
- E. PS 1 - Structural Plywood; 2009 (Revised 2019).
- F. PS 20 - American Softwood Lumber Standard; 2020.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

1.05 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. Species: Douglas Fir-Larch, unless otherwise indicated.

2. 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.
3. 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 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Stud Framing (2 by 2 through 2 by 6 (50 by 50 mm through 50 by 150 mm)):
 1. Species: Douglas Fir-Larch.
 2. Grade: No. 2.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 1. Lumber: S4S, No. 2 or Standard Grade.
 2. Boards: Standard or No. 3.

2.03 ACCESSORIES

- A. Fasteners and Anchors:
 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
- B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
- C. Sill Gasket on Top of Foundation Wall: 1/4 inch (6 mm) thick, plate width, closed cell plastic foam from continuous rolls.
- D. Termite-Resistant Sill Plate Barrier: Self-adhesive, film-backed barrier with release sheet; adheres to concrete substrates and blocks termite access.
 1. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.

PART 3 EXECUTION

3.01 PREPARATION

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches (100 mm) and seal.
- B. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
- C. Coordinate installation of rough carpentry members specified in other sections.

3.02 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.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Provide the following specific nonstructural framing and blocking:

1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Chalkboards and marker boards.
8. Wall paneling and trim.
9. Joints of rigid wall coverings that occur between studs.

3.04 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

END OF SECTION

**SECTION 062000
FINISH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items.

1.02 RELATED REQUIREMENTS

- A. Section 064100 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- B. Section 081416 - Flush Wood Doors.
- C. Section 099123 - Interior Painting: Painting of finish carpentry items.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2016.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 4.0; 2021.
- D. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
 - 2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect from moisture damage.
- B. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

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

2.02 PLASTIC LAMINATE MATERIALS

- A. Plastic Laminate: NEMA LD 3; color as selected by Architect; textured, low gloss finish.
- B. Low Pressure Laminate: Melamine; as selected by Architect color, as selected by Architect and gloss surface texture.
- C. Solid Laminate: as selected by Architect color, as selected by Architect pattern, and gloss surface texture.

2.03 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Lumber for Shimming, Blocking, and ____: Softwood lumber of ____ species.

2.04 HARDWARE

- A. Hardware: Comply with BHMA A156.9.
- B. Specialty Workstation and Countertop Brackets:

1. Material: Steel.
 2. Finish: Manufacturer's standard, factory-applied powder coat.
 3. Color: Selected by Architect from manufacturer's standard range.
 4. Manufacturers:
 - a. RAKKS .
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Standard Shelf, Countertop, and Workstation Brackets:
1. Material: Steel.
 2. Finish: Manufacturer's standard, factory-applied primer.
 3. Color: Selected by Architect from manufacturer's standard range.

2.05 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

END OF SECTION

SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.

1.02 RELATED REQUIREMENTS

- A. Section 123600 - Countertops.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 4.0; 2021.
- C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
- C. Product Data: Provide data for hardware accessories.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Single Source Responsibility: Provide and install this work from single fabricator.

2.02 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.

2.03 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.04 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation; ____: www.formica.com/#sle.
 - 2. Panolam Industries International, Inc; Nevamar Standard HPL: www.panolam.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.05 COUNTERTOPS

- A. Countertops: Solid Surface Epoxy Resin Lab Tops

2.06 ACCESSORIES

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

2.07 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
- C. Fixed Specialty Workstation and Countertop Brackets:
 - 1. Material: Steel.
 - 2. Finish: Manufacturer's standard, factory-applied powder coat.
 - 3. Color: Selected by Architect from manufacturer's standard range.
 - 4. Manufacturers:
 - a. Rakks/Rangine Corporation; EH Series Brackets: www.rakks.com/#sle
 - b. Substitutions: See Section 016000 - Product Requirements.
- D. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ("U" shaped wire pull, steel with chrome finish, 100 mm centers).
- E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- F. Drawer Slides:
 - 1. Type: Extension types as indicated.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
- G. Hinges: European style concealed self-closing type, steel with nickel-plated finish.

2.08 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- C. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

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

3.03 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

**SECTION 068316
FIBERGLASS REINFORCED PANELING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.

1.02 REFERENCE STANDARDS

- A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels:
 - 1. Marlite, Inc; _____: www.marlite.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

- A. Wall Panels:
 - 1. Panel Size: 4 by 8 feet (1.2 by 2.4 m).
 - 2. Panel Thickness: 0.10 inch (2.5 mm).
 - 3. Surface Design: Embossed.
 - 4. Color: White.
 - 5. Attachment Method: Adhesive only, sealant joints, no trim.

2.03 MATERIALS

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

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- G. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

**SECTION 072100
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at cavity wall construction and perimeter foundation wall.
- B. Batt insulation and vapor retarder in exterior wall construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
- D. Expanding foam insulation in CMU walls.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.

1.03 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C; 2019a.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- B. Insulation Inside Masonry Cavity Walls: Extruded polystyrene (XPS) carbon black board.
- C. Insulation on Inside of Framed Walls with Exposed Facer Providing Interior Finish: Glass-fiber-reinforced polyisocyanurate with exposed facers.
- D. Insulation Over Roof Deck: Extruded polystyrene (XPS) board.
- E. Insulation at Structural Connections: Rigid, high-strength polyurethane.

2.02 FOAM BOARD INSULATION MATERIALS

- A. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Thickness: 1-1/2 inch (38 mm).

4. Board Edges: Square.
 5. Type and Compressive Resistance: Type XI, 5 psi (35 kPa), minimum.
 6. Thermal Conductivity (k factor) at 25 degrees F: 0.28.
- B. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 3. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
- C. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
1. Classifications:
 - a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
 - 1) Class 1 - Non-reinforced core foam.
 - 2) Compressive Strength: 16 psi (110 kPa), minimum.
 - 3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inch (38.1 mm) thick; 9.0 (1.59) at 75 degrees F (24 degrees C).
 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 4. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
 5. Board Thickness: As specified on drawings.
 6. Board Edges: Square.
- D. Glass-Fiber-Reinforced Polyisocyanurate (ISO) Board Insulation with Facers Both Sides and Providing Interior Finish System: Rigid cellular foam, complying with ASTM C1289.
1. Compressive Strength: 16 psi (110 kPa), minimum.
 2. Thermal Resistance, R-value (RSI-value): Type I, Class 2, at 1-1/2 inch (38.1 mm) thick; 9.0 (1.59) at 75 degrees F (24 degrees C).
 3. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 4. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 5. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
 6. Board Thickness: 1 inch (25 mm).
 7. Board Edges: Square.
 8. Exposed Facer: 4 mil, 0.004 inch (0.1016 mm) embossed white thermoset-coated aluminum.
 9. Non-Exposed Facer: 1.25 mil, 0.00125 inch (0.03175 mm) embossed aluminum.

2.03 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 4. Formaldehyde Content: Zero.
 5. Thermal Resistance: R-value (RSI-value) of 21 walls (R of 30 ceiling).
 6. Facing: Kraft faced..
- C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

2. Thermal Resistance: R-value (RSI-value) of R-19 at exterior walls (____).

2.04 ACCESSORIES

- A. Roof insulation shall be fastened with corrosion resistant fasteners as recommended by roofing system manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Install boards horizontally on foundation perimeter.
1. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Install with factory-applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.
- F. Staple or nail facing flanges in place at maximum 6 inches (152 mm) on center.
- G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
- H. Install 3-1/2" sound batt insulation at all interior partitions.

3.04 CMU INSULATION INSTALLATION

- A. Install/fill all ungrouted CMU cells of all CMU building walls with the self-expanding foam insulation per manufacturer's instructions.

3.05 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.

3.06 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

**SECTION 072400
EXTERIOR INSULATION AND FINISH SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Composite wall and soffit cladding of rigid insulation and reinforced finish coating over cementitious base coat, Class PM.

1.02 RELATED REQUIREMENTS

- A. Section 054000 - Cold-Formed Metal Framing: Sheathing on metal studs.
- B. Section 072500 - Weather Barriers.
- C. Section 076200 - Sheet Metal Flashing and Trim: Perimeter flashings.
- D. Section 079200 - 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 C150/C150M - Standard Specification for Portland Cement; 2021.
- C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.
- D. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2021.
- E. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- F. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).
- G. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.
- H. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2015 (Reapproved 2020).
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- L. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2026.
- M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- N. ASTM E2486/E2486M - Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS); 2022.
- O. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- P. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.
- Q. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).

- R. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies; 2015, with Editorial Revision (2022).
- S. NFPA 259 - Standard Test Method for Potential Heat of Building Materials; 2023, with Errata.
- T. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.
- U. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.
- C. Shop Drawings: Indicate wall and soffit joint patterns, joint details, and molding profiles.
- D. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.

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 30 years.

1.06 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 (5 degrees C).
- D. Do not leave installed insulation board exposed to sunlight for extended periods of time.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Exterior Insulation and Finish Systems Manufacturers:
 - 1. Sto Corp; StoTherm ci XPS: www.stocorp.com/#sle.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 EXTERIOR INSULATION AND FINISH SYSTEM

- A. Exterior Insulation and Finish System: BARRIER type; reinforced finish coating on insulation board adhesive-applied direct to substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate in tested samples.
- B. Fire Characteristics:
 - 1. Flammability: Pass, when tested in accordance with NFPA 285.
 - 2. Ignitability: 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 (mJ/sq m).
- C. 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 (299 Pa) 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.
 - D. 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 (100 by 150 mm) in size.
 - E. 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.
 - F. 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.
 - G. 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.
 - H. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.
 - I. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons (500 liters) of sand.
 - J. Impact Resistance: Construct system to provide the following impact resistance without exposure of broken reinforcing mesh, when tested in accordance with ASTM E2486/E2486M:
 1. Standard: 25 to 49 in-lb (2.83 to 5.54 J), for areas not indicated as requiring higher impact resistance.

2.03 MATERIALS

- A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
 1. Texture: Sto Corp; Polymer-Enhanced Acrylic Stolit 1.0 Fine: www.stocorp.com/#sle.
 2. Color: As selected by Architect from manufacturer's standard range.
- 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. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578, with natural skin surfaces.
 1. Board Size: 48 by 96 inch (1220 by 2440 mm).
 2. Board Size Tolerance: 1/16 inch (1.5 mm) from square and dimension.
 3. Board Thickness: 1-1/2 inches (37.5 mm).
 4. Board Edges: Square.
 5. Type and Thermal Resistance, R-value (RSI-value): Type X, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.

- 6. Type and Compressive Resistance: Type X, 15 psi (104 kPa), minimum.
- 7. Type and Board Density: Type X, 1.30 pcf (21 kg/cu m), minimum.
- 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. Trim: EIFS manufacturer's standard PVC trim accessories, as required for a complete project and including starter track and drainage accessories.
- C. 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 (6 mm) when tested with a 10 ft (3 m) straightedge.

3.02 PREPARATION

- A. Install self-furring metal lath over solid substrates that are deemed unacceptable to receive adhesively applied insulation. Install in accordance with ASTM C1063, except for butt-lapping instead of overlapping.
 - 1. Attach to concrete and concrete masonry using corrosion-resistant power or powder actuated fasteners or hardened concrete stub nails not less than 3/4 inch (19 mm) long and with heads not less than 3/8 inch (9.5 mm) wide. Ensure that fasteners are securely attached to substrate and spaced at maximum 16 inches (406 mm) on center horizontally and 7 inches (178 mm) vertically.

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 (50 mm) 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 (1.6 mm).
- E. Fill gaps greater than 1/16 inch (1.6 mm) with strips or shims cut from the same insulation material.
- F. Rasp irregularities off surface of installed insulation board.
- G. Adhesive Attachment: Use method recommended by EIFS manufacturer.

3.06 INSTALLATION - CLASS PM FINISH

- A. Joints: Install control and expansion joints at spacings indicated on drawings. Do not exceed 150 sq ft (14 sq m) for areas defined by the placement of control joints.
- B. Reinforcing Mesh: Install in strict accordance with manufacturer's instructions, using mechanical fasteners at spacing recommended.
 - 1. Lap reinforcing mesh edges and ends 2 inches (50 mm) minimum.
- C. Base Coat: Install to minimum thickness specified, following manufacturer's instructions. Leave base coat in condition suitable to receive finish coat.
- D. Finish Coat: Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.
- E. 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 017000 - 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

SECTION 075423
THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING - CARLISLE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Adhered system with thermoplastic polyolefin (TPO) roofing membrane.
- B. Insulation, flat and tapered.
- C. Flashings.
- D. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood nailers and curbs.
- B. Section 076200 - Sheet Metal Flashing and Trim: Counterflashings, reglets and _____.
- C. Section 077100 - Roof Specialties: Prefabricated roofing expansion joint flashing.
- D. Section 077200 - Roof Accessories: Roof-mounted units; prefabricated curbs.

1.03 REFERENCE STANDARDS

- A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
- B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
- C. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.
- D. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2024).
- E. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2022).
- F. NRCA (RM) - The NRCA Roofing Manual; 2026.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's written information listed below.
- C. Warranty:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Protect products in weather protected environment, clear of ground and moisture.
- C. Protect foam insulation from direct exposure to sunlight.
- D. Provide Safety Data Sheets (SDS) at the project site at all times during transportation, storage, and installation of materials.
- E. Comply with requirements from Owner to prevent overloading or disturbance of the structure when loading materials onto the roof.

1.06 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather. Refer to manufacturer's written instructions.

- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C) or above ____ degrees F (____ degrees C).
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- E. Proceed with work so new roofing materials are not subject to construction traffic as work progresses.
- F. Do not allow grease, oil, fats, or other contaminants to come into direct contact with membrane.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.
- C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
 - 1. Warranty Term: 20 years.
 - 2. For repair and replacement include costs of both material and labor in warranty.
 - 3. Include accidental punctures according to the manufacturer's standard warranty terms.
 - 4. Include hail damage according to the manufacturer's standard warranty terms.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Carlisle SynTec: www.carlisle-syntec.com/#sle.
- B. Substitutions: See Section 016000 - Product Requirements.

2.02 ROOFING APPLICATIONS

- A. TPO Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Roofing Assembly Performance Requirements and Design Criteria:

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Single Source Responsibility: Provide and install products from single source.
- B. Membrane:
 - 1. Material: Thermoplastic Polyolefin (TPO) complying with ASTM D6878/D6878M.
 - 2. Thickness: 60 mils (0.060 inch) (1.5 mm), minimum.
 - 3. Color: White.
 - 4. Product:
 - a. Carlisle Sure-Weld.
- C. Seaming Materials: As recommended by membrane manufacturer.
- D. Flexible Flashing Material: Same material as membrane.
- E. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.04 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: ASTM C1289, Type II, Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of the core foam.
 - 1. Grade and Compressive Strength: Grade 2, 20 psi (Grade 2, 138 kPa), minimum.
 - 2. Product:

2.05 ACCESSORIES

- A. Prefabricated Flashing Accessories:
 - 1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
 - 2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
 - 3. Sealant Pockets: Same material as membrane, with manufacturer's standard accessories, in manufacturer's standard configuration.
 - 4. Pressure Sensitive Cover Strips: 6 inch (152 mm) wide, 45 mils (0.045 inch) (1.1 mm) thick, non-reinforced TPO membrane laminated to 35 mils (0.035 inch) (0.9 mm) thick cured synthetic rubber with pressure sensitive adhesive.
 - 5. TPO Pressure Sensitive RUSS:
 - 6. Walkway Rolls: Sure-Flex Heat Weldable Walkway Rolls; 80 mils (0.080 inch) (2 mm) thick; gray membrane.
 - 7. Miscellaneous Flashing: Non-reinforced TPO membrane; 80 mils (0.080 inch) (2 mm) thick, in manufacturer's standard lengths and widths.
- B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
- C. Membrane Adhesive: As recommended by membrane manufacturer.
- D. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- E. Sealants: As recommended by membrane manufacturer.
- F. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.
- G. Edgings and Terminations: Manufacturer's standard edge and termination accessories.
 - 1. Snap-On Edge System:
 - 2. Anchor Bar Fascia System:
 - 3. Drip Edge: Carlisle Sure-Seal Drip Edge.
 - 4. Coping:
 - 5. TPO Coated Sheet Metal.
 - 6. Termination Bar.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 METAL DECK PREPARATION

- A. Install deck sheathing on metal deck:
 - 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 - 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
 - 3. Tape joints.
 - 4. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.
 - a. Over entire roof area, fasten sheathing using 6 fasteners with washers per sheathing board.

3.03 INSTALLATION - GENERAL

- A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.04 INSULATION APPLICATION

- A. Attachment of Insulation:
 - 1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
- B. Lay subsequent layers of insulation with joints staggered minimum 6 inch (152 mm) from joints of preceding layer.
- C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- D. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- E. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch (6.3 mm). Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- F. Do not apply more insulation than can be completely waterproofed in the same day.

3.05 MEMBRANE APPLICATION

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive at manufacturer's recommended rate. Fully embed membrane in adhesive except in areas directly over or within 3 inches (75 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Seam Welding:
 - 1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches (51 mm).
 - 2. Cover seams with manufacturer's recommended joint covers.
 - 3. Probe seams once welds have thoroughly cooled. (Approximately 30 minutes.)
 - 4. Repair deficient seams within the same day.
 - 5. Seal cut edges of reinforced membrane after seam probe is complete.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 4 inches (100 mm) onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Coordinate installation of roof drains and sumps and related flashings. Locate all field splices away from low areas and roof drains. Lap upslope sheet over downslope sheet.
- G. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.06 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove bituminous markings from finished surfaces.
- C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- D. Repair or replace defaced or damaged finishes caused by work of this section.

3.07 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

**SECTION 076200
SHEET METAL FLASHING AND TRIM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, sheet metal roofing, exterior penetrations, through wall scuppers, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 077100 - Roof Specialties: Manufactured copings, flashings, and expansion joint covers.
- C. Section 079200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

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

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gauge, 0.0239 inch (0.61 mm) thick base metal, shop pre-coated with silicone modified polyester coating.
 - 1. Color: as selected by Architect.

2.02 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 (13 mm); 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 flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.03 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- 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.

PART 3 EXECUTION

3.01 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.

3.02 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.

END OF SECTION

SECTION 077100 ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured roof specialties, including copings, fascias, and gravel stops.

1.02 RELATED REQUIREMENTS

- A. Section 077200 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.03 REFERENCE STANDARDS

- A. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.
- B. NRCA (RM) - The NRCA Roofing Manual; 2026.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

PART 2 PRODUCTS

2.01 COMPONENTS

- A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 - 1. Configuration: Fascia, cant, and edge securement for roof membrane.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Exposed Face Height: As indicated on drawings.
 - 4. Color: To be selected by Architect from manufacturer's standard range.
- B. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 - 1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Color: To be selected by Architect from manufacturer's standard range.

2.02 FINISHES

- A. Color Anodized Finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.

2.03 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Seal joints within components when required by component manufacturer.
- C. Anchor components securely.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- E. Coordinate installation of flashing flanges into reglets.

END OF SECTION

**SECTION 077200
ROOF ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof curbs.
- B. Roof penetrations mounting curbs.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 ROOF CURBS

- A. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
 - 1. Roof Curb Mounting Substrate: Curb substrate consists of standing seam metal roof panel system.
 - 2. Sheet Metal Material:
 - a. Aluminum: 0.080 inch (2.03 mm) minimum thickness, with 3003 alloy, and H14 temper.
 - 3. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
 - a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch (152 mm) clearance between curb and metal roof panel flange allowing water to properly flow past curb.
 - b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.
 - c. Maintain at least 12 inch (305 mm) clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
 - d. Lap lower curb flange ovetop of down sloping metal roof panel and seal connection.
 - 4. Provide layouts and configurations indicated on drawings.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

END OF SECTION

SECTION 079200 JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware: Setting exterior door thresholds in sealant.
- B. Section 088000 - Glazing: Glazing sealants and accessories.
- C. Section 092116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

- A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes 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. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 - 1. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
 - 2. Sika Corporation; _____: www.usa-sika.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
 - 1. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
 - 2. Sika Corporation; _____: www.usa-sika.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Other joints indicated below.
3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints between suspended panel ceilings/grid and walls.

2.03 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

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 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. 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.

END OF SECTION

**SECTION 081113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware.
- B. Section 088000 - Glazing: Glass for doors and borrowed lites.
- C. Section 099113 - Exterior Painting: Field painting.
- D. Section 099123 - Interior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2018.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2015.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021.
- H. 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; 2025.
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- J. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
 - 2. Steelcraft, an Allegion brand; _____: www.allegion.com/#sle.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Type _____, Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.
 - 2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
 - 3. Top Closures for Outswinging Doors: Flush with top of faces and edges.
 - 4. Door Face Sheets: Flush.
 - 5. Door Finish: Factory primed and field finished.
- C. Type _____, Interior Doors, Non-Fire-Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.
 - 2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
 - 1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

- 2. Frame Finish: Factory primed and field finished.
- 3. Weatherstripping: Separate, see Section 087100.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 - 2. Frame Finish: Factory primed and field finished.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Door Window Frames: Door window frames with glazing securely fastened within door opening.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Install door hardware as specified in Section 087100.

3.02 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 081213 HOLLOW METAL FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal frames for non-hollow metal doors.

1.02 RELATED REQUIREMENTS

- A. Section 081416 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.
- B. Section 087100 - Door Hardware: Hardware, silencers, and weatherstripping.
- C. Section 088000 - Glazing: Glazed borrowed lites.
- D. Section 099123 - Interior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2018.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021.
- G. 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; 2025.
- H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- J. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- K. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- L. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Frames with Integral Casings:
 - 1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
 - 2. Steelcraft, an Allegion brand; _____: www.allegion.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Refer to Door and Frame Schedule on drawings for frame sizes, fire ratings, sound ratings, finishing, door hardware to be installed, and other variations, if any.
- B. Door Frame Type: Provide hollow metal door frames with _____.
- C. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
- D. Accessibility: Comply with ICC A117.1 and ADA Standards.
- E. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- F. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

2.03 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

- A. Type _____, Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

2.04 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.05 ACCESSORIES

- A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Install door hardware as specified in Section 087100.

END OF SECTION

**SECTION 081416
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, special function, and _____.

1.02 RELATED REQUIREMENTS

- A. Section 081113 - Hollow Metal Doors and Frames.
- B. Section 081213 - Hollow Metal Frames.
- C. Section 087100 - Door Hardware.
- D. Section 088000 - Glazing.
- E. Section 099300 - Staining and Transparent Finishing: Field finishing of doors.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 4.0; 2021.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples: Submit two samples of door veneer, ____ by ____ inches (____ by ____ mm) in size illustrating wood grain, stain color, and sheen.
- E. Warranty, executed in Owner's name.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Haley Brothers; ____: www.haleybros.com/#sle.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 DOORS AND PANELS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Wood veneer facing for field transparent finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Natural birch, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- E. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 1, Lacquer, Nitrocellulose.
 - b. Stain: As selected by Architect.
 - c. Sheen: Flat.
- B. Factory finish doors in accordance with approved sample.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 081113.
- B. Hollow Metal Door Frames: See Section 081213.
- C. Door Window Frames: Door window frames with glazing securely fastened within door opening.
- D. Glazing: See Section 088000.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

3.02 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION

**SECTION 083100
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted access units.
- B. Ceiling mounted access units.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware: Mortise cylinder and core hardware.
- B. Section 099123 - Interior Painting: Field paint finish.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Ceiling-Mounted Units with Return Air Grille:
 - 1. Location: provide in hard ceilings in bathrooms.
 - 2. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
 - 3. Size - Other Ceilings: 12 by 12 inches (305 by 305 mm).
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL AND CEILING MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries; _____:
www.activarcpg.com/#sle.
 - a. Multipurpose Access Panel: Activar/JL Industries TM.
 - 2. Best Access Doors: www.bestaccessdoors.com/#sle.
 - a. Universal Access Panel Drywall: Best Access Doors; Series BA-UAP.
- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Material: Steel.
 - 2. Door Style: Single thickness with rolled or turned in edges.
 - 3. Frames: 16 gauge, 0.0598 inch (1.52 mm), minimum thickness.
 - 4. Steel Finish: Primed.
 - 5. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

**SECTION 083323
OVERHEAD COILING DOORS**

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 083323.13 - Overhead Rapid Coiling Doors.
- C. Section 260583 - Wiring Connections: Power to disconnect.

1.02 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ITS (DIR) - Directory of Listed Products; current edition.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).
- G. UL (DIR) - Online Certifications Directory; Current Edition.
- H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general construction, electrical equipment, component connections and details, and _____.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures, and _____.
- E. Maintenance Data: Indicate lubrication requirements and frequency, periodic adjustments required, and _____.

1.04 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Overhead Coiling Doors:
 - 1. Overhead Door Company.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 COILING DOORS

- A. Exterior Coiling Doors Type Overhead Door Stormtite 620: Steel slat curtain.

1. Capable of withstanding positive and negative wind loads of 20 psf (940 Pa) without undue deflection or damage to components.

2.03 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
 1. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
 2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
 3. Steel Slats: Minimum thickness, ____ gauge, ____ inch (____ mm); ASTM A653/A653M galvanized steel sheet.
- B. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.
- C. Guides - Angle: ASTM A36/A36M metal angles, size as indicated.
- D. Lock Hardware:
 1. For motor operated units, additional lock or latching mechanisms are not required.
 2. Latch Handle: Manufacturer's standard.
 3. Manual Chain Lift: Provide padlockable chain keeper on guide.
- E. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb (10 kg) nominal force to operate.

2.04 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
 1. Provide interlock switches on motor operated units.
- B. Electric Operators:
 1. Mounting: Side mounted.
 2. Motor Enclosure:
 3. Motor Rating: 1/3 HP (250 W); continuous duty.
 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 6. Controller Enclosure: NEMA EN 10250, Type 4.
 7. Opening Speed: 12 inches per second (300 mm/sec).
 8. Brake: Manufacturer's standard type, activated by motor controller.
 9. Manual override in case of power failure.
 10. See Section 260583 for electrical connections.
- C. Control Station: Provide standard three button, 'Open-Close-Stop' momentary-contact control device for each operator complying with UL 325.
 1. 24 volt circuit.
 2. Surface mounted, at interior door jamb.
 3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
- D. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 260583.
- F. Complete wiring from disconnect to unit components.

END OF SECTION

**SECTION 08 71 00
DOOR HARDWARE**

PART I - GENERAL

1.01 DESCRIPTION

- A. Related Work:
1. Cabinet Hardware: Interior Architectural Woodwork.
 2. Threshold Caulking: Joint Sealants.
 3. Connecting Electrical Hardware: Electrical

1.02 QUALITY ASSURANCE

- A. Design Criteria: Provide Underwriter's Laboratory listed hardware for fire or accident hazard where scheduled or required to maintain rating of openings. Comply with requirements of door and door frame labels. Comply with NFPA No. 80 and local codes that are in effect in the area of the project.

1.03 SUBMITTALS

- A. Hardware Schedule: Within 10 days after receipt of a contract for the finish hardware, prepare a complete schedule and submit 8 copies of the hardware schedule with 3 copies of catalogue cuts, highlighted to show each different hardware item to the Architect for review.
- B. Do not order hardware until an approved copy of the schedule is returned to the supplier bearing the approval of the Architect.

This schedule shall indicate the following details:

Door numbers	Frame materials
Location	Hand of door
Size and thickness of door	Degree of opening
Door material	Type of attachment
Door Number / Heading Index	

- C. Templates: After receipt of the approved corrected hardware schedule, upon request the hardware supplier shall send 4 sets of all templates and corrected hardware schedule to the general contractor for distribution to the wood door, metal door, and frame manufacturers/suppliers.
- D. Maintenance Manuals: Furnish 1 copy of maintenance manual covering the finish hardware for this project. The manual shall consist of printed sheets from the hardware manufacturer bound in a three-ring binder and properly indexed.

Include the following information in the maintenance manuals:

1. Address and telephone number of the hardware supplier.
2. Address and telephone number of each hardware manufacturer.
3. Maintenance instructions and parts list for each type of operating hardware including:
 - a. Locks.
 - b. Exit Devices.
 - c. Closers.
4. Warranty for closers and all other hardware.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hardware to the jobsite only after proper provision for storage has been made. NO DIRECT SHIPMENTS WILL BE ALLOWED.
- B. Properly package and clearly identify each item relative to the hardware schedule.
- C. The hardware supplier shall authorize his representative to be present when all finish hardware is delivered to the jobsite and shall check-in each item and turn over to the General Trades Contractor for storage in a secure place under lock and key.

1.05 WARRANTY

- A. Furnish 3 copies of the following written warranty to be included in the Maintenance Manuals:
 - 1. Warranty against mechanical failure of door closers for a 10 year period.
 - 2. Warranty against failure of parts of all hardware except door closers for a period 1 year.
 - 3. Warranty shall include cylinder locks.
 - 4. Starting date for all warranty periods to be the date of substantial completion of building by owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Butts:	Ives, Hager, Stanley	IVE
B. Exit Devices:	Von Duprin – 99 SERIES***	VON
C. Door Closers:	LCN - 4000 SERIES ***	LCN
D. Cylindrical Locksets:	Accentra – 5400LN SERIES***	ACT
E. Thresholds & Weatherstrip:	Pemko, National Guard, Reese, Zero	ZER
F. Stops & Door Trim:	Ives, Trimco, Rockwood, Glynn Johnson	TRM
G. O/H Stops:	Glynn Johnson	GLY

*** - NMSU's Standard – NO SUBSTITUTES

OTHER MANUFACTURERS BY PRIOR APPROVAL OF THE ARCHITECT AND LISTED IN AN ADDENDUM.

2.02 SCHEDULED HARDWARE

- A. Requirements for design: grade, function, finish, size, and other distinctive qualities of each type of Builder's Hardware is indicated in the Hardware Schedule at the end of this section. Products are identified by using manufacturer's hardware product numbers.
- B. Manufacturer's Product Designation: One or more manufacturers are listed for each hardware type required. The initial after the manufacturer's name indicates whose product designation is used in the Hardware Schedule for purposes of establishing minimum requirements. Provide the product designated, or where more than one manufacturer is listed, the comparable product of one of the other manufacturers which comply with requirements including those specified elsewhere in the section.

2.03 MATERIALS AND FABRICATION

- A. Hand of Door: The drawings show the direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of the door movement as shown.
- B. Base Metals: Produce hardware units of the basic metal and forming method indicated using the manufacturer's standard metal alloy, composition, temper, and hardness. Do not furnish "Optional" materials or forming methods for those indicated, except as otherwise specified.
- C. Fasteners: Manufacture hardware to conform to published templates generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping screws except as specifically indicated.
 - 1. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match the hardware finish or if exposed in surfaces of other work to match the finish of such other work as closely as possible including "prepared for paint" in surfaces to receive painted finish.
 - a. Sex Bolts: Install door closer, door holders, and exit devices on wood doors by means of thru bolts and sex nuts.
 - 2. Provide concealed fasteners for hardware units which are exposed when the door is closed except to the extent no standard units of the type specified are available with concealed fasteners. Do not use thru bolts for installation where the bolt head or the nut on the opposite face is exposed in other work except where it is not feasible to adequately reinforce the work.

2.04 BUTTS, HINGES, AND PIVOTS

- A. Templates: Provide only template produced units.
- B. Screws: Furnish Phillips flat-head all purpose or machine screws for installation of units except furnish Phillips flat-head all purpose wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins: Except as otherwise indicated provide hinge pins as follows:

1. Steel Hinges:	Steel pins
2. Non-ferrous Hinges:	Stainless steel pins
3. Exterior Doors:	Non-removable pins (NRP)
4. Interior doors:	Non-rising pins
5. Tips.	Flat button and matching plug finished to match leaves
- D. Number of hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90" or less in height and 1 additional hinge for each 30" of additional height.
- E. Size of hinge leaves: 4.5" high, except 5" for doors 3'6" wide and wider.
- F. Width of hinges: Shall be sufficient to clear trim projection when door swings 180 degrees.
- G. Fire rated doors over 8'0" shall have heavy weight hinges.
- H. All hinges SHALL be made of steel and have steel ball bearings.

2.05 KEYING

- A. All final cylinders and keying by owner.

- B. Material supplier shall supply 0-bit cylinders for all doors with two keys per cylinder. Contact NMSU OFS Lockshop for keyway. (575) 646-5226 / (575) 646-6613.

2.06 CYLINDRICAL TYPE LOCKSETS

- A. All locksets and latch sets shall have steel cylindrical cases with interior parts made of steel or brass. No plastic, die cast, or aluminum mechanisms will be allowed.
- B. Chassis: Cylindrical design, corrosion - resistant plated cold-rolled steel.
- C. Latch Retractors: Forged steel. Balance of inner parts: Corrosion-resistant plated steel, or stainless steel.
- D. Lever Trim: Accessible design, independent operation, spring-cage supported, minimum 2" clearance from lever mid-point to door face.
- E. Locks shall be of such construction that when locked, the door may be opened from within by using lever and without the use of a key or special knowledge.
- F. Rosettes: Minimum 3-7/16" diameter for coverage of ANSI/DHI A115.18, 1994 door preparation, through-bolt lugs on both spring cages to fully engage this pattern.
- G. Springs: Full compression type.
- H. Strikes: 16 gage curved steel, bronze or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.

2.07 CLOSER AND DOOR CONTROL DEVICES

- A. Surface type door closers shall be fully hydraulic, full rack and pinion action with a one piece forge steel piston. Barrier-free where designated.
- B. Separate adjusting valves shall be provided for closing speed, latching speed and back-check.
- C. Adjusting valves shall be made of a metal material, concealed, adjustable only with special wrench and shall be seated with "O" type rings.
- D. Closers shall NOT be supplied with "Pressure Relief Valves".

2.08 EXIT DEVICES

- A. Exit devices: Von Duprin as scheduled with push-through pad design, no exposed touch bar fasteners, no exposed cavities when operated.
 - 1. Provide certification by independent testing laboratory that specified devices have completed over 1,000,000 cycles and still perform in accordance to ANSI/BHMA A156.3 - 1997.
 - 2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
 - 3. Mechanism case shall have an average thickness of .140" Compression spring engineering.
 - 4. Non-handled basic device design with center case interchangeable with all functions.
 - 5. All devices shall have quiet return fluid dampeners.
 - 6. All latchbolts for wide stile devices shall be deadlocking with 3/4" throw and have a self-lubricating coating to reduce friction and wear.
 - 7. Device push bar must release when a force of 32 pounds, or less, of pressure is applied when a force of 250 pounds is applied to the door.
 - 8. Device shall bear UL label for fire and or panic as may be required.

9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
- B. Lever Trim: "Breakaway" design, forged brass or bronze escutcheon with a minimum of .130" thickness, match lockset lever design.
 - C. Removable Mullions: Removable with single turn of building key, securely reinstalled without need for key.
 - D. Furnish glass bead kits for vision lites where required. Devices for flush doors must fit flat on the door.
 - E. Exit devices shall be able to have latch-bolt monitoring switches, request to exit switches, electric latch-retraction, alarm kits, electric outside trim, or cylinder dogging added to the existing unit as the need arises for future electrified openings without replacing the original exit device.

2.09 MISCELLANEOUS DOOR TRIM UNITS

- A. Material shall be brass, bronze or stainless steel as appropriate for required finish. Brass bronze material to be 0.050" minimum thickness, and stainless steel to be 0.050" minimum thickness. Edges of plates to be beveled and polished except lower edge can be square.
- B. Width of plates shall be 2" less than door width.
- C. Push Plates: Plate shall be 4" x 16".
- D. Pull Plates: Plate shall be 4" x 16". Grip shall be extruded or cast bronze or stainless steel located on center of plate.
- E. Smoke Seal shall be a self-adhesive SILICONE material measuring 3/8" x 1/4".

2.10 TOOLS FOR MAINTENANCE

- A. Furnish a complete set of specialized tools as needed for Owner's continued adjustment, maintenance and removal or replacement of finish hardware.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: All finish hardware shall be installed by General Contractor.
- B. Furnish all items of hardware with attachment screws, bolts, nuts, etc., as required to attach hardware to type of material involved and with finish to match hardware with which they are to be used. Make all attachments to metal by template machine screws.
- C. Provide sex nuts and bolts for door closers, forearm shoes of closers, and holding devices.
- D. Attached hardware to masonry or concrete with expansion bolts or similar drilled anchors to develop full strength of attached device.
- E. Run weather-stripping or sound-stripping full height of both jambs and full width of head. Run thresholds full width of opening. Run door bottoms full width of doors. Set expansion anchors in solid masonry, not mortar joints. Set thresholds in caulking by sealant contractor.

3.02 PROTECTION

- A. Do not install door silencers, kickplates, pushplates, door bottoms, and wall stops until after painting is complete. Loosen locksets and panic hardware prior to painting and re-tighten after painting is complete. Mask all hardware or otherwise protect during painting operation.

3.03 ADJUST AND CLEAN

- A. Check and adjust each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Final Adjustment: Whenever hardware installation is completed more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- C. Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes during the final adjustment of hardware.
- D. Adjust all closers to meet ADA Requirements for sweep time and opening force. Set the closer's back-check valve to slow the doors opening from 85 degrees on.

3.04 HARDWARE SCHEDULE

- A. It is intended the following schedule include all item of finish hardware necessary to complete the work. If a discrepancy is found in the schedule, such as a missing item, improper hardware for frame, door, or fire codes. The Pre-am will be the deciding document.

Elevation riser diagrams included in this section and/or section 28 1300 are based on the electrified products listed in the hardware sets. Any deviation from the specified products shall make the elevation riser diagrams null and void. If non-specified products are submitted on, material supplier to provide new elevation riser diagrams as part of their submittal package.

- C. All items shall be of proper type for attaching securely to type of material on which they occur.
- D. The schedule of materials is as follows:

Abbreviation	Name
ACT	Accentra
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	LCN Commercial Division
SCE	Schlage Electronic Security
TRM	Trimco
VON	Von Duprin
ZER	Zero International Inc

Legend:
 Link to catalog cut sheet
 Electrified Opening

HARDWARE SET: 01

DOOR NUMBER:
102

EACH TO HAVE:						
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	AU5405LN		626	ACT
1	EA	OH STOP	90S		630	GLY
3	EA	SILENCER	1229-A		GRY	TRM

HARDWARE SET: 02

DOOR NUMBER:
107 E03

EACH TO HAVE:						
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE LOCK	AU5407LN		626	ACT
1	EA	WALL STOP	1270-WV		630	TRM
3	EA	SILENCER	1229-A		GRY	TRM

HARDWARE SET: 03

DOOR NUMBER:

109

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	AU5405LN		626	ACT
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	WALL STOP	1270-WX		630	TRM
1	EA	SEALS	188SBK PSA X D.S.		BK	ZER
1	EA	CARD READER	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	DOOR CONTACT	679-05 WD OR HM AS REQ'D	 ⚡	BLK	SCE
1	EA	RX MOTION SENSOR	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC	 ⚡	LGR	SCE
1	EA	WIRING DIAGRAM	POINT TO POINT / RISER	⚡		

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY VALID CREDENTIAL AT CARD READER OR BY KEY AT LOCK.

RX MOTION SENSOR SHUNTS DOOR FORCED OPEN IN ACCESS CONTROL SYSTEM.

KEY OVER-RIDE WILL CAUSE DOOR FORCED ALARM IN ACCESS CONTROL SYSTEM.

FREE EGRESS AT ALL TIMES. **VON050251-00**

ACCESS CONTROL SYSTEM TO BE LENEL S2 W/MERCURY BOARDS

HARDWARE SET: 04

DOOR NUMBER:

116

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	AU5405LN		626	ACT
1	EA	OH STOP	90S		630	GLY
3	EA	SILENCER	1229-A		GRY	TRM

HARDWARE SET: 05

DOOR NUMBER:

117A

EACH TO HAVE:

3	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10		✓ 689	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL 24 VDC		✓ 626	VON
1	EA	RIM CYLINDER	1109		626	ACT
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	RAIN DRIP	142A X D.W. +4"		AA	ZER
1	SET	SEALS	8303AA-S X D.S.		AA	ZER
1	EA	DOOR SWEEP	39A X D.W.		A	ZER
1	EA	THRESHOLD	8655A X D.W.		A	ZER
1	EA	CARD READER	BY ACCESS CONTROL INTEGRATOR	✓		
1	EA	DOOR CONTACT	679-05 WD OR HM AS REQ'D		✓ BLK	SCE
1	EA	RX MOTION SENSOR	BY ACCESS CONTROL INTEGRATOR	✓		
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC		✓ LGR	SCE
1	EA	WIRING DIAGRAM	POINT TO POINT / RISER	✓		

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY VALID CREDENTIAL AT CARD READER OR BY KEY AT CYLINDER.

RX MOTION SENSOR SHUNTS DOOR FORCED OPEN IN ACCESS CONTROL SYSTEM.

KEY OVER-RIDE WILL CAUSE DOOR FORCED ALARM IN ACCESS CONTROL SYSTEM.

FREE EGRESS AT ALL TIMES. **VON050251-00**

ACCESS CONTROL SYSTEM TO BE LENEL S2 W/MERCURY BOARDS

HARDWARE SET: 06

DOOR NUMBER:

117B

EACH TO HAVE:

ALL HARDWARE BY DOOR
MANUFACTURER

HARDWARE SET: 07

DOOR NUMBER:

118

EACH TO HAVE:

3	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10		✓ 689	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL 24 VDC		✓ 626	VON
1	EA	RIM CYLINDER	1109		626	ACT
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	RAIN DRIP	142A X D.W. +4"		AA	ZER
1	SET	SEALS	8303AA-S X D.S.		AA	ZER
1	EA	DOOR SWEEP	39A X D.W.		A	ZER
1	EA	THRESHOLD	8655A X D.W.		A	ZER
1	EA	CARD READER	BY ACCESS CONTROL INTEGRATOR	✓		
1	EA	DOOR CONTACT	679-05 WD OR HM AS REQ'D		✓ BLK	SCE
1	EA	RX MOTION SENSOR	BY ACCESS CONTROL INTEGRATOR	✓		
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC		✓ LGR	SCE
1	EA	WIRING DIAGRAM	POINT TO POINT / RISER	✓		

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY VALID CREDENTIAL AT CARD READER OR BY KEY AT LOCK.

RX MOTION SENSOR SHUNTS DOOR FORCED OPEN IN ACCESS CONTROL SYSTEM.

KEY OVER-RIDE WILL CAUSE DOOR FORCED ALARM IN ACCESS CONTROL SYSTEM.

FREE EGRESS AT ALL TIMES. **VON050251-00**

ACCESS CONTROL SYSTEM TO BE LENEL S2 W/MERCURY BOARDS

HARDWARE SET: 08

DOOR NUMBER:

119

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY SET	AU5402LN		626	ACT
1	EA	SURFACE CLOSER	4040XP		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	WALL STOP	1270-WV		630	TRM
1	EA	SEALS	188SBK PSA X D.S.		BK	ZER

HARDWARE SET: 09

DOOR NUMBER:

120

EACH TO HAVE:

3	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	PUSH PLATE	1001-3		630	TRM
1	EA	PULL PLATE	1017-3		630	TRM
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	WALL STOP	1270-WX		630	TRM
1	EA	SEALS	188SBK PSA X D.S.		BK	ZER

HARDWARE SET: 10

DOOR NUMBER:

130

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	AU5405LN		626	ACT
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	WALL STOP	1270-WX		630	TRM
3	EA	SILENCER	1229-A		GRY	TRM
1	EA	CARD READER	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	DOOR CONTACT	679-05 WD OR HM AS REQ'D	 ⚡	BLK	SCE
1	EA	RX MOTION SENSOR	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC	 ⚡	LGR	SCE
1	EA	WIRING DIAGRAM	POINT TO POINT / RISER	⚡		

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY VALID CREDENTIAL AT CARD READER OR BY KEY AT LOCK.

RX MOTION SENSOR SHUNTS DOOR FORCED OPEN IN ACCESS CONTROL SYSTEM.

KEY OVER-RIDE WILL CAUSE DOOR FORCED ALARM IN ACCESS CONTROL SYSTEM.

FREE EGRESS AT ALL TIMES. **VON050251-00****ACCESS CONTROL SYSTEM TO BE LENEL S2 W/MERCURY BOARDS**

HARDWARE SET: 11

DOOR NUMBER:

E01

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	AU5405LN		626	ACT
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	WALL STOP	1270-WX		630	TRM
1	EA	SEALS	188SBK PSA X D.S.		BK	ZER
1	EA	CARD READER	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	DOOR CONTACT	679-05 WD OR HM AS REQ'D	 ⚡	BLK	SCE
1	EA	RX MOTION SENSOR	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC	 ⚡	LGR	SCE
1	EA	WIRING DIAGRAM	POINT TO POINT / RISER	⚡		

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY VALID CREDENTIAL AT CARD READER OR BY KEY AT LOCK.

RX MOTION SENSOR SHUNTS DOOR FORCED OPEN IN ACCESS CONTROL SYSTEM.

KEY OVER-RIDE WILL CAUSE DOOR FORCED ALARM IN ACCESS CONTROL SYSTEM.

FREE EGRESS AT ALL TIMES. **VON050251-00**

ACCESS CONTROL SYSTEM TO BE LENEL S2 W/MERCURY BOARDS

HARDWARE SET: 12

DOOR NUMBER:

E02

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	AU5405LN		626	ACT
1	EA	WALL STOP	1270-WX		630	TRM
3	EA	SILENCER	1229-A		GRY	TRM

HARDWARE SET: 13

DOOR NUMBER:

E04

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	AU5408LN		626	ACT
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	WALL STOP	1270-WX		630	TRM
1	EA	SEALS	188SBK PSA X D.S.		BK	ZER

HARDWARE SET: 14

DOOR NUMBER:

E05

E06

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	AU5405LN		626	ACT
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	 ⚡	630	VON
1	EA	OH STOP	90S		630	GLY
1	EA	SURFACE CLOSER	4040XP		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	SEALS	188SBK PSA X D.S.		BK	ZER
1	EA	CARD READER	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	DOOR CONTACT	679-05 WD OR HM AS REQ'D	 ⚡	BLK	SCE
1	EA	RX MOTION SENSOR	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC	 ⚡	LGR	SCE
1	EA	WIRING DIAGRAM	POINT TO POINT / RISER	⚡		

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY VALID CREDENTIAL AT CARD READER OR BY KEY AT LOCK.

RX MOTION SENSOR SHUNTS DOOR FORCED OPEN IN ACCESS CONTROL SYSTEM.

KEY OVER-RIDE WILL CAUSE DOOR FORCED ALARM IN ACCESS CONTROL SYSTEM.

FREE EGRESS AT ALL TIMES. **VON050251-00**

ACCESS CONTROL SYSTEM TO BE LENEL S2 W/MERCURY BOARDS

HARDWARE SET: 15

DOOR NUMBER:
E07 E08

EACH TO HAVE:

3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	1001-3		630	TRM
1	EA	PULL PLATE	1017-3		630	TRM
1	EA	SURFACE CLOSER	4040XP		689	LCN
1	EA	KICK PLATE	K0050 10" X 2" LDW-CSK		630	TRM
1	EA	WALL STOP	1270-WX		630	TRM
1	EA	SEALS	188SBK PSA X D.S.		BK	ZER

HARDWARE SET: 16

DOOR NUMBER:

E09

E11

EACH TO HAVE:

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	DOOR CORD	788C-12 WITH 20 GAUGE WIRES	 ⚡	626	SCE
1	EA	PANIC HARDWARE	99-EO		626	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL 24 VDC	 ⚡	626	VON
1	EA	RIM CYLINDER	1109		626	ACT
1	EA	MORTISE CYLINDER	1152 X CAM AS REQ'D		626	ACT
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	WALL STOP	1270-WX		630	TRM
1	SET	SEALS	8303AA-S X D.S.		AA	ZER
1	EA	MULLION SEAL	8780N X D.H.		BK	ZER
2	EA	DOOR SWEEP	39A X D.W.		A	ZER
1	EA	CARD READER	BY ACCESS CONTROL INTEGRATOR	⚡		
2	EA	DOOR CONTACT	679-05 WD OR HM AS REQ'D	 ⚡	BLK	SCE
1	EA	RX MOTION SENSOR	BY ACCESS CONTROL INTEGRATOR	⚡		
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC	 ⚡	LGR	SCE
1	EA	WIRING DIAGRAM	POINT TO POINT / RISER	⚡		

DOORS NORMALLY CLOSED AND LOCKED.

ENTRY BY VALID CREDENTIAL AT CARD READER OR BY KEY AT CYLINDER.

RX MOTION SENSOR SHUNTS DOOR FORCED OPEN IN ACCESS CONTROL SYSTEM.

FREE EGRESS AT ALL TIMES. **VON050251-00**

ACCESS CONTROL SYSTEM TO BE LENEL S2 W/MERCURY BOARDS

HARDWARE SET: 17

DOOR NUMBER:

E10

E12

EACH TO HAVE:

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
2	EA	PANIC HARDWARE	99-EO		626	VON
1	EA	MORTISE CYLINDER	1152 X CAM AS REQ'D		626	ACT
2	EA	PUSH PLATE	1001-3		630	TRM
			TO BLANK OUT EXISTING PULL TRIMS			
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	WALL STOP	1270-WX		630	TRM
1	SET	SEALS	8303AA-S X D.S.		AA	ZER
1	EA	MULLION SEAL	8780N X D.H.		BK	ZER
2	EA	DOOR SWEEP	39A X D.W.		A	ZER

**IT IS THE RESPONSIBILITY OF THE HARDWARE SUPPLIER TO FIELD
VERIFY EXISTING CONDITIONS ON HINGE, LOCK, PANIC, AND STRIKE PREPS AND
SUPPLY HINGES, LOCKS, PANICS, AND STRIKES TO FIT INTO THESE PREPS.**

END OF SECTION

SECTION 088000 GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glass coatings.

1.02 RELATED REQUIREMENTS

- A. Section 081113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- B. Section 081213 - Hollow Metal Frames: Glazed borrowed lites.
- C. Section 081416 - Flush Wood Doors: Glazed lites in doors.
- D. Section 085113 - Aluminum Windows: Glazing provided by window manufacturer.
- E. Section 085400 - Composite Windows: Glazing provided by window manufacturer.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- D. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- E. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- F. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- G. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2017.
- H. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).
- I. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. AGC Glass North America, Inc; _____: www.agcglass.com/#sle.
 - 2. Pilkington North America Inc; _____: www.pilkington.com/na/#sle.
 - 3. Substitutions: See Section 016000 - 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. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 3. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.

2.04 INSULATING GLASS UNITS

- A. 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. Color: Black.
 5. Purge interpane space with dry air, hermetically sealed.
- B. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: _____, nominal.
 7. Visible Light Transmittance (VLT): _____ percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): _____, nominal.

2.05 GLASS COATINGS

- A. Solar Control Coating: Two-component, metal-oxide nano-particles with 5 percent solids content, minimum.

1. Application: Locations as indicated on drawings.
2. Color: Clear, fade resistant.
3. Dry Film Thickness: 10 microns (0.01 mm), bubble and crack resistant.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

3.02 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.

END OF SECTION

**SECTION 092116
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Acoustic insulation.
- D. Gypsum sheathing.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.
- G. Textured finish system.

1.02 RELATED REQUIREMENTS

- A. Section 054000 - Cold-Formed Metal Framing: Structural steel stud framing.
- B. Section 061000 - Rough Carpentry: Building framing and sheathing.
- C. Section 072100 - Thermal Insulation: Acoustic insulation.
- D. Section 078400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- E. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2018).
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2018.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2018.
- J. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
- K. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2019.
- L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

- M. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- N. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- O. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

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

2.02 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. American Gypsum Company; ____: www.americangypsum.com/#sle.
 - 2. CertainTeed Corporation; ____: www.certainteed.com/#sle.
 - 3. USG Corporation; ____: www.usg.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 3. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - b. Ceilings: 5/8 inch (16 mm).
 - 4. Mold Resistant Paper Faced Products:
- C. Backing Board For Wet Areas: One of the following products:
 - 1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 5/8 inch (____ mm).

2.03 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 4 inch (____ mm).
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
 - 1. Corner Beads: Low profile, for 90 degree outside corners.
 - 2. Architectural Reveal Beads:

- a. Reveal Depth: 5/8 inch (16 mm).
- b. Reveal Width: 1/2 inch (12 mm).
- c. Shapes: As indicated on drawings.
- d. Products:
 - 1) Trim-Tex, Inc; _____: www.trim-tex.com/#sle.
- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- E. Textured Finish Materials: Latex-based compound; plain.
- F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center (at 400 mm on center).
- C. Studs: Space studs at 16 inches on center (at 406 mm on center).
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place continuous bead at perimeter of each layer of gypsum board.

3.04 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

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

- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.06 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 3: Walls to receive textured wall finish.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
 - 2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.

3.07 TEXTURE FINISH

- A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

3.08 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

SECTION 093000 TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Stone thresholds.
- D. Ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 092116 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017.
- B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- K. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- L. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2016).
- M. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
- B. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).
- C. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- D. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2010 (Reaffirmed 2016).
- E. ANSI A136.1 - American National Standard for Organic Adhesives for Installation of Ceramic Tile; 2008 (Reaffirmed 2013).
- F. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- G. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
- H. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Samples:
 - 1. Tile: Full size samples in specified colors and finishes.
 - 2. Grout: Cured samples in specified colors.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 2 percent of each size, color, and surface finish combination.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.
- B. Close rooms or spaces to traffic of all types until mortar and grout has set, according to manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers: All products by the same manufacturer.
 - 1. Dal-Tile Corporation: www.daltile.com/#sle.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Glazed Wall Tile, Type __: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
 - 2. Size: 3 by 6 inch (76 by 152 mm), nominal.
 - 3. Surface Finish: High gloss.

4. Color(s): To be selected by Architect from manufacturer's standard range.
5. Products:
 - a. Dal-Tile Corporation; Dal-Tile Color Wheel Classic: www.daltile.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Porcelain Tile: ANSI A137.1 standard grade.
 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 2. Size: 12x24 inch (____by____ mm), nominal.
 3. Thickness: 3/8 inch (9.5 mm).
 4. Edges: Square.
 5. Color(s): To be selected by Architect from manufacturer's standard range.
 6. Products:
 - a. Dal-Tile Corporation; Industrial Park: www.daltile.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.02 TRIM AND ACCESSORIES

- A. Thresholds: provide transition strips across full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams. Thresholds shall be installed with a maximum height of 1/4".
 1. Material: Marble, honed finish.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
- C. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
- D. Organic Adhesive: ANSI A136.1, thinset mastic type.

2.04 GROUTS

- A. Manufacturers:
 1. Custom Building Products; ____: www.custombuildingproducts.com/#sle.
 2. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
 3. Merkrete, by Parex USA, Inc; Merkrete Duracolor Non-Sanded Color Grout: www.merkrete.com/#sle.
- B. Standard Grout: ANSI A118.6 standard cement grout.
 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
 3. Color(s): As selected by Architect from manufacturer's full line.
 4. Products:
 - a. Custom Building Products; Polyblend Non-Sanded Grout: www.custombuildingproducts.com/#sle.
 - b. LATICRETE International, Inc; LATICRETE 1500 Sanded Grout: www.laticrete.com/#sle.
 - c. Merkrete, by Parex USA, Inc; Merkrete Duracolor Non-Sanded Grout: www.merkrete.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
 - 1. Maximum variation in substrate surface: 1/8 inch in 8 feet for walls, 1/8 inch in 10 feet for floors.
 - 2. Maximum height of abrupt irregularities: 1/32 inch
 - 3. Mortar bed method: Maximum 1/4 inch in 10 feet variation in subfloor surface.
- D. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base, and wall joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles coved and external angles bullnosed.
- F. Install thresholds where indicated. Center thresholds on door or opening.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive. Apply sealant to joints.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.

3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated.
- B. Cleavage Membrane: Lap edges and ends.
- C. Mortar Bed Thickness: 5/8 inch (15.9 mm), unless otherwise indicated.

3.06 INSTALLATION - SHOWERS AND BATHTUB WALLS

- A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. Grout with standard grout as specified above.

3.07 INSTALLATION - WALL TILE

- A. Over cementitious backer units install in accordance with TCNA (HB) Method W223, organic adhesive.

3.08 CLEANING

- A. Clean tile and grout surfaces.

3.09 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 095100 ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 RELATED REQUIREMENTS

- A. Section 072100 - Thermal Insulation: Acoustical insulation.
- B. Section 083100 - Access Doors and Panels: Access panels.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2019.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.

1.05 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc; Ultima Lay-in Tegular: www.armstrongceilings.com/#sle.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Suspension Systems:
 - 1. Armstrong World Industries, Inc; Prelude XL 15/16: www.armstrongceilings.com/#sle.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 ACOUSTICAL UNITS

- A. Acoustical Tiles, Type Ultima Lay-in Tegular: Painted mineral fiber, with the following characteristics:
 - 1. Classification: ASTM E1264 Type III.
 - 2. Size: 24 by 24 inches (610 by 610 mm).
 - 3. Thickness: 5/8 inches (16 mm).
 - 4. Tile Edge: Tegular.
 - a. Joint: Kerfed and rabbeted.
 - 5. Suspension System: Exposed grid.
 - 6. Suspension System: Concealed.
 - 7. Products:
 - a. Armstrong World Industries, Inc; Dune: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 - 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Perimeter Moldings: Same metal and finish as grid.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
- C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- F. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- G. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.

END OF SECTION

**SECTION 096500
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2019, with Editorial Revision (2020).
- B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2025.
- C. ASTM F1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing; 2021a.
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021 (Reapproved 2025).
- E. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2019 (Reapproved 2025).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D. Protect roll materials from damage by storing on end.

1.07 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Vinyl Sheet Flooring - Type ____: Homogeneous without backing, with color and pattern throughout full thickness.
 - 1. Manufacturers:
 - a. Armstrong Flooring; Medintone: www.armstrongflooring.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1913.
 - 3. Thickness: 0.080 inch (2.0 mm) nominal.
 - 4. Sheet Width: 49 inch (1250 mm) minimum.
 - 5. Seams: Heat welded.
 - 6. Integral coved base with cap strip.
 - 7. Color: To be selected by Architect from manufacturer's full range.
- B. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.02 TILE FLOORING

- A. Vinyl Composition Tile - Type ____: Homogeneous, with color extending throughout thickness.
 - 1. Manufacturers:
 - a. Armstrong Flooring; Excelon SDT: www.armstrongflooring.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
 - 3. Size: 12 by 12 inch (305 by 305 mm).
 - 4. Thickness: 0.125 inch (3.2 mm).
 - 5. Color: To be selected by Architect from manufacturer's full range.

2.03 RESILIENT BASE

- A. Resilient Base - Type ____: ASTM F1861, Type TP, rubber, thermoplastic; style as scheduled.
 - 1. Manufacturers:
 - a. Tarkett Flooring: www.tarkett.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 2. Height: 4 inches (100 mm).
 - 3. Thickness: 0.125 inch (3.2 mm).
 - 4. Finish: Satin.
 - 5. Color: To be selected by Architect from manufacturer's full range.

2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Adhesive for Vinyl Flooring:
 - 1. Manufacturers:
 - a. Stauf USA, LLC; D737 High-Tack: www.staufusa.com/#sle.
 - b. Substitutions: Section 016000 - Product Requirements.
- D. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is fully cured.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Seal seams by heat welding where indicated.
- C. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.05 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.06 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

END OF SECTION

**SECTION 096700
FLUID-APPLIED FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. 2-Part layer Fluid-applied Epoxy flooring system.

1.02 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 079200 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- C. Manufacturer's Installation Instructions: Indicate special procedures.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section.

1.06 MOCK-UP

- A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
 - 1. Number of Mock-Ups to be Prepared: One.
 - 2. Use same materials and methods for use in the work.
 - 3. Locate where directed.
 - 4. Minimum Size: 48 inches by 48 inches (1220 mm by 1220 mm).

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.08 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F (13 degrees C).
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fluid-Applied Flooring:

1. Sherwin-Williams Company; Armorseal 100% Solids Epoxy: www.protective.sherwin-williams.com/#sle.
2. Armorpoxy: www.armorpoxy.com.
3. Substitutions: See Section 016000 - Product Requirements.

2.02 FLUID-APPLIED FLOORING SYSTEMS

- A. Fluid-Applied Flooring: 2-Part Epoxy base coat(s), high performance top coat
 1. System Thickness: See manufacturer specifications.
 2. Texture: Smooth.
 3. Top Coat: Polyurethane.
 4. Sheen: High gloss.
 5. Color: As selected by Architect.
 6. Basis of Design Product: ArmorPoxy II: Standard VOC 2-Layer Epoxy System.
 - a. Primer: ARM144X Armorpoxy II -STD VOCPrimer
 - b. TopCoat: ARM321X Armorultra High Performance Topcoat
 7. Products:
 - a. ArmorPoxy II 2-Part Epoxy System Armorpoxy: www.armorpoxy.com.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Fluid-Applied Flooring: 2-Part Epoxy base coat(s), high performance top coat(s), with Non-skid additive.
 1. Top Coat: Polyurethane.
 2. Texture: Slip resistant.
 3. Sheen: High gloss.
 4. Color: As selected by Architect.
 5. Basis of Design Product: ArmorPoxy II, 2-Part Epoxy base coat(s), ArmorUltra High Performance Topcoat, UltraWear Non-Skid Additive top coat.
 6. Location: Rooms to have Non-Skid addtiive texture:
 - a. Powder Printers 101
 - b. Metal Printing 102
 - c. Storage Room 105
 7. Products:
 - a. ArmorPoxy II 2-Part Epoxy System Armorpoxy: www.armorpoxy.com..
 - b. Substitutions: See Section 016000 - Product Requirements.

2.03 ACCESSORIES

- A. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- B. Primer: Type recommended by fluid-applied flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.
- C. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by flooring materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.

- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.

3.03 INSTALLATION - FLOORING

- A. Apply in accordance with manufacturer's instructions.
- B. Apply each coat to minimum thickness indicated.
- C. Finish to smooth level surface.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

3.05 PROTECTION

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Barricade area to protect flooring until fully cured.

END OF SECTION

SECTION 096813 TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, loose laid with edges and control grid adhered.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2019, with Editorial Revision (2020).
- C. CRI 104 - Standard for Installation of Commercial Carpet; 2018.

1.04 SUBMITTALS

- A. See Section 013000 - 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. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Interface, Inc: www.interface.com/#sle.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Tile Carpeting: Tufted, manufactured in one color dye lot.
 - 1. Product: Open Air Stria Collection manufactured by Interface Flor.
 - 2. Tile Size: 18 by 18 inch (450 by 450 mm), nominal. (50cmX50cm)
 - 3. Color: As selected by Architect from full range of standard color options (two color selections).
 - 4. Pattern: Open Air Stria install non-directional.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, _____ color.
- C. 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 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 alternating to next unit, set parallel to building lines.
- F. Trim carpet tile neatly at walls and around interruptions.
- G. Complete installation of edge strips, concealing exposed edges.

3.03 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 099100 PAINTING

PART 1.GENERAL

1.01 RELATED DOCUMENTS

- A. The Drawings, General Provisions including General Conditions, Supplementary General Conditions and Division 1 - General Requirements apply to the work of this Section.

1.02 WORK INCLUDED

- A. Surface preparation.
- B. Surface finish schedule.

1.03 RELATED WORK

- A. Section 04200 - Unit Masonry.
- B. Section 05210 - Steel Joists: Shop Preparation and Priming of Joists.
- C. Section 05310 - Steel Deck: Shop Preparation and Priming of Steel Deck.
- D. Section 05500 - Metal Fabrication.
- E. Section 08111 - Steel Doors and Frames.

1.04 REFERENCES

- A. ANSI/ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.
- C. ASTM D1546 - Method for Performance Tests of Clear Floor Sealers.

1.05 DEFINITIONS

- A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

1.06 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with five years experience.
- B. Applicator: Company specializing in commercial painting and finishing with three years documented experience.

1.07 SUBMITTALS

- A. Provide product data on all finishing products.
- B. Submit samples under provisions of Section 01 3000 - Submittals.
- C. Submit two samples 6 x 6 inch in size illustrating range of colors and textures available for each surface-finishing product scheduled, after color selection.
- D. Submit manufacturer's application instructions under provisions of Section 01 3000 - Submittals.

1.08 FIELD SAMPLES

- A. Provide one field sample panel, 12 inches long by 12 inches wide, illustrating special texture and finish.
- B. Accepted sample may not remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site according to manufacturer's recommendations.
- B. Store and protect products according to manufacturer's recommendations.
- C. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.

- D. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- E. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in well ventilated area, unless required otherwise by manufacturer's instructions.
- F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 55 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 55 degrees F for interiors; 65 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 50 ft candles measured mid-height at substrate surface.

1.11 EXTRA STOCK - PAINT & COATINGS.

- A. Provide a one gallon container of each color and surface texture to Owner.
- B. Label each container with color, texture, and room locations in addition to the manufacturer's label.

PART 2.PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - PAINT AND COATINGS

- A. Kwal Paint, Inc. (PPI Inc.)
- B. Dunn-Edwards, Inc.
- C. Sherwin-Williams Company.

2.02 ACCEPTABLE MANUFACTURERS - CONCRETE SEALERS

- A. OKON Water Repellant Sealers, with grey tint.

2.03 SUBSTITUTIONS

- A. Architect/Engineer will consider requests for substitutions only within 30 days after date established in Notice to Proceed.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that the Bidder:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the Substitution as for the specified product.
 - 3. Waives claims for additional costs or time extension, which may subsequently become apparent.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

- F. Substitution Submittal Procedure:
 - 1. Submit four copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
- G. The Architect/Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 3.EXECUTION

3.01 INSPECTION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished before commencement of work. Report any condition that may potentially affect proper application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
- D. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
- E. Interior Located Wood: 15 percent, measured in accordance with ASTM D2016.
- F. Beginning of installation means acceptance of existing surfaces.

3.02 PREPARATION - PAINT & COATINGS

- A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- B. Correct minor defects and clean surfaces which affect work of this Section.
- C. Shellac and seal, marks that may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- F. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint or Coating Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter (power-wash). Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are to be similarly cleaned. Spot prime paint after repairs.
- H. Shop Primed Steel 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. Prime metal items including shop primed items.
- I. Metal or Wood Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.03 PREPARATION - CONCRETE SEALER

- A. Only apply to dry concrete surface on dry days.
- B. Do not thin the sealer.

3.04 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.

- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.05 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than proceeding coat unless otherwise approved.
- E. Sand lightly between coats to achieve required finish.
- F. Allow applied coat to dry before next coat is applied.
- G. Spray applied primer on gypsum board must be back rolled.

3.06 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Section 23 and Section 26 for schedule of color-coding and identification banding of equipment, ductwork, piping, and conduit. If there is no such information, paint all exposed surfaces the same color and finish as the adjacent wall or ceiling structure color and finish.
- B. Paint shop primed equipment.
- C. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, bracket, collars and supports, and except where items are prefinished.
- D. Replace identification markings on mechanical or electrical equipment when painted accidentally.
- E. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, and grilles, to match face panels.
- F. Paint exposed conduit and electrical equipment occurring in finished areas.
- G. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
- H. Color code equipment, piping, conduit, and exposed ductwork in accordance with requirements indicated. Color band and identify as required.
- I. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.07 CLEANING

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work, maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material, which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.08 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

- A. Metal Fabrication (05 5000): Exposed surfaces of the metal doorframe for overhead coiling doors and miscellaneous steel items.
- B. Section Steel Doors and Frames (08 1100): Exposed surfaces of hollow metal doors and frames.

3.09 SCHEDULE - OF PAINTING AND COATINGS

- A. EXTERIOR PAINT SCHEDULE
 - 1. Utilize neutral base paint where required by darker paint color selections.

2. Concrete Unit Masonry; Two finish coats of a Flat exterior 100% Acrylic Latex over a Block Filler.
 - a. Block Filler; Kwal 5940 Accu-Guard 100% Acrylic Block Filler.
 - 1) D/E W305 Blocfil 100% Acrylic Block filler.
 - 2) S/W PrepRite Interior/Exterior Block Filler B25W25
 - b. 2. Finish Coats; Kwal 6300 Accu-Pro 100% Acrylic Flat Finish.
 - 1) D/E W704 Acri-Flat Exterior Flat Latex.
 - 2) S/W A-100 Exterior Latex Flat House & Trim Paint A6 Series.
3. Exterior Gypsum Soffit Board; Two finish coats of a Flat 100% Acrylic Latex over an Exterior Primer.
 - a. Primer; Kwal 5862 Embassy WB E-Z Sand 100% Acrylic Primer.
 - 1) D/E W708 E-Z Prime 100% Acrylic Primer.
 - 2) S/W A-100 Exterior Latex Wood Primer B42W41
 - b. 2. Finish Coats; Kwal 6300 Accu-Pro 100% Acrylic Flat Finish.
 - 1) D/E W704 Acri-Flat Exterior Flat Latex.
 - 2) S/W A-100 Exterior Latex Flat House & Trim Paint A6 Series.
4. Wood, Trim and Siding; Two finish coats of a Gloss 100% Acrylic Latex over an Exterior Wood Primer.
 - a. Primer; Kwal 5862 Embassy WB E-Z Sand 100% Acrylic Primer.
 - 1) D/E W708 E-Z Prime 100% Acrylic Primer.
 - 2) S/W A-100 Exterior Latex Wood Primer B42W41.
 - b. Finish Coats; Kwal 8400 Ambassador 100% Acrylic Gloss Block Resistant Enamel.
 - 1) D/E W960 Premagloss 100% Acrylic Gloss Enamel.
 - 2) S/W SuperPaint Exterior High Gloss Latex Enamel A85 Series
5. Exterior Ferrous Metal: Two Finish Coats Of Gloss Alkyd Enamel Over A Factory Formulated Rust Inhibiting Metal Primer.
 - a. Prime Coat: Kwal 35 Series Alkyd Metal Primer.
 - 1) D/E 43-5 Corrobar Primer.
 - 2) S/W kem Kromik Universal metal Primer.
 - b. Finish Coats: Kwal 31 Line Urethane/Alkyd Gloss Enamel.
 - 1) D/E 10 series Synlusto Alkyd Gloss Enamel.
 - 2) S/W B-54 Industrial Enamel.
6. Exterior Non-Ferrous Metal: Two Finish Coats Of Gloss 100% Acrylic Enamel Over A Factory Formulated Galvanized/Aluminum Primer.
 - a. Prime Coat: Kwal 5810 G-Prime Premium 100% Acrylic Universal Primer.
 - 1) D/E W715 Ultra Grip Primer.
 - 2) S/W B50WZ3 Galvite HS Paint.
 - b. Finish Coats: Kwal 8300 W.B. DTM Gloss Enamel.
 - 1) D/E W960 Permagloss 100% Acrylic Gloss Enamel.
 - 2) S/W B66W100 Series DTM Gloss acrylic Coating.

B. INTERIOR PAINT SCHEDULE

1. Utilize neutral base paint where required by darker paint color selections.
2. Concrete Unit Masonry; Two finish coats of a Low-Luster Acrylic Latex over a Block Filler.
 - a. Block Filler; Kwal 5940 Accu-Guard 100% Acrylic Block Filler.
 - 1) D/E W305 Blocfil 100% Acrylic Block filler.
 - 2) S/W PrepRite Interior/Exterior Block Filler B25W25
 - b. 2. Finish Coats; Kwal 1900 Series Pro-Finish Latex Satin Enamel Finish.
 - 1) D/E W7400 Spartashell Acrylic Enamel.
 - 2) S/W ProMar 200 Interior Latex Eggshell Enamel B20W200 Series.
3. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces.

- a. Provide Interior drywall Basecoat Prior to application of decorative Texture (see Section 092116 - Gypsum Board Systems).
- b. Basecoat: Kwal Paint; 0873 QUICK PREP drywall basecoat (Back rolling recommended). Applied at a wet mil thickness of not less than 5.7 mils.
- c. Low-Luster Acrylic-Enamel Finish: Two finish coats.
- d. Primer: Kwal 0800 Accu-Tone Hi-Hide PDQ Sealer
 - 1) D/E W101 Vinylastic Water base Sealer.
 - 2) S/W PrepRite 200 Latex Wall Primer B28W200 Series
- e. Finish Coats: Kwal 1910 series Pro-Finish Latex satin Enamel.
 - 1) D/E W7400 Spartashell Acrylic Enamel.
 - 2) S/W ProMar 200 Interior Latex Eggshell Enamel B20W200 Series.
- 4. Wood Opaque; Two finish Coats of Semi-Gloss Alkyd Enamel over a Wood Primer.
 - a. Primer; Kwal 0890 Accu-Pro Sandable Primer.
 - 1) D/E W707 UniKote acrylic Enamel Undercoater.
 - 2) S/W PrepRite Wall and Wood Primer B49W200 Series.
 - b. Finish Coats; Kwal 4600 Accu-Pro Alkyd Semi-Gloss.
 - 1) D/E 9 Synlusto Alkyd Semi-Gloss Enamel.
 - 2) S/W ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200 Series.
- 5. Ferrous Metal, Doors and HMF; Two finish Coats of Semi-Gloss Alkyd Enamel over a Metal Primer.
 - a. Primer; Kwal 9210 Accu-Pro Rust Inhibitive Primer.
 - 1) D/E 43-5 Corrobar Primer.
 - 2) S/W Kem Kromik Universal Metal Primer B50NZ6/B50WZ1.
 - b. Finish Coats; Kwal 4600 Accu-Pro Alkyd Semi-Gloss.
 - 1) D/E 9 Synlusto Alkyd Semi-Gloss Enamel.
 - 2) S/W ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200 Series.
- 6. Wood Stained or natural; Two Finish Coats of a clear Satin Alkyd Varnish over a stain.
 - a. Note: All wood doors to be pre-finished.
 - b. Stain; Kwal 8709 Woodkraft Semi-Transparent Stain.
 - 1) D/E V109 Stainseal II
 - 2) S/W Wood Classics Interior Oil Stain A-48 Series.
 - c. Finish Coats; Kwal 4039 Woodkraft Satin Varnish.
 - 1) D/E 6700 Series McClosky Heirloom Varnish.
 - 2) S/W Wood Classics Fast Dry Oil Varnish, Satin A66-300 Series.
- 7. Interior Concrete Floor Sealer: One Coat of Low Gloss Clear Coating (water based) Follow Manufacturers Recommendation for Floor Preparation.
 - a. Seal Coat: OKON Seal & Finish. Applied at 300 to 400 Square Foot per Gallon.

3.10 SCHEDULE - SURFACES TO BE PAINTED

- A. Refer to the Finish Schedule on the Drawings.

END OF SECTION

SECTION 101400 SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door signs.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Manufacturer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs:
 - 1. Best Sign Systems, Inc; ____: www.bestsigns.com/#sle.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 _____, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 - 3. Character Height: 1 inch (25 mm).
 - 4. Sign Height: 2 inches (50 mm), unless otherwise indicated.
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 - 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.
 - 1. Edges: Square.
 - 2. Corners: Square.
 - 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: as selected by Architect from full range of standard colors.
 - 4. Character Color: as selected by Architect color.

2.04 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
 - 1. Total Thickness: 1/16 inch (1.6 mm).

2.05 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

**SECTION 102113.13
METAL TOILET COMPARTMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal toilet compartments.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Blocking and supports.

1.03 REFERENCE STANDARDS

- A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall, floor, and ceiling supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Toilet Compartments:
 - 1. All American Metal Corp - AAMCO; _____: www.allamericanmetal.com/#sle.
 - 2. ASI Accurate Partitions; Powder Coated Steel: www.asi-accuratepartitions.com/#sle.
 - 3. ASI Global Partitions; Powder Coated Steel: www.asi-globalpartitions.com/#sle.
 - 4. Substitutions: Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Stainless Steel Sheet: ASTM A666/A666M, Type 304.

2.03 COMPONENTS

- A. Toilet Compartments: Stainless steel, floor-mounted headrail-braced.
- B. Doors, Panels, and Pilasters: Sheet steel faces, pressure bonded to sound deadening core, formed and closed edges; corners made with corner clips or mitered, welded, and ground smooth.
 - 1. Panel Faces: 20 gauge, 0.0359 inch (0.91 mm).
 - 2. Door Faces: 22 gauge, 0.0299 inch (0.76 mm).
 - 3. Pilaster Faces: 20 gauge, 0.0359 inch (0.91 mm).
 - 4. Reinforcement: 12 gauge, 0.1046 inch (2.66 mm).
- C. Door and Panel Dimensions:
 - 1. Thickness: 1 inch (25 mm).
 - 2. Door Width for Handicapped Use: 36 inch (915 mm) , out-swinging.
 - 3. Height: 58 inch (1473 mm).
- D. Pilasters: 1-1/4 inch (32 mm) thick, of sizes required to suit compartment width and spacing.
- E. Urinal Screens: Wall mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and ceiling.
- F. Urinal Screen Splash Panels: Stainless steel sheet 30 inch (76 mm) wide by 42 inch (1,066 mm) high mounted on partitions adjacent to urinals. Fasten with stainless steel screws spaced 8 inches (20 mm) on center.

2.04 ACCESSORIES

- A. Pilaster Shoes: Formed chromed steel with polished finish, 3 inch (175 mm) high, concealing floor fastenings.
- B. Head Rails: Hollow chrome-plated steel tube, 1 by 1-5/8 inch (25 by 41 mm) size, with anti-grip strips and cast socket wall brackets.
- C. Brackets: Polished chrome-plated non-ferrous cast metal.
- D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
- E. Hardware: Polished chrome plated non-ferrous cast metal:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Thumb turn or sliding door latch with exterior emergency access feature.
 - 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 5. Provide door pull for outswinging doors.

2.05 FINISHING

- A. Stainless Steel Compartments: No. 4 finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch (9 to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.02 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 102800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Under-lavatory pipe supply covers.
- C. Utility room accessories.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- C. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. American Specialties, Inc; ____: www.americanspecialties.com/#sle.
 - 2. Bradley Corporation; ____: www.bradleycorp.com/#sle.
 - 3. Substitutions: Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666/A666M, Type 304.
- D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- E. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel, spindleless type for tension spring delivery designed to prevent theft of tissue roll.
 - 1. Products:
- B. Paper Towel Dispenser: Folded paper type, stainless steel, semi-recessed, with viewing slots on sides as refill indicator and tumbler lock.
 - 1. Capacity: 300 C-fold minimum.
- C. Waste Receptacle: Stainless steel, freestanding style with swing top.
 - 1. Minimum capacity: 10 gallons (38 liters).

- D. Automated Soap Dispenser: Liquid soap dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, tumbler lock.
- E. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
 - 1. Size: as indicated on drawings.
 - 2. Frame: .5 inch (___ mm) angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
- F. Grab Bars: Stainless steel, smooth surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
 - b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
- G. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

2.05 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:
 - 1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
 - 2. Color: White.
 - 3. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.

2.06 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, hat-shaped channel.
 - 1. Holders: Three spring-loaded rubber cam holders.
 - 2. Length: Manufacturer's standard length for number of holders.
 - 3. Products:
 - a. American Specialties, Inc; ____: www.americanspecialties.com/#sle.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 - 1. Grab Bars: As indicated on drawings.

END OF SECTION

**SECTION 104400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 099123 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2017, with Errata (2018).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com/#sle.
 - 2. Larsen's Manufacturing.
 - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: www.activarcpg.com/#sle.
 - 2. Larsen's Manufacturing Co; _____: www.larsensmfg.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. Size: 10 pound (4.54 kg).
 - 3. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to ____ degrees F (____ degrees C).
- C. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
 - 1. Class: K type.
 - 2. Size: 1.6 gallons (6 L).
 - 3. Temperature range: Minus 20 degrees F (Minus 29 degrees C) to 120 degrees F (49 degrees C).

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Fire Rated Cabinet Construction: One-hour fire rated.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 INSTALLATION

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

END OF SECTION

SECTION 105617
WALL MOUNTED STANDARDS AND SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Steel shelf standards, brackets, and accessories.
- B. Steel shelf support brackets.
- C. Shelves.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking in walls for attachment of standards.
- B. Section 092116 - Gypsum Board Assemblies: Blocking in wood stud walls for attachment of standards.

1.03 REFERENCE STANDARDS

- A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products under cover and elevated above grade.
- B. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Aluminum Shelf Standards, Brackets, and Accessories:
 - 1. Rakks/Rangine Corporation; _____: www.rakks.com/#sle.
- B. Steel Shelf Support Brackets:

2.02 COMPONENTS

- A. Steel Shelf Standards, Brackets, and Accessories:
 - 1. Regular-Duty Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - a. Load Capacity: Recommended by manufacturer for loading of 120 to 320 pounds (55 to 145 kg) per pair of standards.
 - b. Finish: Electroplated, chrome-look.
 - c. Bracket Quantity: Provide one bracket for each 12 inches (305 mm) of standard length.
- B. Shelving:
 - 1. Laminate Faced Shelves: Particleboard or medium density fiberboard covered with high pressure decorative laminate on both sides.
 - a. Edge Finish: Matching laminate, all four edges.
 - b. Substrate Thickness: 3/4 inch (19 mm), nominal.
 - c. Laminate: NEMA LD 3 Type HGL.
 - d. Laminate Color and Pattern: To be selected by Architect from manufacturer's full line.

- C. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount standards or brackets to solid backing capable of supporting intended loads.
- C. Install brackets, shelving, and accessories.

END OF SECTION

**SECTION 105723
CLOSET AND UTILITY SHELVING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Laminated wood storage systems.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Blocking in walls for attachment of shelving or storage system.
- B. Section 092116 - Gypsum Board Assemblies: Blocking in wood stud walls for attachment of standards or mounting rails.

1.03 REFERENCE STANDARDS

- A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, with installation instructions.
- C. Shop Drawings: Provide drawings prepared specifically for this project; show dimensions of shelving or storage system and attachment to substrates.
- D. Selection Samples: For each color selection required, submit color chips representing manufacturer's full range of available colors and finish.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.
- C. Store flat to prevent warpage and bending.

PART 2 PRODUCTS

2.01 LAMINATED WOOD STORAGE SYSTEMS

- A. Applications:
 - 1. Closet Storage System: Wall-mounted thermally fused laminate clad vertical panels with attached components and accessories, as indicated on drawings.
- B. Laminated Storage Components:
 - 1. Edge Finish: Hot-melt PVC edge banding, matching color.
 - 2. Substrate Thickness: 3/4 inch (19 mm), nominal.
 - 3. Color: White.
- C. Cabinet Doors: Sizes and configurations indicated on drawings.
 - 1. Particle board, thermally fused laminate finish.
 - 2. Color/Pattern: as selected by Architect.
- D. Drawers: Sizes and configurations indicated on drawings.
 - 1. Drawer Front: To match cabinet doors in style, material, and finish.
 - 2. Interior Finish: Manufacturer's standard.
- E. Cabinet Hardware: As selected from manufacturer's standard types, styles and finishes.
 - 1. Drawer and Cabinet Pulls: _____.
 - 2. Hinges: Manufacturer's standard self-closing concealed hinges.
 - 3. Drawer Slides: Manufacturer's standard full extension drawer slides.

- F. Mounting Hardware for Laminated Wood Storage System: Provide manufacturer's standard mounting rail, mounting fasteners, shelf hardware, full extension drawer glides, hanging rod assembly, and other accessories for a complete installation of the storage system.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install laminated wood storage system in accordance with drawings. Position units level, plumb, and at proper location relative to adjoining units and related work.
- B. Install wire shelving in accordance with manufacturer's instructions, with shelf surfaces level.
- C. Cap exposed ends of cut wire shelving.
- D. Install wire shelving back clips, end clips at side walls, and support braces at open ends. Install intermediate support braces as recommended by manufacturer.

3.02 CLEANING

- A. Clean soiled surfaces after installation.

3.03 PROTECTION

- A. Protect installed work from damage.
- B. Touch-up, repair, or replace damaged products before Substantial Completion in a manner that eliminates evidence of replacement.

END OF SECTION

**SECTION 123200
MANUFACTURED WOOD CASEWORK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured standard and custom casework, with cabinet hardware.
- B. Countertops.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Blocking and nailers for anchoring casework.
- B. Section 079200 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 4.0; 2021.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Component dimensions, configurations, construction details, joint details, attachments.
- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.
- D. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches (51 mm by 75 mm).
 - 1. Plastic laminate samples, for color, texture, and finish selection.
- E. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- F. Finish touch-up kit for each type and color of materials provided.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:
 - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
 - 1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

PART 2 PRODUCTS

2.01 CASEWORK, GENERAL

- A. Quality Standard: AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom Grade.

2.02 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Construction: As required for selected grade.
- C. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- D. Apron Frames: Construction similar to other cabinets, with modifications.

2.03 PLASTIC-LAMINATE-CLAD CASEWORK

- A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
 - 1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
 - 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
 - a. Base Cabinets: 22 inches (559 mm).
 - b. Tall Cabinets: 22 inches (559 mm).
 - c. Wall Cabinets: 16 inches (406 mm).
 - 3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
 - a. Finish: Matte or suede, gloss rating of 5 to 20.
 - b. Surface Color and Pattern: As selected by Architect from manufacturer's full line.

2.04 COUNTERTOPS

- A. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade, unless otherwise noted.
- B. Plastic Laminate Countertops: High pressure decorative laminate sheet bonded to substrate.
 - 1. Custom configuration for exposed edges, back and end splashes, with details indicated on drawings.
- C. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
 - 1. Manufacturer's standard configuration for exposed edges, back and end splashes.
 - 2. Fabricate in accordance with manufacturer's standard requirements.

2.05 CABINET HARDWARE

- A. Manufacturer's standard types, styles and finishes.
- B. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.
 - 1. Hinged Doors: Cam type lock, bright chromium plated over nickel on base material.
- C. Shelves in Cabinets:
 - 1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- D. Swinging Doors: Hinges, pulls, and catches.
 - 1. Hinges: Visible, number as required by referenced standards for width, height, and weight of door.
 - a. Visible Hinges: Installed on framed cabinet face, and on door face, bright chromium plated over nickel on base material.
 - 2. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
 - 3. Catches: Magnetic.

- E. Drawers: Pulls and slides.
 - 1. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
 - 2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

2.06 MATERIALS

- A. Wood-Based Materials:
 - 1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.

2.07 ACCESSORIES

- A. Concealed Joint Fasteners: Corrosion-resistant, standard with manufacturer.
- B. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.
- C. Sealant for Use in Casework Installation:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Environmental Conditions:
 - 1. Do not deliver casework until the following conditions have been met:
 - a. Building has been enclosed (windows and doors sealed and weather-tight).
 - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
 - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
 - d. Installation areas do not require further "wet work" construction.
- B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch (13 mm) leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
- C. Verify adequacy of support framing and anchors.
- D. Verify that service connections are correctly located and of proper characteristics.

3.02 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch (1.6 mm). In addition, do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch (1.6 mm) in 10 feet (3 m).
 - 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch (3 mm) in 10 feet (3 m).
 - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
 - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.6 mm).

- F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches (407 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- G. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches (407 mm) on center.
- H. Install hardware uniformly and precisely.
- I. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- J. Replace units that are damaged, including those that have damaged finishes.

3.03 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.04 CLEANING

- A. Clean casework and other installed surfaces thoroughly.

END OF SECTION

SECTION 123600 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.
- C. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

- A. Section 064100 - Architectural Wood Casework.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2016.
- B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2018.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- D. PS 1 - Structural Plywood; 2009 (Revised 2019).
- E. SEFA 2 - Installations; 2010.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- C. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
 - 1. Laminate Sheet, Type ____: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
 - a. Manufacturers:
 - 1) Formica Corporation; ____: www.formica.com/#sle.
 - 2) Wilsonart; ____: www.wilsonart.com/#sle.
 - 3) Substitutions: See Section 016000 - Product Requirements.
 - b. Finish: Matte or suede, gloss rating of 5 to 20.
 - c. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.
 - 2. Back and End Splashes: Same material, same construction.
- B. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
 - 1. Flat Surface Thickness: 1 inch (25 mm), nominal.

2. Flammability: Self-extinguishing, when tested in accordance with ASTM D635.
3. Surface Finish: Smooth, non-glare.
4. Color: Black.
5. Back and End Splashes: Same material, same thickness; separate for field attachment.

2.02 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- D. Joint Sealant: Mildew-resistant silicone sealant, color to match laminate.

2.03 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 (25 mm) 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. Height: 4 inches (102 mm), unless otherwise indicated.
- C. 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.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 INSTALLATION

- A. Install laboratory worksurface countertops in compliance with requirements of SEFA 2.
- B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- C. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- D. Attach epoxy resin countertops using compatible adhesive.
- E. Seal joint between back/end splashes and vertical surfaces.

END OF SECTION

**SECTION 133413
GLAZED STRUCTURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Greenhouses.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete for foundations, slabs, and equipment pads.
- B. Section 076200 - Sheet Metal Flashing and Trim: Base and sill flashing installation.
- C. Section 079200 - Joint Sealants: Sealing joints between glazed structures and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- E. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
- F. 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 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets for each product to be used.
- C. Shop Drawings: Include project-specific information not fully detailed in manufacturer's standard product data, including, but not limited to plans, elevations, and details.
- D. Samples:
 - 1. Metal Finish Selection: Two for color selection of framing members, representing manufacturer's standard range.
 - 2. Glazing: Two of each type. (Polycarbonate Glazing)
 - a. Minimum Sample Size: 12 inches by 12 inches (305 mm by 305 mm).
- E. Design Documents:
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 016000 - Product Requirements for additional provisions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in manufacturer's original packaging with manufacturer's name and product identification intact and legible.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

- B. Correct defective work within five year period after Date of Substantial Completion.
- C. Provide extended warranty period for the following components:
 - 1. Glazing: Provide glazing manufacturer's standard warranty against defective materials, delamination, seal failure, and other defects in manufacturing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Greenhouses:
 - 1. GGS Structures, Inc; ____: www.ggs-greenhouse.com/#sle.
 - 2. Florian Solar Products, LLC; www.floriangreenhouse.com/#sle..
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 GLAZED STRUCTURE APPLICATIONS

- A. Installation: Attached to side of existing structure as extension.
- B. Greenhouse:
 - 1. Roof Shape: Gable, straight eave, single-bay.
 - a. Roof Slope: As indicated on drawings.
 - 2. Framing: Mill-finish aluminum.
 - 3. Wall System: Mill-finish aluminum framing with glazing type P-1 - multiwall polycarbonate sheet.
 - 4. Roof System: Mill-finish aluminum framing with glazing type P-1 - multiwall polycarbonate sheet.
 - 5. Layout and Dimensions: As indicated on drawings.

2.03 DESIGN CRITERIA

- A. Design structural framing that is capable of transferring moments and forces into foundations. Framing members to be considered include rafters, purlins, and vertical mullions. Use design loads stipulated by applicable building code requirements.

2.04 PERFORMANCE CRITERIA

- A. Greenhouse Glazing:
 - 1. Air and Water Leakage: Leakage measured at differential test pressure amounting to 20 percent of specified strength performance pressure required with operable windows, doors, or joints (if any) sealed during testing procedure.
 - 2. Structural Performance: No glazing material breakage or permanent damage to fasteners, anchors, hardware, or actuating mechanisms, when tested in accordance with ASTM E330/E330M.
 - a. Design Pressure (DP): In accordance with applicable codes.
 - b. Normal Wall Deflection Limit: Not to exceed 1/175 of clear span for span lengths of 13 feet 6 inches (4115 mm) or less and 1/240 plus 1/4 inch (6.35 mm) for others.
 - c. Concentrated Load: Design to withstand 250 lb (114 kg) concentrated load at any location on framing members without permanent set.

2.05 COMPONENTS

- A. Framing System: Manufacturer's standard for indicated roof shape and bay width, using mill-finish aluminum for primary and secondary structural members.
- B. Glazing Systems: Pressure glazing bar system.
 - 1. Monolithic Glazing: Single sheet or pane of material.
 - a. Type P-1 - Multiwall Polycarbonate Sheet: Ultraviolet (UV) protected.
 - 1) Applications: As indicated on drawings.
 - 2) Type: Cellular (multiwall structure) sheet.
 - 3) Tint: Clear.
 - 4) Multiwall Thickness: 3/8 inch double-wall (10 mm double-wall) overall.

- 5) Width: 48 inches (1219 mm).
- 6) Light Transmittance (LT): 80 percent, nominal.
- C. Flashings and Closures: Manufacturer's standard for specified system.

2.06 MATERIALS

- A. Aluminum Extrusions: Alloy and temper 6063-T5, 6063-T6, or 6061-T6 members complying with ASTM B221 (ASTM B221M), with minimum thickness 1/8 inch (3.2 mm) for structural members and 1/16 inch (1.6 mm) for nonstructural members.
- B. Flashings: Metal and finish matching system framing components, with thickness as recommended by manufacturer for conditions encountered.
- C. Glazing Setting Blocks, Edge Blocks, and Spacers: Manufacturer's standard, compatible with glazing type.
- D. Weatherseal Sealant: Silicone, with adhesion complying with ASTM C794; compatible with glazing accessories.
- E. Anchors and Fasteners: Recommended by manufacturer.

2.07 FABRICATION

- A. Perform major fabrication tasks at manufacturing location and not on site.
- B. Fabricate components to allow for expansion and contraction with minimum clearance and shim spacing around perimeter of assembly.
- C. Drain to exterior any water entering exterior joints, condensation occurring in glazing channels, or migrating moisture occurring within system.

2.08 FINISHES

- A. Aluminum Finishes:
 - 1. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick; exterior surfaces only.
 - 2. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system; interior surfaces only.
 - 3. Color: as selected by Architect from full range of standard options.

PART 3 EXECUTION

3.01 PREPARATION

- A. Inspect work related and/or adjacent to glazed structure construction.
- B. Do not begin installation until substrates have been properly prepared in compliance with drawings and approved by glazed structure manufacturer.

3.02 GLAZED STRUCTURE AND ENVELOPE INSTALLATION

- A. Install in accordance with shop drawings and manufacturer's instruction and installation manual(s).
- B. Provide attachments and shims to permanently fasten system to building structure.
- C. Maintain dimensional tolerances and alignment with adjacent work.
- D. Anchor securely in place, allowing for required movement, including expansion and contraction.
- E. Install glazing sealants, including surface preparation in accordance with manufacturer's instructions and best industry practices.
- F. Install base flashings in accordance with Section 076200.
- G. Set sill members in bed of sealant. Set other members with internal sealants to provide weather tight construction.

- H. Install flashings, bent metal closures, corners, gutters, and other accessories as required or detailed.
- I. Touch up damaged finishes so repair is imperceptible from distance of 6 feet (1.8 m), and remove and replace components that cannot be acceptably touched up.

3.03 ADJUSTING AND CLEANING

- A. Remove temporary coverings and means of protection of adjacent work areas.
- B. Repair or replace damaged installed products.
- C. Clean abraded finish surfaces and touch up with air dry paint, using means and methods approved and furnished by manufacturer, in color matching factory-applied finishes.

3.04 PROTECTION

- A. Touch-up, repair, or replace damaged products before Date of Substantial Completion.
- B. Protect installed products until completion of project.

END OF SECTION

SECTION 22 05 16
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

- A. Section 21 05 00 - Common Work Results for Fire Suppression.
- B. Section 22 10 05 - Plumbing Piping.

1.03 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- B. EJMA (STDS) - EJMA Standards; Eleventh Edition.
- C. FM (AG) - FM Approval Guide; Current Edition.
- D. ITS (DIR) - Directory of Listed Products; Current Edition.
- E. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- D. Maintenance Data: Include adjustment instructions.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Manufacturers:

1. Flex-Weld, Inc: www.kelcoind.com/#sle.
2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
3. The Metraflex Company: www.metraflex.com/#sle.
4. Unisource Manufacturing, Inc; Series 401, Stainless Steel Threaded Connectors: www.unisource-mfg.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Inner Hose: Stainless steel.

C. Exterior Sleeve: Single braided, stainless steel.

D. Pressure Rating: 125 psi up to 12 inch (862 kPa up to 300 mm, DN).

E. Maximum Service Temperature: 450 degrees F (232 degrees C).

F. End Connections: Threaded.

G. Size: Use pipe sized units.

H. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.

2.03 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Manufacturers:

1. Flex-Weld, Inc: www.kelcoind.com/#sle.
2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
3. The Metraflex Company: www.metraflex.com/#sle.
4. Unisource Manufacturing, Inc; Series 411, Bronze Braided Flex Connectors: www.unisource-mfg.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Inner Hose: Bronze.

C. Exterior Sleeve: Braided bronze.

D. Pressure Rating: 250 psi up to 1-1/4 inch (1723.7 kPa up to 32 mm, DN).

E. Maximum Service Temperature: 450 degrees F (232 degrees C).

F. End Connections: Flanged.

G. Size: Use pipe sized units.

H. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.

- I. Application: Copper piping.

2.04 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 - 1. Flex-Weld, Inc; Keflex 7Q Series - Quadra-Side: www.kelcoind.com/#sle.
 - 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Pressure Rating: 125 psi and 400 degrees F (862 kPa and 204 degrees C).
- C. Maximum Compression: 1-3/4 inches (45 mm).
- D. Maximum Extension: 1/4 inch (6 mm).
- E. Joint Type: Externally pressurized with flanged ends.
- F. Size: Use pipe sized units.
- G. Application: Steel piping 4 inches (102 mm) and under.

2.05 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Pressure Rating: 125 psi and 400 degrees F (862 kPa and 204 degrees C).
- C. Maximum Compression: 15/16 inch (24 mm).
- D. Maximum Extension: 5/16 inch (8 mm).
- E. Maximum Offset: 1/8 inch (3 mm).
- F. End Connections: Flanged.
- G. Size: Use pipe sized units.
- H. Accessories: Internal flow liner.
- I. Application: Steel piping over 2 inches (50 mm).

2.06 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE CONNECTOR

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
 - 3. Unisource Manufacturing, Inc; Series 301, Single Sphere Connectors: www.unisource-mfg.com/#sle.

- 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Body Construction: Nylon-reinforced rubber tube.
- C. End Connections: Carbon steel flanges.
- D. Cover and Tube Elastomer: EPDM and EPDM.
- E. Maximum Compression: 1/2 inch (13 mm).
- F. Maximum Elongation: 3/8 inch (10 mm).
- G. Maximum Offset: 3/8 inch (10 mm).
- H. Maximum Angular Movement: 15 degrees.
- I. Accessories: Control rods.
- J. Service Rating: Up to 35 psi at 220 degrees F (241.3 kPa at 104.4 degrees C).

2.07 EXPANSION JOINTS - TWO-PLY BRONZE BELLOWS TYPE

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Construction: Bronze with anti-torque device, limit stops, internal guides.
- C. Pressure Rating: 125 psi and 400 degrees F (862 kPa and 204 degrees C).
- D. Maximum Compression: 1-3/4 inches (45 mm).
- E. Maximum Extension: 1/4 inch (6 mm).
- F. Joint: Soldered.
- G. Size: Use pipe sized units.
- H. Application: Copper piping.

2.08 EXPANSION JOINTS - COMPENSATORS

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. Unisource Manufacturing, Inc; Series 416, Expansion Compensators: www.unisource-mfg.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Type: Two-ply 304 stainless steel bellows with carbon steel shroud.
- C. Maximum Working Pressure: 200 psi (1378.9 kPa).
- D. Maximum Working Temperature: 400 degrees F (205 degrees C).

- E. Maximum Compression: 1/2 inch (12.7 mm).
- F. Maximum Extension: 5/32 inch (4.0 mm).
- G. End Connections: Female copper sweat.
- H. Application: Copper piping up to 3 inches (75 mm, DN) in size or steel piping up to 4 inches (100 mm, DN) in size.

2.09 EXPANSION JOINTS - STEEL WITH PACKED SLIDING SLEEVE

- A. End Connections: Flanged.
- B. Size: Use pipe sized units.
- C. Application: Steel piping 2 inches (50 mm) and over.

2.10 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

- A. Working Pressure: 125 psi (862 kPa).
- B. Maximum Temperature: 250 degrees F (121 degrees C).
- C. End Connections: Flanged.
- D. Size: Use pipe sized units.
- E. Application: Copper or steel piping 2 inches (50 mm) and over.

2.11 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. Flex-Weld, Inc; Keflex Ke-Loop: www.kelcoind.com/#sle.
 - 2. The Metraflex Company; Metraloop: www.metralflex.com/#sle.
 - 3. Unisource Manufacturing, Inc; V-Loop: www.unisource-mfg.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.
- C. Maximum Allowable Motion: 2 inch (50.8 mm) in the x, y, and z planes with no thrust loads to the building structure.
- D. Maximum Working Pressure: 150 psi (1030 kPa) at 800 degrees F (426.7 degrees C).
- E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment.
 - 1. Selected Product to Accommodate:
 - a. Angular Rotation: 15 degrees.
 - b. Force developed by 1.5 times specified maximum allowable operating pressure.

2. Provide necessary accessories including, but not limited to, swivel joints.

2.12 EXPANSION JOINTS - EXTERNALLY PRESSURIZED

A. Manufacturers:

1. Flex-Weld, Inc; Keflex Externally-Pressurized Expansion Joints: www.kelcoind.com/#sle.
2. The Metraflex Company; Metragator: www.metraflex.com/#sle.
3. Unisource Manufacturing, Inc; Series EP: www.unisource-mfg.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Bellows Type: Two-ply, single bellows constructed of 304 stainless steel.

C. Internal Liner: Carbon steel with internal and external guides.

D. End Connections: Class 150, carbon steel, welded flange.

E. Maximum Axial Compression: 4 inches (102 mm).

F. Maximum Working Pressure: 150 psi (1030 kPa) at 700 degrees F (372 degrees C).

G. Application: Steel piping 2 inches (50 mm) and over.

2.13 ACCESSORIES

A. Stainless Steel Pipe: ASTM A269/A269M, seamless type, Grade TP304.

B. Pipe Alignment Guides:

1. Manufacturers:

- a. Flex-Weld, Inc: www.kelcoind.com/#sle.
- b. The Metraflex Company; PGQ Glide Riser Guide: www.metraflex.com/#sle.
- c. Substitutions: See Section 01 60 00 - Product Requirements.

2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch (25 mm) thick insulation, minimum 3 inches (75 mm) travel.

C. Swivel Joints:

1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- G. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION

SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 22 05 23 - General-Duty Valves for Plumbing Piping.
- C. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Piping identification.
- D. Section 22 07 16 - Plumbing Equipment Insulation.
- E. Section 22 07 19 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.05 QUALITY ASSURANCE

- A. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a One year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Manufacturers:
 - 1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Vertical Piping:
 - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- D. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- G. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.
- H. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Manufacturers:
 - 1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.

2. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.
 3. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Modular Mechanical Sleeve-Seal:
1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 3. Size and select seal component materials in accordance with service requirements.
 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. Fire Resistant: 1 hour, UL (DIR) approved.
 - e. High Temperature, up to 400 degrees F (204 degrees C).
 - f. Low temperature, down to minus 67 degrees F (minus 55 degrees C).
 5. Glass-reinforced plastic pressure end plates.
- C. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.
- D. Pipe Sleeve Material:
1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
 2. Masonry Structures: Sheet metal or fiber.
- E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.
- F. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch (76.2 mm) thick.
- G. Pipeline-Casing Seals:
1. Coated boltless casing-spacer for 4 inch (100 mm) carrier pipe.
 2. Coated boltless modular seal for 6 inch (150 mm) carrier pipe.
 3. Carbon steel band with risers for 12 inch (305 mm) carrier pipe.
 4. End Seals: 1/8 inch (3.1 mm), pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations: Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 - 2. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch (12.7 mm) where penetrations occur between conditioned and unconditioned spaces.
 - 3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
 - 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.

2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Angle valves.
- B. Ball valves.
- C. Butterfly valves.
- D. Check valves.
- E. Flow limiting valves.
- F. Gate valves.
- G. Globe valves.
- H. Lubricated plug valves.
- I. Chainwheels.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- C. Section 22 07 16 - Plumbing Equipment Insulation.
- D. Section 22 07 19 - Plumbing Piping Insulation.
- E. Section 22 10 05 - Plumbing Piping.
- F. Section 22 15 00 - General-Service Compressed-Air Systems.

1.03 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- G. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.

- H. ASME B31.9 - Building Services Piping; 2020.
- I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).
- L. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2021.
- M. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts; 2018, with Editorial Revision (2019).
- N. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- O. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- P. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
- Q. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- R. AWWA C606 - Grooved and Shouldered Joints; 2015.
- S. MSS SP-45 - Drain and Bypass Connections; 2020.
- T. MSS SP-67 - Butterfly Valves; 2022.
- U. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- V. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- W. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- X. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- Y. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- Z. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
- AA. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- BB. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.
- CC. NSF 61 - Drinking Water System Components - Health Effects; 2021.
- DD. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.07 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.

- B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball, butterfly, gate or plug.
 - 2. Dead-End: Single-flange butterfly (lug) type.
 - 3. Throttling: Provide globe, angle, ball, or butterfly.
 - 4. Swing Check (Pump Outlet):
 - a. 2 inch (50 mm, DN) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2 inch (65 mm, DN) and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
 - c. 2-1/2 inch (65 mm, DN) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. 2 inch (50 mm, DN) and Smaller: Threaded ends.
 - b. 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 inch (125 mm, DN) and Larger: Grooved or flanged ends.
 - d. Grooved-End Copper Tubing and Steel Piping: Grooved.
 - 2. Copper Tube:
 - a. 2 inch (50 mm, DN) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 inch (125 mm, DN) and Larger: Grooved or flanged ends.
- F. Low Pressure, Compressed Air Valves 150 psi (1,035 kPa) or Less:
 - 1. 2 inch (50 mm, DN) and Smaller:
 - a. Bronze and Brass: Provide with solder-joint ends.

- b. Ball: One piece, full port, brass with brass trim.
 - c. Bronze Lift Check: Class 125, bronze disc.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
2. 2-1/2 inch (65 mm, DN) and Larger:
- a. Iron, 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Provide with threaded ends.
 - b. Iron Single-Flange Butterfly: 200 CWP, NBR Seat, aluminum-bronze disc.
 - c. Iron Grooved-End Butterfly: 175 CWP.
 - d. Iron Swing Check: Class 125, metal seats.
 - e. Iron Grooved-End Swing Check: 300 CWP.
 - f. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
 - g. Iron Plate-Type Check: Class 125; single plate; metal seat.
 - h. Iron Gate: Class 125, NRS.
- G. High Pressure, Compressed Air Valves 150 psi (1,035 kPa) to 200 psi (1,380 kPa):
1. 2 inch (50 mm, DN) and Smaller:
- a. Bronze: Provide with solder-joint ends.
 - b. Ball: One piece, full port, brass with brass trim.
 - c. Bronze Lift Check: Class 125, bronze disc.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
2. 2-1/2 inch (65 mm, DN) and Larger:
- a. Iron Valves, 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Provide with threaded ends.
 - b. Iron Single-Flange Butterfly: 200 CWP, NBR seat, aluminum-bronze disc.
 - c. Iron Grooved-End Butterfly: 175 CWP.
 - d. Iron Swing Check: Class 125, metal seats.
 - e. Iron Grooved-End Swing Check: 300 CWP.
 - f. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
 - g. Iron Plate-Type Check: Class 125; single plate; metal seat.
 - h. Iron Gate: Class 125, NRS.
- H. Domestic, Hot and Cold Water Valves:
1. 2 inch (50 mm, DN) and Smaller:

- a. Bronze and Brass: Provide with solder-joint ends.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: One piece, full port, brass with brass trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
2. 2-1/2 inch (65 mm, DN) and Larger:
- a. Iron, 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Provide with threaded ends.
 - b. Iron Ball: Class 150.
 - c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
 - d. Iron Grooved-End Butterfly: 175 CWP.
 - e. Iron Swing Check: Class 125, metal seats.
 - f. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - g. Iron Grooved-End Swing Check: 300 CWP.
 - h. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
 - i. Iron Plate-Type Check: Class 125; single plate; metal seat.
 - j. Iron Gate: Class 125, NRS.
 - k. Iron Globe: Class 125.
- I. Sanitary Waste Water Valves:
1. 2 inch (50 mm, DN) and Smaller:
- a. Bronze and Brass: Provide with solder-joint.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: One piece, full port, brass with brass trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
2. 2-1/2 inch (65 mm, DN) and Larger:
- a. Iron, 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Provide with threaded ends.
 - b. Iron Ball: Class 150.
 - c. Iron Swing Check: Class 125, metal seats.
 - d. Iron Swing Check with Closure Control: Class 125, lever and spring.

- e. Iron Grooved-End Swing Check: 300 CWP.
- f. Iron Gate: Class 125, NRS.
- g. Iron Globe: Class 125.
- h. Lubricated Plug: Class 125, regular gland.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 inch (200 mm, DN) and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 6 inch (150 mm, DN) and smaller except plug valves.
 - 4. Wrench: Plug valves with square heads.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Insulated Piping Valves: With 2 inch (50 mm, DN) stem extensions and the following features:
 - 1. Gate Valves: Rising stem.
 - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: Extended neck.
 - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 inch (15 mm, DN) through 24 inch (600 mm, DN): ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
 - 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Solder-joint Connections: ASME B16.18.
 - 3. Building Services Piping Valves: ASME B31.9.

- G. Potable Water Use:

1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Valve Bypass and Drain Connections: MSS SP-45.
- I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

- A. Class 125; CWP Rating: 200 psi (1,380 kPa):
1. Comply with MSS SP-80, Type 1.
 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 3. End Connections: Pipe thread.
 4. Stem: Bronze.
 5. Disc: Bronze.
 6. Packing: Asbestos free.
 7. Handwheel: Bronze or aluminum.

2.04 BRASS, BALL VALVES

- A. One Piece, Full Port with Brass Trim and Push-to-fit or Threaded Connections:
1. Comply with MSS SP-110.
 2. CWP Rating: 200 psi (1,379 kPa).
 3. Body: Forged brass.
 4. Seats: PTFE.
 5. Stem: Brass.
 6. Ball: Chrome-plated brass.
 7. Operator: Handle.
 8. Manufacturers:
 - a. FNW; X485A: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Two Piece, Full Port with Brass Trim and Female Thread, Male thread, or Solder Connections:
1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi (1,035 kPa).
 3. WOG Rating: 600 psi (4,140 kPa).
 4. Body: Forged brass.

5. Seats: PTFE.
6. Stem: Brass.
7. Ball: Chrome-plated brass.
8. Cap: Include cap-gasket and chain for 3/4 inch (20 mm, DN) hose connection.
9. Operator: Lockable handle and memory stop.
10. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; 410A: www.fnw.com/#sle.
 - c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Two Piece, Full Port with Press Connections:

1. WOG Rating: 250 psi (1,724 kPa).
2. Body: Forged brass.
3. Seats: EPDM.
4. Ball: Chrome-plated brass.
5. Blow-out Proof Stem: Forged brass.
6. Operator: Provide lockable handle.
7. Maximum Service Temperature: 250 degrees F (121.1 degrees C).
8. Manufacturers:
 - a. FNW; 430: www.fnw.com/#sle.
 - b. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

D. Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi (1,035 kPa).
3. CWP Rating: 600 psi (4,140 kPa).
4. Body: Forged brass.
5. End Connections: Pipe thread.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.

9. Operator: Provide lockable handle.
10. Manufacturers:
 - a. FNW; _____: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 BRONZE, BALL VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. One Piece, Reduced Port with Bronze Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 400 psi (2,760 kPa).
3. CWP Rating: 600 psi (4,140 kPa).
4. Body: Bronze.
5. End Connections: Pipe press.
6. Seats: PTFE.
7. Ball: Chrome plated brass.
8. Operator: Provide lockable handle.

C. Two Piece, Full Port with Bronze Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi (1,035 kPa).
3. WOG Rating: 600 psi (4,140 kPa).
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Bronze, blowout proof.
8. Ball: Chrome plated brass.
9. Operator: Provide lockable handle and stem extension.
10. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; X450: www.fnw.com/#sle.
 - c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi (1,035 kPa).
3. CWP Rating: 600 psi (4,140 kPa).
4. Body: Bronze.
5. End Connections: Pipe thread or press.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Operator: Provide lockable handle.
10. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 CARBON STEEL, BALL VALVES

A. One Piece, Standard Port, Fire Safe, Class 150, Flanged with Stainless Steel Trim:

1. WSP Rating: 150 psi (1,035 kPa), fire safe.
2. Seats: TFM.
3. Stem: Stainless steel, blowout proof.
4. Ball: Stainless steel, vented.
5. Operator: Lockable handle with actuator-mounting pad.
6. Pressure and Temperature Rating: ASME B16.34.
7. Manufacturers:
 - a. FNW; 501B: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Two Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi (1,035 kPa).
3. CWP Rating: 2,000 psi (13,790 kPa).
4. Seats: TFM.
5. Stem: Stainless steel, blowout proof.

6. Ball: Stainless steel, vented.
 7. End Connections: Threaded or socket weld.
 8. Operator: Lockable handle.
 9. Pressure and Temperature Rating: ASME B16.34.
 10. Manufacturers:
 - a. FNW; 221A: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Two Piece, Full Port, Fire Safe, Class 150, Flanged with Stainless Steel Trim:
1. WSP Rating: 150 psi (1,035 kPa).
 2. Seats: TFM.
 3. Stem: Stainless steel, blowout proof.
 4. Ball: Stainless steel, vented.
 5. Operator: Lockable handle with actuator-mounting pad.
 6. Pressure and Temperature Rating: ASME B16.34.
 7. Manufacturers:
 - a. FNW; 601B: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
 2. WSP Rating: 250 psi (1,723 kPa).
 3. CWP Rating: 2,000 psi (13,790 kPa).
 4. Vacuum Rating: Down to 29.3 in-Hg (97.9 kPa).
 5. Seats: TFM.
 6. Stem: Stainless steel, blowout proof.
 7. Ball: Stainless steel, vented.
 8. Bolts: Stainless steel.
 9. End Connections: Threaded or socket weld.
 10. Operator: Lockable handle.
 11. Pressure and Temperature Rating: ASME B16.34.
 12. Manufacturers:
 - a. FNW; 311A: www.fnw.com/#sle.

- b. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 STAINLESS STEEL, BALL VALVES

A. One Piece, Standard Port with Stainless-Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi (1,035 kPa).
3. CWP Rating: 1,000 psi (6,895 kPa).
4. Seats: PTFE.
5. Stem: Stainless steel, blowout proof.
6. Ball: Stainless steel.
7. End Connections: Threaded.
8. Operator: Lockable handle.
9. Manufacturers:
 - a. FNW; 100A: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

B. One Piece, Standard Port, Class 150, Flanged with Stainless Steel Trim:

1. WSP Rating: 150 psi (1,035 kPa).
2. Seats: TFM.
3. Stem: Stainless steel, blowout proof.
4. Ball: Stainless steel.
5. Operator: Lockable handle with actuator-mounting pad.
6. Pressure and Temperature Rating: ASME B16.34.
7. Manufacturers:
 - a. FNW; 500B: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

C. Two Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi (1,035 kPa).
3. CWP Rating: 2,000 psi (13,790 kPa).
4. Seats: PFTE.
5. Stem: Stainless steel, blowout proof.
6. Ball: Stainless steel, vented.

7. End Connections: Threaded.
 8. Operator: Lockable handle.
 9. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; 200A: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Two Piece, Full Port, Fire Safe, Class 150, Flanged with Stainless Steel Trim:
1. WSP Rating: 150 psi (1,035 kPa).
 2. Seats: TFM.
 3. Stem: Stainless steel, blowout proof.
 4. Ball: Stainless steel, vented.
 5. Operator: Lockable handle with actuator-mounting pad.
 6. Pressure and Temperature Rating: ASME B16.34.
 7. Manufacturers:
 - a. FNW; 600B: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi (1,035 kPa).
 3. WOG Rating: 2,000 psi (13,790 kPa).
 4. Vacuum Rating: 26.9 in-Hg (91.1 kPa).
 5. Seats: PFTE.
 6. Stem: Stainless steel, blowout proof.
 7. Ball: Stainless steel, vented.
 8. Bolts: Stainless steel.
 9. End Connections: Threaded, press, or socket weld.
 10. Operator: Lockable handle.
 11. Comply with ASME B16.34 for pressure-temperature range.
 12. Extended Working Temperature: Minus 4 to 392 degrees F (Minus 20 to 200 degrees C).
 13. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.

- b. FNW; 310A: www.fnw.com/#sle.
- c. Substitutions: See Section 01 60 00 - Product Requirements.

2.08 IRON, BALL VALVES

- A. Class 125, Full Port, Stainless Steel Trim:
 - 1. Comply with MSS SP-72.
 - 2. CWP Rating: 200 psi (1,380 kPa).
 - 3. Body: ASTM A536 Grade 65-45-12, ductile iron.
 - 4. End Connections: Flanged.
 - 5. Seats: PTFE.
 - 6. Stem: Stainless steel.
 - 7. Ball: Stainless steel.
 - 8. Operator: Lever with locking handle.
 - 9. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.09 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug Style; Bi-directional dead-end service without use of downstream flange:
 - 1. Class 125 or Class 150 flanges.
 - 2. Comply with MSS SP-67, Type I.
 - 3. Lug Style, Service Pressure Ratings:
 - a. 100 psi (689.5 kPa) for sizes 14 to 24 inch (350 to 600 mm, DN).
 - b. 150 psi (1,034 kPa) for sizes 2 to 12 inch (50 to 300 mm, DN).
 - c. Vacuum down to 29.9 in-Hg (101.2 kPa).
 - 4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
 - 5. Stem: One or two-piece stainless steel.
 - 6. Seat: EPDM.
 - 7. Disc: Stainless steel.
 - 8. Finish: Epoxy coated.
 - 9. Operator: Gear operator with handwheel over direct-mount actuator base.
 - 10. Manufacturers:

- a. Apollo Valves: www.apollovalves.com/#sle.
- b. FNW; 711: www.fnw.com/#sle.
- c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
- d. Substitutions: See Section 01 60 00 - Product Requirements.

2.10 IRON, GROOVED-END BUTTERFLY VALVES

- A. CWP Rating: 175 psi (1,200 kPa).
 - 1. Comply with MSS SP-67, Type I.
 - 2. Body: Coated ductile iron.
 - 3. Stem: Two-piece stainless steel.
 - 4. Disc: Coated ductile iron.
 - 5. Disc Seal: EPDM.

2.11 BRONZE, LIFT CHECK VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
 - 1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
 - 2. CWP Rating: 200 psi (1,380 kPa).
 - 3. Design: Vertical flow.
 - 4. Body: Comply with ASTM B61 or ASTM B62, bronze.
 - 5. End Connections: Threaded.
 - 6. Disc (Type 1): Bronze.

2.12 BRASS, INLINE CHECK VALVES

- A. Class 150:
 - 1. WOG Rating: 200 psi (1,380 kPa).
 - 2. Maximum Service Temperature: 250 degrees F (121.1 degrees C).
 - 3. Body: Forged brass.
 - 4. Disc: Forged brass.
 - 5. Seal: PTFE, bubble-tight.
 - 6. End Connections: Press.

7. Manufacturers:
 - a. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 - b. FNW; X431: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.13 BRASS, HORIZONTAL SWING CHECK VALVES

- A. Class 125, Threaded End Connections:
 1. WOG Rating: 200 psi (1,380 kPa).
 2. Body: Forged brass.
 3. Disc: Forged brass.
 4. Hinge-Pin, Screw, and Cap: Forged brass.
 5. Manufacturers:
 - a. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Class 125, Press End Connections:
 1. WOG Rating: 200 psi (1,380 kPa).
 2. Body: Forged brass.
 3. Disc: Forged brass.
 4. Hinge-Pin, Screw, and Cap: Forged brass.
 5. Manufacturers:
 - a. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.14 BRONZE, SWING CHECK VALVES

- A. General:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. WOG Rating: 200 psi (1,380 kPa).
 4. Body: Bronze, ASTM B62.

5. End Connections: Threaded.
6. Disc: Bronze.
7. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

C. Class 150:

1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. WSP Rating: 150 psi (1,034 kPa).
4. WOG Rating: 300 psi (2,068 kPa).
5. Body: Bronze, ASTM B62.
6. End Connections: Threaded or soldered.
7. Disc: Bronze.
8. Manufacturers:
 - a. FNW; 1241, Federal: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.15 IRON, HORIZONTAL SWING CHECK VALVES

A. Class 125:

1. Pressure and Temperature Rating: MSS SP-71, Type I.
2. Design: T-body style for clear or full waterways.
3. WOG Rating: 200 psi (1,380 kPa).
4. WSP Rating: 125 psi (861.6 kPa) at 450 degrees F (232.2 degrees C).
5. Body: ASTM A126, gray cast iron with bolted bonnet.
6. End Connections: Flanged.
7. Trim: Composition.
8. Seat Ring and Disc Holder: Bronze.
9. Disc: PTFE.
10. Gasket: Asbestos free.
11. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.

- b. FNW; 671B: www.fnw.com/#sle.
- c. Flomatic Valves; Flo-Flex Swing Check Valve: www.flomatic.com/#sle.
- d. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
- e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Class 250:

- 1. Comply with MSS SP-71, Type I.
- 2. CWP Rating: 500 psi (3,450 kPa).
- 3. Design: T-body style for clear or full waterway.
- 4. Body: ASTM A126, gray iron with bolted bonnet.
- 5. End Connections: Flanged.
- 6. Trim: Bronze.
- 7. Metal Seat.
- 8. Gasket: Asbestos free.

2.16 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125 with Lever and Spring-Closure Control.

- 1. Comply with MSS SP-71, Type I.
- 2. Description:
 - a. CWP Rating: 200 psi (1,380 kPa).
 - b. Design: Clear or full waterway.
 - c. Body: ASTM A126, gray iron with bolted bonnet.
 - d. Ends: Flanged as indicated.
 - e. Trim: Bronze.
 - f. Gasket: Asbestos free.
 - g. Closer Control: Factory installed, exterior lever, and weight.
- 3. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Flomatic Valves; 90LS/92LS Swing Check Valve: www.flomatic.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.17 CARBON STEEL, SWING CHECK VALVES

A. Class 150:

- 1. Design: T-pattern, horizontal or vertical flow.

2. Body and Disc: ASTM A216/A216M.
3. CWP Rating: 150 psi (1,034 kPa).
4. End Connections: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.
6. Manufacturers:
 - a. FNW; 571: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Class 300:

1. Design: T-pattern, horizontal or vertical flow.
2. Body and Disc: ASTM A216/A216M.
3. CWP Rating: 300 psi (2,068 kPa).
4. End Connections: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.
6. Manufacturers:
 - a. FNW; 572: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.18 STAINLESS STEEL, SWING CHECK VALVES

A. Class 150:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. Design: T-pattern, horizontal or vertical flow.
3. CWP Rating: 150 psi (1,034 kPa).
4. Connection Ends: Flanged.
5. Pressure and Temperature Rating: ASME B16.34.
6. Manufacturers:
 - a. FNW; 471A: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Class 300:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. Design: T-pattern, horizontal or vertical flow.
3. CWP Rating: 300 psi (2,068 kPa).
4. Connection Ends: Flanged.

5. Pressure and Temperature Rating: ASME B16.34.
6. Manufacturers:
 - a. FNW; 472A: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.19 IRON, GROOVED-END SWING CHECK VALVES

- A. Class 300:
 1. CWP Rating: 300 psi (2,070 kPa).
 2. Body: ASTM A536, Grade 65-45-12 ductile iron.
 3. Seal: EPDM.
 4. Disc: Ductile iron.
 5. Coating: Black, non-lead paint.

2.20 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Compact-Wafer:
 1. Comply with MSS SP-125.
 2. CWP Rating: 200 psi (1,380 kPa).
 3. Body: ASTM A126 gray iron.
 4. Metal Seat: Unleaded bronze.
 5. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Flomatic Valves; 888R Wafer Check Valve: www.flomatic.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Class 125, Globe:
 1. Comply with MSS SP-125.
 2. CWP Rating: 200 psi (1,380 kPa).
 3. Body: ASTM A126 gray iron.
 4. Style: Spring loaded.
 5. End Connections: Flanged.
 6. Metal Seat: Unleaded bronze.
 7. Metal Seat: Stainless steel.
 8. Manufacturers:
 - a. Flomatic Valves; 402S6R Globe Check Valve: www.flomatic.com/#sle.

- b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Class 150, Compact-Wafer:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 300 psi (2,070 kPa).
 - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 4. Metal Seat: Unleaded bronze.
 - 5. Manufacturers:
 - a. Flomatic Valves; 888R Wafer Check Valve: www.flomatic.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Class 150, Globe:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 300 psi (2,070 kPa).
 - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 4. Style: Spring loaded.
 - 5. End Connections: Flanged.
 - 6. Metal Seat: Unleaded bronze.
 - 7. Manufacturers:
 - a. Flomatic Valves; 402BTR Globe Check Valve: www.flomatic.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Class 250, Compact-Wafer:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 400 psi (2,760 kPa).
 - 3. Body: ASTM A126, gray iron.
 - 4. Style: Spring loaded.
 - 5. Metal Seat: Unleaded bronze.
- F. Class 250, Globe:
 - 1. Comply with MSS SP-125.
 - 2. 2-1/2 inch (65 mm, DN) to 12 inch (300 mm, DN); CWP Rating: 400 psi (2,760 kPa).
 - 3. 14 inch (350 mm, DN) to 24 inch (600 mm, DN); CWP Rating: 300 psi (2,070 kPa).
 - 4. Body Material: ASTM A126, gray iron.
 - 5. Style: Spring loaded.

- 6. End Connections: Flanged.
- 7. Metal Seat: Unleaded bronze.
- G. Class 300, Compact-Wafer:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 500 psi (3,450 kPa).
 - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 4. Style: Spring loaded.
 - 5. Metal Seat: Unleaded bronze.
- H. Class 300, Globe:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 500 psi (3,450 kPa).
 - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 4. Style: Spring loaded.
 - 5. End Connections: Flanged.
 - 6. Metal Seat: Unleaded bronze.

2.21 IRON, PLATE TYPE CHECK VALVES

- A. Class 125 Single-Plate:
 - 1. Comply with API STD 594.
 - 2. CWP Rating: 200 psi (1,380 kPa).
 - 3. Design: Wafer, spring-loaded plate.
 - 4. Body: ASTM A126, gray iron.
 - 5. Resilient Seat: EPDM.
- B. Class 125, Dual-Plate:
 - 1. Comply with API STD 594.
 - 2. CWP Rating: 200 psi (1,380 kPa).
 - 3. Design: Wafer, spring-loaded plates.
 - 4. Body: ASTM A126, gray iron.
 - 5. Resilient Seat: EPDM.
- C. Class 150, Dual-Plate:
 - 1. Comply with API STD 594.
 - 2. CWP Rating: 300 psi (2,070 kPa).

3. Design: Wafer, spring-loaded plates.
 4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 5. Resilient Seat: NBR.
- D. Class 250, Single-Plate:
1. Comply with API STD 594.
 2. CWP Rating: 400 psi (2,760 kPa).
 3. Design: Wafer, spring-loaded plate.
 4. Body: ASTM A126, gray iron.
 5. Resilient Seat: NBR.
- E. Class 250, Dual-Plate:
1. Comply with API STD 594.
 2. CWP Rating: 400 psi (2,760 kPa).
 3. Design: Wafer, spring-loaded plates.
 4. Body: ASTM A126, gray iron.
 5. Resilient Seat: NBR.
- F. Class 300, Dual-Plate:
1. Comply with API STD 594.
 2. CWP Rating: 500 psi (3,450 kPa).
 3. Design: Wafer, spring-loaded plates.
 4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 5. Metal Seat: Bronze.
- 2.22 FLOW LIMITING VALVES
- A. Manufacturers:
1. Nexus Valve, Inc: www.nexusvalve.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Size: As indicated on drawings, female threaded.
- C. Flow Setting: As indicated on drawings.
- D. Flow Accuracy: Plus or minus 5 percent.
- E. Body and Cap: Lead-free brass.
- F. Cap and Plug: Lead-free brass.

- G. Cartridge: Stainless steel with replaceable EPDM seal.
- H. Maximum Service Pressure: 600 psi (4,137 kPa), WOG.
- I. Maximum Service Temperature: 250 degrees F (121.1 degrees C).
- J. Accessories: Provide hanging tag and test-plug outlet extensions.

2.23 BRONZE, GATE VALVES

A. General:

- 1. Fabricate from dezincification resistant material.
- 2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Rising Stem or OS&Y:

- 1. Pressure-Temperature Range: MSS SP-80, Type I.
- 2. Class 125:
 - a. WSP Rating: 125 psi (861.8 kPa), saturated.
 - b. CWP Rating: 200 psi (1,380 kPa).
- 3. Class 150: CWP Rating; 300 psi (2,070 kPa).
- 4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
- 5. End Connections: Threaded or solder.
- 6. Stem: Bronze.
- 7. Disc: Solid wedge; bronze.
- 8. Packing: Asbestos free.
- 9. Handwheel Operator: Malleable iron.
- 10. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; 1221, Federal: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

C. Non-Rising Stem or NRS

- 1. Pressure-Temperature Range: MSS SP-80, Type I.
- 2. Class 125:
 - a. WSP Rating: 125 psi (861.8 kPa), saturated.
 - b. CWP Rating: 200 psi (1,380 kPa).
- 3. Class 150: CWP Rating; 300 psi (2,070 kPa).

4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. Ends Connections: Threaded or solder.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron.
10. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; 1211, Federal: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.24 IRON, GATE VALVES

- A. Bolted Bonnet: OS&Y; Rising Stem:
 1. Pressure and Temperature Rating: MSS SP-70, Type I.
 2. Class 125: WOG Rating; 200 psi (1,380 kPa).
 3. Class 250: WOG Rating; 500 psi (3,450 kPa).
 4. Body: ASTM A126, gray iron with bolted bonnet.
 5. End Connections: Flanged.
 6. Trim: Bronze.
 7. Disc: Solid wedge.
 8. Packing and Gasket: Asbestos free.
 9. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; 651B: www.fnw.com/#sle.
 - c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.25 CARBON STEEL, GATE VALVES

- A. Class 150:
 1. Body and Disc: ASTM A216/A216M.
 2. CWP Rating: 150 psi (1,034 kPa).
 3. Bolted Bonnet: OS&Y; Rising Stem.
 4. End Connections: Flanged.

5. Packing and Gasket: Asbestos free.
6. Pressure and Temperature Rating: ASME B16.34.
7. Manufacturers:
 - a. FNW; 551: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Class 300:

1. Body and Disc: ASTM A216/A216M.
2. CWP Rating: 300 psi (2,068 kPa).
3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Pressure and Temperature Rating: ASME B16.34.
7. Manufacturers:
 - a. FNW; 552: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.26 STAINLESS STEEL GATE VALVES

A. Class 125:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 125 psi (861.8 kPa).
3. Bonnet: NRS; Non-rising Stem.
4. End Connections: Threaded.
5. Adjustable Stem Packing: PTFE.
6. Operator: Handwheel.
7. Working Service Temperature: Minus 4 to 356 degrees F (Minus 20 to 180 degrees C).
8. Pressure and Temperature Rating: ASME B16.34.
9. Manufacturers:
 - a. FNW; 15B-200: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Class 150:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 150 psi (1,034 kPa).

3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Handwheel.
7. Pressure and Temperature Rating: ASME B16.34.
8. Manufacturers:
 - a. FNW; 451A: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

C. Class 300:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 300 psi (2,068 kPa).
3. Bolted Bonnet: OS&Y; Rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Handwheel.
7. Pressure and Temperature Rating: ASME B16.34.
8. Manufacturers:
 - a. FNW; 452A: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.27 BRONZE, GLOBE VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125 and Class 250:

1. Class 125:
 - a. WOG Rating: 200 psi (1,380 kPa).
 - b. WSP Rating: 125 psi (861.8 kPa), saturated.
2. Class 250: WOG Rating; 300 psi (2,070 kPa).
3. Comply with MSS SP-80, Type 1.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. End Connections: Threaded or solder.

6. Bonnet: NRS; Non-rising Stem.
7. Non-Rising Stem: Bronze.
8. Disc: PTFE.
9. Packing: Asbestos free.
10. Handwheel Operator: Malleable iron.
11. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; 1231, Federal: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.28 IRON, GLOBE VALVES

- A. Class 125 and Class 250:
 1. Class 125, WOG Rating: 200 psi (1,380 kPa).
 2. Class 250, WOG Rating: 500 psi (3,450 kPa).
 3. Comply with MSS SP-85, Type I.
 4. Body: Gray iron; ASTM A126, with bolted bonnet.
 5. Bonnet: OS&Y; Rising Stem.
 6. Connection Ends: Flanged.
 7. Trim: Bronze.
 8. Packing and Gasket: Asbestos free, adjustable.
 9. Operator: Handwheel or chainwheel.
 10. Temperature Range: Minus 20 to 150 degrees F (Minus 28.8 to 65.6 degrees C).
 11. Pressure and Temperature Rating: ASME B16.1.
 12. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; 661: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.29 CARBON STEEL, GLOBE VALVES

- A. Class 150:
 1. Body: ASTM A216/A216M.
 2. WOG Rating: 150 psi (1,034 kPa).
 3. Bonnet: NRS; Non-rising Stem.

4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Malleable iron handwheel.
7. Pressure and Temperature Rating: ASME B16.34.
8. Manufacturers:
 - a. FNW; 561: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Class 300:

1. Body: ASTM A216/A216M.
2. WOG Rating: 300 psi (2,068 kPa).
3. Bonnet: NRS; Non-rising Stem.
4. End Connections: Flanged.
5. Packing and Gasket: Asbestos free.
6. Operator: Malleable iron handwheel.
7. Pressure and Temperature Rating: ASME B16.34.
8. Manufacturers:
 - a. FNW; 562: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.30 STAINLESS STEEL, GLOBE VALVES

A. Class 125:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. WOG Rating: 200 psi (1,379 kPa).
3. Bonnet: NRS; Non-rising Stem.
4. End Connections: Threaded.
5. Stem Packing: PTFE.
6. Operator: Malleable iron handwheel.
7. Temperature Range: Minus 4 to 356 degrees F (Minus 20 to 180 degrees C).
8. Pressure and Temperature Rating: ASME B16.34.
9. Manufacturers:
 - a. FNW; 17B-200: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Class 150:

1. Body and Disc: ASTM A351/A351M-CF8M.
2. Bonnet: NRS; Non-rising Stem.
3. WOG Rating: 150 psi (1,034 kPa).
4. End Connections: Flanged.
5. Trim: Stainless steel.
6. Packing and Gasket: Asbestos free.
7. Operator: Malleable iron handwheel.
8. Pressure and Temperature Rating: ASME B16.34.
9. Manufacturers:
 - a. FNW; 461A: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.31 LUBRICATED PLUG VALVES

A. Regular Gland with Flanged Ends:

1. Comply with MSS SP-78, Type II.
2. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
3. Pattern: Regular or short.
4. Plug: Cast iron or bronze with sealant groove.
5. Manufacturers:
 - a. Flomatic Valves: www.flomatic.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.32 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron. Include zinc coating.
4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Lift Check: Install with stem plumb and vertical.
 - 2. Swing Check: Install horizontal maintaining hinge pin level.
 - 3. Orient plate-type into horizontal or vertical position, between flanges.
- E. Provide chainwheels on operators for valves 4 inch (100 mm, DN) and larger where located 96 inch (2,400 mm, DN) or more above finished floor, terminating 60 inch (1,520 mm, DN) above finished floor.

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prefabricated trapeze-framed systems.
- B. Strut systems for pipe or equipment support.
- C. Beam clamps.
- D. Pipe hangers.
- E. Pipe rollers and roller supports.
- F. Pipe supports, guides, shields, and saddles.
- G. Nonpenetrating rooftop supports for low-slope roofs.
- H. Retrofit piping cover system.
- I. Anchors and fasteners.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 50 00 - Metal Fabrications.
- C. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2022.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- E. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.

- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- I. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.
- L. FM (AG) - FM Approval Guide; Current Edition.
- M. MFMA-4 - Metal Framing Standards Publication; 2004.
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- O. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL (DIR) - Online Certifications Directory; Current Edition.
- Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.05 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 metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
 - 1. Fiberglass Strut Channel Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- C. Installer Qualifications for Field-Welding.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Vibration Isolation and Seismic Restraint Requirements: See Section 22 05 48.
- G. Materials for Metal Fabricated Supports.
 - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- H. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.02 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

A. Prefabricated Trapeze-Framed Metal Strut Systems:

1. Manufacturers:
 - a. Anvil International, LLC: www.asc-es.com/#sle.
 - b. Custom Strut and Roll Forming, LLC: www.customstrut.com/#sle.
 - c. Gripple, Inc; Fast Track - Standard: www.gripple.com/#sle.
 - d. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - f. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MFMA-4 compliant, pre-fabricated, MSS SP-58 Type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
3. MFMA-4 compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
4. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
6. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
7. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

B. Prefabricated Trapeze-Framed Fiberglass Strut Systems:

1. Manufacturers:
 - a. Enduro Composites: www.endurocomposites.com/#sle.
 - b. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 type 59, prefabricated continuous-slot fiberglass strut channel, associated fittings, and related accessories.
3. Channel Material: Use polyester resin or vinyl ester resin.
4. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 1 inch (25 mm) height.

5. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.

2.03 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:

1. Manufacturers:
 - a. ABB Installation Products: electrification.us.abb.com/#sle.
 - b. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B. Hanger Rods:

1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch (13 mm, DN) diameter.
 - b. Piping up to 1 inch (25 mm, DN): 1/4 inch (6 mm, DN) diameter.
 - c. Piping larger than 1 inch (25 mm, DN): 3/8 inch (10 mm, DN) diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch (10 mm) in length.

C. Channel Nuts:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7821: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

D. Cable Hanging System Kits:

1. Manufacturers:

- a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. Ductmate Industries, Inc: ductmate.com/#sle.
 - c. Gripple, Inc: www.gripple.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- 2. Provide cable-wire in bulk or pre-cut lengths with respective cable hangers as required to hold minimum weight of 120 lb (54.4 kg).
 - 3. Accessories: Provide brackets, clip or c-clip hangers, covers, and y-hook hangers.

2.04 BEAM CLAMPS

A. Manufacturers:

- 1. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
- 2. FNW; 7201: www.fnw.com/#sle.
- 3. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
- 4. Substitutions: See Section 01 60 00 - Product Requirements.
- 5. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.

C. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.

D. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).

E. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.

F. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.

G. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.

H. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

I. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.05 PIPE HANGERS

A. Band Hangers, Adjustable:

1. Manufacturers:

- a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
- b. Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle.
- c. Substitutions: See Section 01 60 00 - Product Requirements.

- d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- 2. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
- B. J-Hangers, Adjustable:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7025: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 - 3. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- C. Swivel Ring Hangers, Adjustable:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7010: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 10, epoxy-painted, zinc-colored.
 - 3. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 4. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
 - 5. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- D. Clevis Hangers, Adjustable:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7005: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
 - 3. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.

4. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
5. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
6. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch (65 to 200 mm, DN).
7. FM (AG) listed: Pipe sizes 2-1/2 to 8 inch (65 to 200 mm, DN).

E. Nonmetallic Pipe Hangers:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. DecoShield Systems, Inc; Snap-2 Hangers: www.decoshield.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
2. CPVC fabricated, snap-action hanger for pendant or sidewall applications.

2.06 PIPE CLAMPS

A. Riser Clamps:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7020: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
5. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
6. UL (DIR) listed: Pipe sizes 1/2 to 8 inch (15 to 200 mm, DN).

B. Extension Split Pipe Clamp:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7001: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.

- d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- 2. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
- 3. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
- 4. Provide hanger rod and nuts of the same type and material for a given pipe run.
- 5. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- C. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- D. Strut Clamps:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7815: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
 - 3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil (26,398,000 V/m).
 - 4. Service Temperature Range: Minus 65 to 275 degrees F (Minus 53.8 to 135 degrees C).
- E. Insulation Coupling:
 - 1. Manufacturers:
 - a. FNW; 7897: www.fnw.com/#sle.
 - b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Two bolt-type clamps designed for installation under insulation.
 - 3. Material: Carbon steel with epoxy copper or zinc finish.

2.07 PIPE ROLLERS AND ROLLER SUPPORTS

- A. Manufacturers:
 - 1. ASC Engineered Solutions: www.asc-es.com/#sle.

2. FNW; 7902: www.fnw.com/#sle.
 3. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
 5. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- B. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
- C. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
- D. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.08 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Stanchions:
1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
 4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- C. U-Bolts:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7610: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
- D. Intermediate Anchors and Pipe Alignment Guides:

1. Manufacturers:
 - a. Anvil International, LLC: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Sizes 6 inch (150 mm, DN) and Smaller: Minimum clearance of 0.16 inch (4 mm).
 3. Pipe Size 8 inch (200 mm, DN): 0.625 inch (16 mm) U-bolt with double nuts providing minimum clearance of 0.28 inch (7 mm).
 4. Pipe Size 10 inch (250 mm, DN): 0.75 inch (19 mm) U-bolt.
 5. Pipe Sizes 12 to 16 inch (300 to 400 mm, DN): 0.875 inch (24 mm) U-bolt.
 6. Pipe Sizes 18 to 30 inches (450 to 750 mm, DN): 1 inch (25 mm) U-bolt.
 7. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- E. Pipe Alignment Guides, Galvanized steel:
1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Sizes 8 inch (200 mm, DN) and Smaller: Spider or sleeve type.
 3. Pipe Sizes 10 inch (250 mm, DN) and Larger: Roller type.
 4. Pipe Sizes 18 to 30 inch (450 to 750 mm, DN): 1 inch (25 mm) U-bolt.
- F. Pipe Shields for Insulated Piping:
1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. FNW; 7753: www.fnw.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

3. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch (321 mm).
 - d. Service Temperature: Minus 40 to 178 degrees F (Minus 40 to 81 degrees C).
 - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

G. Pipe Supports:

1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up to 122 degrees F (50 degrees C):
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
3. Operating Temperatures from 122 to 446 degrees F (50 to 230 degrees C):
 - a. Overhead Support: MSS SP-58 type 1 or 3 through 12 clamps with appropriate saddle of MSS SP-58 type 40 for insulated pipe.
 - b. Roller Chair: MSS SP-58 types 41 or 43 through 46 roller chair support with appropriate saddle of MSS SP-58 type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 types 35 through 38.

H. Pipe Supports, Thermal Insulated:

1. Manufacturers:
 - a. Buckaroos, Inc: www.buckaroos.com/#sle.
 - b. KB Enterprises: www.snappitz.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
2. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
 - c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - d. Provide pipe supports for 1/2 to 30 inch (15 to 750 mm, DN) iron pipes.
 - e. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.

3. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
 - b. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - c. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - d. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - e. Minimum Thickness: 60 mil, 0.06 inch (1.524 mm).
 - f. Connections: Brush-on welding adhesive.
4. Products:
 - a. Buckaroos, Inc; CoolDry: www.buckaroos.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Copper Pipe Supports:
 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.
- J. PEX Pipe Supports:
 1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.
- K. CPVC Pipe Supports:
 1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- L. Thermal Insulated, Surface-Mounted Pipe Supports:
 1. Manufacturers:
 - a. FNW; 7701: www.fnw.com/#sle.

- b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Material: Carbon steel with epoxy copper or zinc finish.
 - 3. Weather and UV light resistant foam, plastic, or rubber material with built-in strut. Maximum Load: 50 lb (22.7 kg) for single pipe or multiple landed on top strut.
- M. Overhead Pipe Supports:
- 1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- N. Plenum Pipe Supports:
- 1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- O. Telescoping Pipe Supports:
- 1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.09 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

- A. Manufacturers:
- 1. Anvil International; H-Block: www.anvilintl.com/#sle.
 - 2. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - 3. nVent Erico, a brand of nVent: www.erico.com/#sle.
 - 4. PHP Systems/Design: www.phpsd.com/#sle.
 - 5. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.

6. Substitutions: See Section 01 60 00 - Product Requirements.
 7. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- B. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
- C. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
- D. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
- E. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.

2.10 RETROFIT PIPING COVER SYSTEM

- A. Manufacturers:
1. DecoShield Systems, Inc: www.decoshield.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. General Requirements:
1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.
- C. Materials:
1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
 2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
 3. Unit Length: 7.5 feet (2.29 m).
 4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
 5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

2.11 ANCHORS AND FASTENERS

- A. Manufacturers - Mechanical Anchors:
1. FNW; 7502: www.fnw.com/#sle.
 2. Hilti, Inc: www.us.hilti.com/#sle.
 3. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 4. Powers Fasteners, Inc: www.powers.com/#sle.
 5. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Manufacturers - Powder-Actuated Fastening Systems:
1. Hilti, Inc: www.us.hilti.com/#sle.
 2. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 3. Powers Fasteners, Inc: www.powers.com/#sle.
 4. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- D. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- E. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- F. Hollow Masonry: Use toggle bolts.
- G. Hollow Stud Walls: Use toggle bolts.
- H. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
- I. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
- J. Sheet Metal: Use sheet metal screws.
- K. Wood: Use wood screws.
- L. Plastic and lead anchors are not permitted.
- M. Powder-actuated fasteners are permitted only as follows:
1. Where approved by Architect.
 2. Use only threaded studs; do not use pins.
- N. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- O. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
1. Channel Material: Use galvanized steel.
 2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm) minimum base metal thickness.
 3. Manufacturer: Same as manufacturer of metal strut channel framing system.
- P. Concrete Inserts:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Field-Welding (where approved by Architect).
- H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- I. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch (80 mm) high concrete pad.

- 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
 - J. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
 - K. Secure fasteners according to manufacturer's recommended torque settings.
 - L. Remove temporary supports.
- 3.03 FIELD QUALITY CONTROL
- A. See Section 01 40 00 - Quality Requirements for additional requirements.
 - B. Inspect support and attachment components for damage and defects.
 - C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
 - D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Underground warning tape.
- E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Identification painting.
- B. Section 22 60 00 - Gas and Vacuum Systems for Laboratory and Healthcare Facilities: Supply of pipe labels for placement under this section.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Schedules:
 - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
 - 2. Detail proposed component identification data in terms of wording, symbols, letter size, and color coding to be applied to corresponding product.
 - 3. Valve Data Format: Include id-number, location, function, and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

- A. Nameplates:
 - 1. Heat exchangers, water heaters, and other heat transfer products.
 - 2. Control panels, transducers, and other related control equipment products.
 - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.

B. Tags:

1. Piping: 3/4 inch (20 mm) diameter and smaller.
2. Manual operated and automated control valves.
3. Instrumentation, relays, gauges, and other related control equipment products.
4. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.

C. Pipe Markers: 3/4 inch (20 mm) diameter and higher.

2.02 NAMEPLATES

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Laminated piece with up to three lines of text.

1. Letter Color: White.
2. Letter Height: 1/4 inch (6 mm).
3. Background Color: Black.
4. Nameplate Height: 3/4 inch (19 mm).
5. Nameplate Material:
 - a. Flexible: Vinyl with adhesive backing per ASTM D709.
 - b. Metal: Brass with center-side holes for screw fastening.

2.03 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
2. Brady Corporation: www.bradycorp.com/#sle.
3. Brimar Industries, Inc: www.pipemarker.com/#sle.
4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
6. Seton Identification Products: www.seton.com/#sle.
7. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch (40 mm) in diameter.
- C. Metal: Brass, 19 gauge 1-1/2 inch (40 mm) in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
- D. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.
- E. Piping: 3/4 inch (20 mm) diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

2.04 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com/#sle.
 - 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products: www.seton.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Comply with ASME A13.1.
- C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- D. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches (150 mm) wide by 4 mil, 0.004 inch (0.10 mm) thick, manufactured for direct burial service.
- F. Identification Scheme, ASME A13.1:
 - 1. Primary: External Pipe Diameter, Uninsulated or Insulated.
 - a. 3/4 to 1-1/4 inches (19 to 32 mm): Use 8 inch (203 mm) field-length with 1/2 inch (13 mm) text height.
 - b. 1-1/2 to 2 inches (38 to 51 mm): Use 8 inch (203 mm) field-length with 3/4 inch (19 mm) text height.
 - c. 2-1/2 to 6 inches (64 to 152 mm): Use 12 inch (305 mm) field-length with 1-1/4 inch (32 mm) text height.
 - d. 8 to 10 inches (204 to 254 mm): Use 24 inch (610 mm) field-length with 2-1/2 inch (64 mm) text height.
 - e. Over 10 inches (over 254 mm): Use 32 inch (813 mm) field-length with 3-1/2 inch (89 mm) text height.
 - 2. Secondary: Color scheme per fluid service.

- a. Combustible Fluids: White text on brown background.
 - b. Compressed Air: White text on blue background.
 - c. Fire Quenching Fluids: White text on red background.
 - d. Flammable and Oxidizing Fluids: Black text on yellow background.
 - e. Toxic and Corrosive Fluids: Black text on orange background.
 - f. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
3. Tertiary: Other Details.
- a. Directional flow arrow.
 - b. Line pressure.
 - c. Line temperature.
 - d. GHS (Globally Harmonized System) pictogram:
 - 1) Health Hazard.
 - 2) Gas Cylinder.
 - 3) Flame Over Circle.
 - 4) Flame.
 - 5) Corrosion.
 - 6) Environment Skull.
 - 7) Exclamation Mark.
 - 8) Exploding Bomb.
 - 9) Skull and Crossbones.

2.05 UNDERGROUND WARNING TAPE

A. Manufacturers:

- 1. Brady Corporation: www.bradyid.com/#sle.
- 2. Brimar Industries, Inc: www.brimar.com/#sle.
- 3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
- 4. Seton Identification Products: www.seton.com/#sle.
- 5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

- 1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.

C. Non-detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 4 mil, 0.004 inch (0.10 mm).

- D. Foil-backed Detectable Type Tape: 3 inches (76 mm) wide, with minimum thickness of 5 mil, 0.005 inch (0.12 mm), unless otherwise required for proper detection.
- E. Legend: Type of service, continuously repeated over full length of tape.
- F. Color:
 - 1. Tape for Buried Power Lines: Black text on red background.
 - 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- C. Color code as follows:
 - 1. Plumbing Equipment: Yellow.
 - 2. Plumbing Valves: Green.
 - 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive identification products.
- B. Prepare surfaces for stencil painting, see Section 09 91 23.

3.02 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags in clear view and align with axis of piping
- C. Apply stencil painted identification in compliance with Section 09 91 23 requirements. Identify unit with assigned id-number and area being served using pipe marking rules.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- G. Apply ASME A13.1 Pipe Marking Rules:
 - 1. Place pipe marker adjacent to changes in direction.

2. Place pipe marker adjacent each valve port and flange end.
 3. Place pipe marker at both sides of floor and wall penetrations.
 4. Place pipe marker every 25 to 50 feet (7.6 to 15.2 m) interval of straight run.
- H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.03 SCHEDULE

- A. Equipment Type:
1. Identification:
 2. Background:
 - a. Size:
 - b. Color:
 3. Lettering:
 - a. Size:
 - b. Color:

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cellular glass insulation.
- B. Cellular melamine insulation.
- C. Expanded perlite insulation.
- D. Expanded polystyrene insulation.
- E. Flexible elastomeric cellular insulation.
- F. Flexible removable and reusable blanket insulation.
- G. Glass fiber insulation.
- H. Hydrous calcium silicate insulation.
- I. Polyethylene insulation.
- J. Polyisocyanurate cellular plastic insulation.
- K. Weather barrier coatings.
- L. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

- G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017.
- H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020a.
- I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022.
- J. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- K. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- L. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.
- M. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.
- N. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2021.
- O. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2017.
- P. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- Q. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
- R. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2017 (Reapproved 2023).
- S. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- T. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2022.
- U. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- V. ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
- W. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
- X. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- Y. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- Z. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- AA. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.
- BB. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.

- CC. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 CELLULAR MELAMINE INSULATION

- A. Manufacturers:
 - 1. TECHLITE: www.techlite.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Flexible preformed open-cell polymeric foam tubing, slit lengthwise for installation, complying with applicable requirements of ASTM C1410.
 - 1. K (Ksi) Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
 - 2. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 3. Maximum Service Temperature: 350 degrees F (176 degrees C).
 - 4. Density: 0.56 pcf (8.97 kg/cu m).
 - 5. Factory-Applied Jacketing Material: Paper/Foil/Scrim.
 - a. Color: White.
 - 6. Jacketing material to be field-applied.

2.03 GLASS FIBER INSULATION

A. Manufacturers:

1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville Corporation: www.jm.com/#sle.
3. Knauf Insulation; Earthwool 1000 Degree Pipe 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.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
2. Maximum Service Temperature: 850 degrees F (454 degrees C).
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 (Ksi) Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C).
2. Maximum Service Temperature: 220 degrees F (104 degrees C).
3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.

1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
2. Maximum Service Temperature: 650 degrees F (343 degrees C).
3. Maximum Moisture Absorption: 0.2 percent by volume.

E. 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 (0.029 ng/(Pa s m)).

F. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

G. Vapor Barrier Lap Adhesive: Compatible with insulation.

H. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

I. Fibrous Glass Fabric:

1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
2. Blanket: 1.0 pcf (16 kg/cu m) density.
3. Weave: 5 by 5.

J. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- K. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- L. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- M. Insulating Cement: ASTM C449.

2.04 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

- A. Manufacturers:
1. Auburn Manufacturing Inc; Ever Green Cut 'n Wrap: www.auburnmfg.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C553 Type V; flexible, noncombustible.
1. Comply with ASTM C1695.
 2. K (Ksi) Value: 0.37 at 100 degrees F (0.053 at 38 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
 3. Minimum Service Temperature: 32 degrees F (0 degrees C).
 4. Maximum Service Temperature: 500 degrees F (260 degrees C).
 5. Maximum Water Vapor Absorption: Less than 5.0 percent by weight.
 6. Color: Green.
 7. Weight: 12.5 oz/sq ft (3814.4 g/sq m).
 8. Effective Thickness: 1.25 plus/minus 0.25 inch (0.032 plus/minus 0.0064 m).

2.05 CELLULAR GLASS INSULATION

- A. Manufacturers:
1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C552, Type II, Grade 6.
1. K (Ksi) Value: 0.35 (0.050) at 100 degrees F (38 degrees C).
 2. Service Temperature Range: From 250 degrees F (121 degrees C) to 800 degrees F (427 degrees C).
 3. Water Vapor Permeability: 0.005 perm inch (0.007 ng/(Pa s m)) maximum per inch.
 4. Water Absorption: 0.5 percent by volume, maximum.

2.06 EXPANDED POLYSTYRENE INSULATION

- A. Insulation: ASTM C578; rigid closed cell.

1. K (Ksi) Value: 0.23 at 75 degrees F (0.033 at 24 degrees C).
2. Maximum Service Temperature: 165 degrees F (74 degrees C).
3. Maximum Water Vapor Permeance: 5.0 perm inch (287 ng/(Pa s m)).

2.07 EXPANDED PERLITE INSULATION

A. Manufacturers:

1. Schundler Company: www.schundler.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C610, molded.

1. Maximum Service Temperature: 1,200 degrees F (649 degrees C).
2. Maximum Water Vapor Transmission: 0.1 perm (0.06590 ng/(Pa s m)).

2.08 HYDROUS CALCIUM SILICATE INSULATION

A. Manufacturers:

1. Johns Manville Corporation: www.jm.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.

1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 149 degrees C) when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1,200 degrees F (649 degrees C).
3. Density: 15 pcf (240 kg/cu m).

C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

D. Insulating Cement: ASTM C449.

E. High Temperature Adhesive: Fire-retardant, sodium silicate based adhesive with fibers treated in compliance with ASTM D93.

1. Manufacturers:

- a. Vimasco Corporation: www.vimasco.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

2.09 POLYISOCYANURATE CELLULAR PLASTIC INSULATION

A. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.

1. Dimension: Comply with requirements of ASTM C585.
2. K (Ksi) Value: 0.18 at 75 degrees F (0.026 at 24 degrees C), when tested in accordance with ASTM C518.

3. Minimum Service Temperature: Minus 70 degrees F (Minus 57 degrees C).
4. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842.
5. Moisture Vapor Transmission: 4.0 perm inch (5.8 ng/(Pa s m)).
6. Connection: Waterproof vapor barrier adhesive.

2.10 POLYETHYLENE INSULATION

A. Manufacturers:

1. Armacell LLC: www.armacell.us/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.

1. K (Ksi) Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
2. Maximum Service Temperature: 200 degrees F (93 degrees C).
3. Density: 2 pcf (32 kg/cu m).
4. Maximum Moisture Absorption: 1.0 percent by volume.
5. Moisture Vapor Permeability: 0.05 perm inch (0.073 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
6. Connection: Contact adhesive.

2.11 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT): www.aeroflexusa.com/#sle.
2. Armacell LLC; AP Armaflex: www.armacell.us/#sle.
3. K-Flex USA LLC; Insul-Tube: www.kflexusa.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.

1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
2. Maximum Service Temperature: 220 degrees F (104 degrees C).
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Weather Barrier: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

1. Manufacturers:

- a. Vimasco Corporation: www.vimasco.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements

2.12 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
 - 1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; Childers - CP Series Weather Barrier Coating: www.fosterproducts.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 - 3. Water Vapor Permeance: Greater than 1.0 perm (57 ng/(Pa s m)) in accordance with ASTM E96/E96M.
 - 4. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 - 5. Color: As selected by Architect.

2.13 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:
 - 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/(Pa s m)), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 - 3. Covering Adhesive Mastic: Compatible with insulation.
- B. ABS Plastic Jacket:
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - c. Moisture Vapor Permeability: 0.012 perm inch (0.018 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.

- d. Thickness: 30 mil, 0.03 inch (0.75 mm).
 - e. Connections: Brush on welding adhesive.
- C. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 - 1. Lagging Adhesive: Compatible with insulation.
 - a. Manufacturers:
 - 1) Vimasco Corporation: www.vimasco.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- D. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch (0.41 mm) with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch (0.40 mm) sheet.
 - 3. Finish: Smooth.
 - 4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 5. Fittings: 0.016 inch (0.40 mm) thick die-shaped fitting covers with factory-attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
- E. Aluminum-Foil Laminate Jacket:
 - 1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; Foster - Vapor-Fas: www.fosterproducts.com/#sle.
 - b. Ideal Tape Co., Inc: www.idealtape.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
 - 3. Finish: Aluminum smooth.
 - 4. Comply with ASTM C1775.
- F. Stainless Steel Jacket: ASTM A666/A666M, Type 304 stainless steel.
 - 1. Thickness: 0.010 inch (0.25 mm).
 - 2. Finish: Smooth.
 - 3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.
- G. Reinforced Tape:
 - 1. Manufacturers:
 - a. Ideal Tape Co., Inc: www.idealtape.com/#sle.

- b. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
- 3. Comply with UL 723 or ASTM E84.
- 4. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
- 5. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Install cellular melamine with factory-applied jackets with a manufacturer-approved adhesive along seams, both straight lap joints and circumferential lap joints.
 - 1. Install seal over seams with factory-approved room temperature vulcanization (RTV) silicone sealant to ensure a positive vapor barrier seal in outdoor and sanitary washdown environments.
- F. 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.
- G. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- H. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- I. 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.
- J. Inserts and Shields:
1. Application: Piping 1-1/2 inches (40 mm) 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 (150 mm) 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.
- K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.
- L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.
- M. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- N. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- O. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

END OF SECTION

**SECTION 22 10 05
PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary waste piping, buried beyond 5 feet (1500 mm) of building.
- B. Sanitary waste piping, buried within 5 feet (1500 mm) of building.
- C. Sanitary waste piping, above grade.
- D. Chemical-resistant sanitary waste piping.
- E. Domestic water piping, buried beyond 5 feet (1500 mm) of building.
- F. Domestic water piping, buried within 5 feet (1500 mm) of building.
- G. Domestic water piping, above grade.
- H. Storm drainage piping, buried beyond 5 feet (1500 mm) of building.
- I. Storm drainage piping, buried within 5 feet (1500 mm) of building.
- J. Storm drainage piping, above grade.
- K. Propane gas piping, buried beyond 5 feet (1500 mm) of building.
- L. Propane gas piping, buried within 5 feet (1500 mm) of building.
- M. Propane gas piping, above grade.
- N. Natural gas piping, buried beyond 5 feet (1500 mm) of building.
- O. Natural gas piping, buried within 5 feet (1500 mm) of building.
- P. Natural gas piping, above grade.
- Q. Pipe flanges, unions, and couplings.
- R. Pipe hangers and supports.
- S. Pipe sleeve-seal systems.
- T. Ball valves.
- U. Butterfly valves.
- V. Balancing valves.
- W. Flow-balancing valves.
- X. Pressure reducing valves.

- Y. Pressure relief valves.
- Z. Control and service valves.
- AA. Pressure-temperature valves.
- BB. Strainers.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 31 00 - Access Doors and Panels.
- C. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.
- D. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
- E. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- F. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- G. Section 22 07 19 - Plumbing Piping Insulation.
- H. Section 31 23 16 - Excavation.
- I. Section 31 23 23 - Fill.
- J. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

- A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.
- B. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- F. ASME B31.1 - Power Piping; 2022.
- G. ASME B31.9 - Building Services Piping; 2020.
- H. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2021.
- I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- J. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Potable Water Distribution Systems; 2020.

- K. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- M. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- N. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- P. ASTM B32 - Standard Specification for Solder Metal; 2020.
- Q. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- R. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- S. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- T. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- U. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- V. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- W. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- X. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- Y. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2022.
- Z. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2021.
- AA. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
- BB. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
- CC. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2021.
- DD. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
- EE. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping; 2020.

- FF. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
- GG. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.
- HH. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019a.
- II. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- JJ. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.
- KK. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- LL. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2021.
- MM. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2017.
- NN. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.
- OO. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2020.
- PP. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).
- QQ. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.
- RR. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2022a, with Editorial Revision.
- SS. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe; 2017, with Editorial Revision (2021).
- TT. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe; 2017.
- UU. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2022.
- VV. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- WW. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- XX. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- YY. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- ZZ. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.

AAA.AWWA C606 - Grooved and Shouldered Joints; 2015.

BBB.AWWA C651 - Disinfecting Water Mains; 2014, with Addendum (2020).

CCC. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm); 2016, with Errata (2018).

DDD. AWWA C950 - Fiberglass Pressure Pipe; 2020.

EEE.CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.

FFF. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.

GGG. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential; 1989.

HHH. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

III. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.

JJJ. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

KKK.MSS SP-67 - Butterfly Valves; 2022.

LLL. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

MMM. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

NNN. NFPA 58 - Liquefied Petroleum Gas Code; 2020, with Amendment.

OOO. NSF 61 - Drinking Water System Components - Health Effects; 2021.

PPP.NSF 372 - Drinking Water System Components - Lead Content; 2022.

QQQ. PPI TR-4 - PPI HSB Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe; 2021.

RRR. UL (DIR) - Online Certifications Directory; Current Edition.

SSS.UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - 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.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 SANITARY WASTE PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. ABS Pipe: ASTM F628.
 - 1. Fittings: ABS.
 - 2. Joints: Solvent welded with ASTM D2235 cement.
- C. PVC Pipe: ASTM D3034, DR-35.
 - 1. Fittings: PVC.
 - 2. Joints: Push-on, using ASTM F477 elastomeric gaskets.

2.03 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- C. ABS Pipe: ASTM F628.
 - 1. Fittings: ABS.
 - 2. Joints: Solvent welded with ASTM D2235 cement.
- D. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 SANITARY WASTE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. ABS Pipe: ASTM F628.
 - 1. Fittings: ABS.
 - 2. Joints: Solvent welded with ASTM D2235 cement.
- D. PVC Pipe: ASTM D2729.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.05 CHEMICAL-RESISTANT SANITARY WASTE PIPING

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.

2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. ABS Pipe: ASTM F628.

1. Fittings: ABS.
2. Joints: Solvent welded with ASTM D2235 cement.

2.06 DOMESTIC WATER PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

A. Ductile Iron Pipe: AWWA C151/A21.51.

1. Fittings: AWWA C110/A21.10, ductile or gray iron, standard thickness.
2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket with 3/4-inch (19 mm) diameter rods.

B. Copper Pipe: ASTM B42, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.

C. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.
3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) FNW; Copper Press: www.fnw.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

D. PE Pipe: ASTM D2239.

1. Fittings: ASTM D2609, PE.
2. Joints: Mechanical with stainless steel clamp.

E. PVC Pipe: AWWA C900.

F. Fiberglass Pipe: AWWA C950.

G. Polyethylene and Aluminum Composite Pipe: ASTM F1281 or ASTM F1282, tested for potable water and residual chlorine use.

1. Fittings and Joints: Brass compression type.

2.07 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2. Joints: ASTM B32, alloy Sn95 solder.
- B. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) FNW; Copper Press: www.fnw.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- C. PE Pipe: ASTM D2239.
 1. Fittings: ASTM D2609, PE.
 2. Joints: Mechanical with stainless steel clamp.
- D. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
 1. Manufacturers:
 - a. Uponor, Inc: www.uponorengineering.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. PPI TR-4 Pressure Design Basis:
 - a. 160 psig (1102 kPa) at maximum 73 degrees F (23 degrees C).
 - b. 100 psig (689 kPa) at maximum 180 degrees F (82 degrees C).
 - c. 80 psig (551 kPa) at maximum 200 degrees F (93 degrees C).
 3. Fittings: Brass and engineered polymer (EP) ASTM F1960.
 4. Joints: Mechanical compression fittings.
 5. Joints: ASTM F1960 cold-expansion fittings.

2.08 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) Anvil International: www.anvilintl.com/#sle.

- 2) Apollo Valves: www.apollovalves.com/#sle.
 - 3) FNW; Copper Press: www.fnw.com/#sle.
 - 4) Grinnell Products: www.grinnell.com/#sle.
 - 5) Substitutions: See Section 01 60 00 - Product Requirements.
- B. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
1. Manufacturers:
 - a. IPEX USA, LLC; Xirtec CPVC Schedule 40: www.ipexna.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 3. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
- C. Polyethylene and Aluminum Composite Pipe: ASTM F1281 or ASTM F1282, tested for potable water and residual chlorine use.
1. Fittings and Joints: Brass compression type.
- D. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
1. Manufacturers:
 - a. SharkBite, a brand of Reliance Worldwide Corporation: www.sharkbite.com/#sle.
 - b. Uponor, Inc: www.uponorengineering.com/#sle.
 - c. Zurn Industries, LLC: www.zurn.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. PPI TR-4 Pressure Design Basis:
 - a. 160 psig (1102 kPa) at maximum 73 degrees F (23 degrees C).
 - b. 100 psig (689 kPa) at maximum 180 degrees F (82 degrees C).
 - c. 80 psig (551 kPa) at maximum 200 degrees F (93 degrees C).
 3. Fittings: Brass and copper.
 4. Fittings: Brass and engineered polymer (EP) ASTM F1960.
 5. Joints: Mechanical compression fittings.
 6. Joints: ASTM F1960 cold-expansion fittings.
 7. Push-To-Connect Fittings and Couplings:
 - a. Manufacturers:
 - 1) SharkBite, a brand of Reliance Worldwide Corporation: Brass Push; www.sharkbite.com/#sle.

- 2) SharkBite, a brand of Reliance Worldwide Corporation: EvoPEX Push; www.sharkbite.com/#sle.
- 3) SharkBite, a brand of Reliance Worldwide Corporation: Brass Crimp; www.sharkbite.com/#sle.
- 4) SharkBite, a brand of Reliance Worldwide Corporation: Poly Crimp; www.sharkbite.com/#sle.
- 5) Substitutions: See Section 01 60 00 - Product Requirements.

2.09 STORM DRAINAGE PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 1. Fittings: Cast iron.
 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. PVC Pipe: ASTM D3034 DR 35.
 1. Fittings: PVC.
 2. Joints: Push-on, using ASTM F477 elastomeric gaskets.

2.10 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 1. Fittings: Cast iron.
 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 1. Fittings: Cast iron.
 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. ABS Pipe: ASTM D2680.
 1. Fittings: ABS.
 2. Joints: Solvent welded with ASTM D2235 cement.
- D. PVC Pipe: ASTM D2665 or ASTM D3034.
 1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.11 STORM DRAINAGE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 1. Fittings: Cast iron.
 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. ABS Pipe: ASTM D2680.
1. Fittings: ABS.
 2. Joints: Solvent welded with ASTM D2235 cement.
- D. PVC Pipe: ASTM D2665.
1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.
- 2.12 PROPANE GAS PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING
- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Manufacturers:
 - a. Wheatland Tube Company: www.wheatland.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.
 3. Joints: ASME B31.1, welded.
- B. Flexible Gas Piping:
1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 2. Fittings: Provided by piping system manufacturer.
 3. Manufacturers:
 - a. Omega Flex, Inc; TracPipe PS-II: www.omegaflex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- 2.13 PROPANE GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING
- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Manufacturers:
 - a. Wheatland Tube Company: www.wheatland.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.
 3. Joints: ASME B31.1, welded.
- B. Flexible Gas Piping:

1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
2. Fittings: Provided by piping system manufacturer.
3. Manufacturers:
 - a. Omega Flex, Inc; TracPipe PS-II: www.omegaflex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.14 PROPANE GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 1. Manufacturers:
 - a. Wheatland Tube Company: www.wheatland.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 3. Joints: NFPA 58, threaded or welded to comply with ASME B31.1.
- B. Flexible Gas Piping:
 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 2. Comply with ASTM E84.
 3. Fittings: Provided by piping system manufacturer.
 4. Provide piping with integral lightning protection.
 5. Manufacturers:
 - a. Omega Flex, Inc; TracPipe CounterStrike: www.omegaflex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.15 NATURAL GAS PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 1. Manufacturers:
 - a. Wheatland Tube Company: www.wheatland.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.
 3. Joints: ASME B31.1, welded.
- B. Flexible Gas Piping:
 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 2. Fittings: Provided by piping system manufacturer.

3. Manufacturers:
 - a. Omega Flex, Inc; TracPipe PS-II: www.omegaflex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - C. Polyethylene Pipe: ASTM D2513, SDR 11.
 1. Fittings: ASTM D2683 or ASTM D2513 socket type.
 2. Joints: Fusion welded.
- 2.16 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING
- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 1. Manufacturers:
 - a. Wheatland Tube Company: www.wheatland.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Fittings: ASTM A234/A234M, wrought steel welding type.
 3. Joints: ASME B31.1, welded.
 4. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.
 - B. Flexible Gas Piping:
 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 2. Fittings: Provided by piping system manufacturer.
 3. Manufacturers:
 - a. Omega Flex, Inc; TracPipe PS-II: www.omegaflex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- 2.17 NATURAL GAS PIPING, ABOVE GRADE
- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 2. Joints: Threaded or welded to ASME B31.1.
 - B. Flexible Gas Piping:
 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 2. Comply with ASTM E84.
 3. Fittings: Provided by piping system manufacturer.
 4. Provide piping with integral lightning protection.
 5. Manufacturers:

- a. Omega Flex, Inc; TracPipe CounterStrike: www.omegaflex.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

2.18 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch (80 mm, DN) and Under:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 - 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Sizes Over 1 inch (25 mm, DN):
 - 1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 - 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 1. Dimensions and Testing: In accordance with AWWA C606.
 - 2. Housing Material: Provide ASTM A47/A47M malleable iron, ASTM A47/A47M malleable iron, ductile iron, ductile iron, _____, or _____, galvanized , galvanized.
 - 3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
 - 4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 - 5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
 - 6. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. Apollo Valves: www.apollovalves.com/#sle.
 - c. Grinnell Products: www.grinnell.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. No-Hub Couplings:
 - 1. Testing: In accordance with ASTM C1277 and CISPI 310.
 - 2. Gasket Material: Neoprene complying with ASTM C564.
 - 3. Band Material: Stainless steel.
 - 4. Eyelet Material: Stainless steel.
 - 5. Manufacturers:
 - a. MIFAB, Inc; MI-QHUB: www.mifab.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

E. Shielded, Heavy Duty No-Hub Couplings:

1. Testing: In accordance with ASTM C1540 and FM 1680.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.
5. Manufacturers:
 - a. MIFAB, Inc; MI-QXHUB: www.mifab.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

F. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.19 PIPE HANGERS AND SUPPORTS

A. See Section 22 05 29 for additional requirements.

B. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - a. Cold and Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Double hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.
5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High-density polypropylene.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment and Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
 - e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
 - f. Manufacturers:
 - 1) PHP Systems/Design: www.phpsd.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

C. Plumbing Piping - Drain, Waste, and Vent:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
3. Wall Support for Pipe Sizes to 3 inch (80 mm, DN): Cast iron hook.
4. Wall Support for Pipe Sizes 4 inch (100 mm, DN) and Over: Welded steel bracket and wrought steel clamp.
5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D. Plumbing Piping - Water:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 to 4 inch (50 to 100 mm, DN): Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Adjustable steel yoke, cast iron pipe roll, double hanger.
5. Wall Support for Pipe Sizes Up to 3 inch (80 mm, DN): Cast iron hook.
6. Wall Support for Pipe Sizes 4 inch (100 mm, DN) and Larger: Welded steel bracket and wrought steel clamp.
7. Wall Support for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Floor Support for Hot Pipe Sizes to 4 inch (100 mm, DN): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

E. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Comply with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Comply with ICC-ES AC01.
3. Concrete Screw Type Anchors: Comply with ICC-ES AC193.
4. Masonry Screw Type Anchors: Comply with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Comply with ICC-ES AC308.
6. Other Types: As required.

7. Manufacturers:
 - a. Powers Fasteners, Inc: www.powers.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.20 PIPE SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
 1. BMW Company: www.bmwcompany.com/#sle.
 2. GPT, a company of Enpro Industries, Inc: www.gptindustries.com/#sle.
 3. The Metraflex Company; MetraSeal: www.metraflex.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Modular Mechanical Seals:
 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 3. Size and select seal component materials in accordance to service requirements.
 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. Fire Resistant: 1 hour, UL (DIR) approved.
 - e. High Temperature, up to 400 deg F (204 deg C).
 - f. Low temperature, down to minus 67 deg F (minus 55 deg C).
 5. Glass reinforced plastic pressure end plates.
- C. Wall Sleeve: PVC material with water-stop collar, and nailer end-caps.
- D. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch (76.2 mm) thick.
- E. Pipeline-Casing Seals:
 1. Coated metallic boltless casing-spacer for 4 inch (100 mm) carrier pipe.
 2. Coated metallic boltless modular seal for 6 inch (150 mm) carrier pipe.
 3. Carbon steel band with risers for 12 inch (305 mm) carrier pipe.
 4. End Seals: 1/8 inch (3.1 mm), pull-on type, rubber or synthetic rubber based.

2.21 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. Nibco, Inc: www.nibco.com/#sle.
 5. SharkBite, a brand of Reliance Worldwide Corporation: www.sharkbite.com/#sle.
 6. Uponor, Inc: www.uponorengineering.com/#sle.
 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Construction, 4 inch (100 mm, DN) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.22 BUTTERFLY VALVES

- A. Manufacturers:
1. Anvil International: www.anvilintl.com/#sle.
 2. Apollo Valves: www.apollovalves.com/#sle.
 3. Crane Company: www.cranecpe.com/#sle.
 4. Flomatic Valves: www.flomatic.com/#sle.
 5. Grinnell Products; B302: www.grinnell.com/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Construction 1-1/2 inch (40 mm, DN) and Larger: MSS SP-67, 200 psi (1380 kPa) CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.
- C. Provide gear operators for valves 8 inches (150 mm, DN) and larger, and chain-wheel operators for valves mounted over 8 feet (2400 mm) above floor.

2.23 BALANCING VALVES

- A. Manufacturers:
1. Anvil International: www.anvilintl.com/#sle.
 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 3. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 4. Griswold Controls: www.griswoldcontrols.com/#sle.
 5. Taco, Inc: www.taco-hvac.com/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Construction: Class 125, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Manual Operated Y-Pattern Globe, Size 1/2 to 2 inch (15 to 50 mm, DN):
 - 1. Class 125, brass or bronze body, multi-turn handwheel, memory stop, variable orifice, soldered connections, dual PT (hot and cold pressure-temperature) test ports for 300 psi (2,068 kPa), minus 4 to 250 deg F (minus 20 to 121.1 deg C) WOG service.
- D. Automatic Flow Limiting Cartridge, Size 3/4 inch (20 mm, DN):
 - 1. Class 125, brass or bronze body, stainless steel cartridge, threaded connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi (2,758 kPa), 0.5 gpm (1.9 Lpm) WOG service.
- E. Automatic Flow Limiting Cartridge with Ball Valve, Size 1/2 to 1 inch (15 to 25 mm, DN):
 - 1. Class 125, brass or bronze body, stainless steel cartridge, leak-proof stem, threaded or soldered connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi (2,758 kPa), 0.25 to 1.5 gpm (0.9 to 5.6 Lpm) WOG service.
- F. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

2.24 FLOW-BALANCING VALVES

- A. Manufacturers:
 - 1. Anvil International: www.anvilintl.com/#sle.
 - 2. Griswold Controls: www.griswoldcontrols.com/#sle.
 - 3. ITT Bell & Gossett: www.bellgossett.com/#sle.
 - 4. Taco, Inc: www.taco-hvac.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

2.25 PRESSURE REDUCING VALVES

- A. Manufacturers:
 - 1. Amtrol Inc: www.amtrol.com/#sle.
 - 2. Apollo Valves: www.apollovalves.com/#sle.
 - 3. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
 - 4. Cla-Val Company: www.cla-val.com/#sle.
 - 5. Flomatic Valves: www.flomatic.com/#sle.

6. Singer, a Mueller brand: www.singervalue.com/#sle.
 7. Watts Regulator Company: www.wattsregulator.com/#sle.
 8. Zurn Industries, LLC; 500XL: www.zurn.com/#sle.
 9. Substitutions: See Section 01 60 00 - Product Requirements.
- B. 2 inch (50 mm, DN) and Smaller:
1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
 2. Pressure Reducing Pilot-Operator:
 - a. Operating Range: 5 to 50 psi (0.35 to 3.5 Bar).
 - b. Connected into brass or bronze pilot piping and fittings.
 - c. Fixed flow restrictor, pressure gauges, and isolation valves.
- C. 2 inch (50 mm, DN) and Larger:
1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.
 2. Pressure Reducing Pilot-Operator:
 - a. Operating Range: 10 to 80 psi (0.7 to 5.5 Bar).
 - b. Connected into brass or bronze pilot piping and fittings.
 - c. Fixed flow restrictor, strainer, pressure gauges, and isolation valves.
- D. Pilot Operated:
1. Cast bronze, 1-1/2 to 8 inch, NPS (40 to 200 mm, DN) in size with flanged end connections. Rated for 300 psi (2,070 kPa) inlet pressure with outlet discharge field-set to system inlet pressure.
- E. Pressure Reducing Valves with Integral Back-Up:
1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Size: 3 to 36 inch (80 to 900 mm, DN), Class 150 flange ends.
 3. ASSE 1003 and AWWA C550 compliant cast iron body, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
 4. Pressure Reducing Pilot-Operator:
 - a. Operating Range: 30 to 145 psi (2.07 to 10 Bar).
 - b. Connected into brass, bronze, or stainless steel pilot piping and fittings.
 - c. Precision fixed-flow restrictor, strainer, pressure gauges, and isolation valves,

- d. Include pilot-side strainer on valve sizes above 4 inch (100 mm, DN).
- F. Pressure Reducing Valves with Low-Flow By-Pass:
 - 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Size: 3 to 10 inch (80 to 250 mm, DN), Class 150 flange ends.
 - 3. ASSE 1003 and AWWA C550 compliant cast iron body, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
 - 4. Pressure Reducing Pilot-Operator:
 - a. Operating Range: 30 to 145 psi (2.07 to 10 Bar).
 - b. Direct Acting By-Pass Range: 5 to 50 psi (0.35 to 35 Bar).
 - c. Connected into brass, bronze, or stainless steel pilot piping and fittings.
 - d. Precision fixed-flow restrictor, strainer, pressure gauges, and isolation valves.
 - e. Include pilot-side strainer on valve sizes above 4 inch (100 mm, DN).
- G. Pressure Reducing and Pressure Sustaining Valves:
 - 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Size: 1/2 to 40 inch (15 to 1,000 mm, DN), Class 150 flange ends.
 - 3. ASSE 1003 and AWWA C550 compliant cast iron body, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
 - 4. Pressure Reducing Pilot-Operator:
 - a. Operating Range: 10 to 80 psi (0.7 to 5.5 Bar).
 - b. Connected into brass, bronze, or stainless steel pilot piping and fittings.
 - c. Precision fixed-flow restrictor, pressure gauges, and isolation valves.
 - d. Include pilot-side strainer on valve sizes above 4 inch (100 mm, DN).
- H. Pressure Reducing and Sustaining Valves:
 - 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Size: 1/2 to 40 inch (15 to 1,000 mm, DN), Class 150 flange ends.

3. ASSE 1003 and AWWA C550 compliant cast iron body, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Dual Pressure Reducing Pilot-Operators:
 - a. Operating Range: 10 to 80 psi (0.7 to 5.5 Bar).
 - b. Connected into brass, bronze, or stainless steel piping and fittings.
 - c. Precision fixed-flow restrictor, pressure gauges, and isolation valves.
 - d. Include pilot-side strainer on valve sizes above 4 inch (100 mm, DN).

2.26 PRESSURE RELIEF VALVES

- A. Manufacturers:
 1. Cla-Val Co: www.cla-val.com/#sle.
 2. Watts Regulator Company: www.wattsregulator.com/#sle.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- C. Surge Anticipating, Pressure Relief Valves:
 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Size: 1/2 to 40 inch (15 to 1,000 mm, DN).
 3. Class 150 flange ends; AWWA C550 compliant cast iron globe valve with elastomeric diaphragm, seat disc, and epoxy coated finish both internally and externally.
 4. Differential Pressure Based Dual Pilot-Operator:
 - a. Low-Surge Operating Range: 7 to 50 psi (0.48 to 3.5 bar).
 - b. High-Surge Operating Range: 10 to 80 psi (0.7 to 5.5 bar).
 - c. Connected into brass, bronze, or stainless steel pilot piping and fittings.
 - d. Precision fixed-flow restrictor, test needle-valve, strainer, swing check valve, pressure gauges, and isolation valves.

2.27 CONTROL AND SERVICE VALVES

- A. Flow Metered Valves:
 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2. Cast iron globe valve, elastomeric diaphragm, seat disc, flow insertion probe, and epoxy coated both internally and externally.
 3. Size: 3 to 36 inch (80 to 750 mm, DN), Class 150 flange ends.
 4. Pre-Inserted Flow Probe:
 - a. Fluid Service Rating: Up to 250 psi (1,724 kPa).
 - b. Electromagnetic, plus or minus two percent NIST traceable accuracy.
 5. AC Powered Flow Converter:
 - a. NEMA EN 10250 Type 4X, local device with grounding ring and outdoor rated cables.
 - b. Digital display with pushbutton interface with reversible flow detection capability.
 - c. Indication: High and low alarms, faults, flow rate, totalized flow, flow range, and forward/reverse flow direction.
 - d. Output: Dual 4 to 20 mA VDC, programmable for remote monitoring.
 - e. Auxiliary Contacts: Four internal relays programmable to data or alarms.
 - f. Control: Provide solenoid valves to control valve at programmable setpoint.
- B. Flow Control Valves:
1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Size: 1/2 to 40 inch (15 to 1,000 mm, DN), Class 150 flange ends.
 3. AWWA C550 compliant cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
 4. Differential Pressure Based Rate-of-Flow Pilot-Operator:
 - a. Operating Range: 25 to 50 psi (1.72 to 3.4 Bar).
 - b. Connected into brass, bronze, or copper pilot piping and fittings.
 - c. Precision fixed-flow restrictor, strainer, pressure gauges, and isolation valves.
- C. Level Control Valves:
1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Size: 3 to 40 inch (80 to 1,000 mm, DN), Class 150 flange ends.
 3. AWWA C550 compliant 2-position operated, cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.

4. Pressure Based Rate-of-Flow Pilot-Operator:
 - a. Connected into brass, copper, ductile iron, or stainless steel pilot piping and fittings.
 - b. Fixed-flow restrictor, check valve, strainer, altitude gauge, and isolation valves.
 - c. Spring Operating Range: 10 to 60 ft (3 to 18 m) with 1 to 3 ft (0.3 to 0.9 m) reservoir head to supply pressure differential.

D. Pump Control Valves:

1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
2. Size: 2 to 20 inch (50 to 500 mm, DN), Class 150 flange ends.
3. AWWA C550 compliant, single chamber, cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. Valve Pilot-Operator:
 - a. Watertight components connected into brass or ductile iron pilot piping and fittings.
 - b. Control: NEMA EN 10250 Type 4X, 120 VAC, 50/60 Hz solenoid valve.
 - c. Monitoring: NEMA EN 10250 Type 4X single-pole double-throw limit switch.
 - d. Fixed-flow restrictor, check valve, needle valve, strainer, pressure gauges, and isolation valves.

E. Electronic Control Valves:

1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
2. Size: 2 to 20 inch (50 to 500 mm, DN), Class 150 flange ends.
3. AWWA C550 compliant, single chamber, normally open cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
4. 2-Position Control:
 - a. Control Function: Energize solenoid to close valve.
 - b. Connected into brass or ductile iron pilot piping and fittings.
 - c. NEMA EN 10250 Type 4X, 120 VAC, 50/60 Hz pilot connected solenoid valve.
 - d. Watertight high and low speed adjusting valves, strainer, and isolation valves.
 - e. Pilot interfaced analog valve position transmitter with 4 to 20 mA VDC output.

F. Pilot and Needle Valves:

1. Manufacturers:

- a. Singer, a Mueller brand: www.singervalue.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements.
2. 5 to 50 psi (0.35 to 35 Bar) Pilot-Operator: Bronze body, 5 to 50 psi (0.35 to 35 Bar), top spring adjusting screw.
3. Needle Valve: Brass body, stainless steel stem with maximum service rating of 400 psi (27.6 Bar) at 140 degrees F (60 degrees C).

2.28 PRESSURE-TEMPERATURE VALVES

A. Manufacturers:

1. Cla-Val Co: www.cla-val.com/#sle.
2. Watts Regulator Company: www.wattsregulator.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

- B. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F (98.9 degrees C), capacity ASME BPVC-IV certified and labelled.

2.29 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. Green Country Filter Manufacturing: www.greencountryfilter.com/#sle.
3. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
4. WEAMCO: www.weamco.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Size 1/2 inch (15 mm, DN) to 3 inch (80 mm, DN):

1. Class 150, threaded forged bronze Y-pattern body, stainless steel perforated mesh screen with cap, and rated for 150 psi (1,034 kPa), 250 deg F (121.1 deg C) WOG service.

C. Size 2 inch (50 mm, DN) and Smaller:

1. Threaded brass body for 175 psi (1200 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi (2070 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

D. Size 1-1/2 inch (40 mm, DN) to 4 inch (100 mm, DN):

1. Class 125, flanged iron body, Y pattern with 1/16 inch (1.6 mm) stainless steel perforated screen.

E. Size 5 inch (125 mm, DN) and Larger:

1. Class 125, flanged iron body, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. 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. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 22 05 16.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 - 1. See Section 22 07 19.
- G. Provide access where valves and fittings are not exposed.
- H. Establish elevations of buried piping outside the building to ensure not less than 2 ft (____ m) of cover.
- I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- K. Provide support for utility meters in accordance with requirements of utility companies.
- L. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
- M. Excavate in accordance with Section 31 23 16.
- N. Backfill in accordance with Section 31 23 23.
- O. Install bell and spigot pipe with bell end upstream.
- P. Install valves with stems upright or horizontal, not inverted. See Section 22 05 23.
- Q. Install water piping to ASME B31.9.

- R. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- S. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- T. Sleeve pipes passing through partitions, walls, and floors.
- 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 (100 mm, DN).
 - 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 ASME B31.9.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 8. Provide copper plated hangers and supports for copper piping.
 - 9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - 10. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 22 05 48.
 - 11. Support cast iron drainage piping at every joint.
- W. Pipe Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.

3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a watertight seal.
 6. Install in accordance with manufacturer's recommendations.
- X. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe valves for throttling, bypass, or manual flow control services.
- F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- G. Provide spring-loaded check valves on discharge of water pumps.
- H. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.06 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
 1. Perform hydrostatic testing for leakage prior to system disinfection.
 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
 3. General:
 - a. Fill the system with water and raise static head to 10 psi (345 kPa) above service pressure. Minimum static head of 50 to 150 psi (345 to 1,034 kPa). As an exception, certain codes allow a maximum static pressure of 80 psi (551.6 kPa).
- C. Gas Distribution Systems:
 1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.

2. General Systems:

- a. Inject a minimum of 10 psi (68.9 kPa) of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.
- b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound (0.45 kg).

3. Welded Pipes or Systems with Service Pressures Above 14 in-wc (3.48 kPa):

- a. Inject a minimum of 60 psi (413.7 kPa) of compressed air into the piping system for a duration of 30 minutes and verify with a gauge that no perceptible pressure drop is measured.
- b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound (0.45 kg) with 1 psi (6.9 kPa) increments.

D. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system in accordance with Section 33 01 10.58.
- B. Prior to starting work, verify system is complete, flushed, and clean.
- C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

2. Provide 18 gauge, 0.0478-inch (1.21 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.

3.09 SCHEDULES

- A. Pipe Hanger Spacing Schedule per manufacturer's recommendations.

END OF SECTION

**SECTION 22 10 06
PLUMBING PIPING SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Washing machine boxes and valves.
- F. Refrigerator valve and recessed box.
- G. Backwater valves.
- H. Backflow preventers.
- I. Water hammer arrestors.
- J. Sumps.
- K. Sanitary waste interceptors.
- L. Mixing valves.
- M. Relief valves.
- N. Air vents.
- O. Floor drain trap seals.
- P. Electronic trap-seal primers.
- Q. Domestic water distribution manifolds.
- R. Exterior penetration accessories.
- S. Fire-rated enclosures.

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Plumbing Piping.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor and Trench Drains; 2019.

- C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2003 (Reaffirmed 2012).
- D. ASME A112.6.9 - Siphonic Roof Drains; 2005 (Reaffirmed 2019).
- E. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2017.
- F. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- I. DIN 19580 - Drainage Channels for Vehicular and Pedestrian Areas - Durability, Mass Per Unit Area and Evaluation of Conformity; 2010.
- J. NSF 61 - Drinking Water System Components - Health Effects; 2021.
- K. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- L. PDI-WH 201 - Water Hammer Arresters; 2017.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- D. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

- A. Manufacturers:
 1. Acudor Platinum, a division of Acudor: www.acudorplatinum.com/#sle.

2. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
3. MIFAB, Inc: www.mifab.com/#sle.
4. Zurn Industries, LLC: www.zurn.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Roof Drains:

1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Removable polyethylene dome with vandal proof screws.
4. Accessories: Coordinate with roofing type, see Section _____:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Controlled flow weir.
 - f. Leveling frame.
 - g. Adjustable extension sleeve for roof insulation.
 - h. Perforated or slotted ballast guard extension for inverted roof.
 - i. Perforated stainless steel ballast guard extension.
 - j. O-ring seal between male and female connection pipes.
5. Manufacturers:
 - a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - b. MIFAB, Inc: www.mifab.com/#sle.
 - c. Zurn Industries, LLC; Z100: www.zurn.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Siphonic Roof Drains:

1. Assembly: ASME A112.6.9.
2. Body: Lacquered cast iron with sump.
3. Strainer: Removable polyethylene dome with vandal proof screws.
4. Accessories: Coordinate with roofing type.
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.

- c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Controlled flow weir.
 - f. Leveling frame.
 - g. Adjustable extension sleeve for roof insulation.
 - h. Perforated or slotted ballast guard extension for inverted roof.
 - i. Perforated stainless steel ballast guard extension.
 - j. O-ring seal between male and female connection pipes.
5. Manufacturers:
- a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - b. MIFAB, Inc; Hydromax: www.mifab.com/#sle.
 - c. Zurn Industries, LLC: www.zurn.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Parapet Drains:
- 1. Lacquered cast iron body with aluminum flashing clamp collar and epoxy coated sloping grate.
- E. Canopy and Cornice Drains:
- 1. Lacquered cast iron body with aluminum flashing clamp collar and epoxy coated flat strainer.
- F. Roof Overflow Drains:
- 1. Lacquered cast iron body and clamp collar and bottom clamp ring; pipe extended to 2" above flood elevation.
- G. Downspout Nozzles:
- 1. Bronze round with straight bottom section.
- H. Area Drains:
- 1. Assembly: ASME A112.6.4.
 - 2. Body: Lacquered cast iron with sump.
 - 3. Strainer: Round nickel-bronze.
 - 4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp.
 - 5. Manufacturers:
 - a. MIFAB, Inc; F1320-C Series: www.mifab.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

I. Area Drains - Aluminum:

1. Assembly: ASME A112.6.4.
2. Body Material:
 - a. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required.
3. Strainer Material :
 - a. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required.
4. Bowl: Refer to drawings.
5. Accessories:
 - a. Provide o-ring seal between male and female connection pipes.
 - b. Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp.
6. Manufacturers:
 - a. Menzies Metal Products; Clamp-Tite Aluminum Flat Top Drain (With Bowl): www.menzies-metal.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

J. Center Drains:

1. Body: Provide stainless-steel with sloped channel to vertical waste pipe.
2. Clamping Ring: Stainless steel mechanism to clamp waterproof membrane to drain body.
3. Strainer: Removable brushed stainless steel or tile top strainer furnished by manufacturer or others.
4. Grate: Tile insert.
 - a. Dimensions: As indicated on drawings.
5. Grate: Cross-hatch.
 - a. Dimensions: As indicated on drawings.
6. Finish on Exposed Surfaces: As selected by from manufacturer's full line.
7. Additional Components: Manufacturer's standard membrane, sealant, fasteners, and anchors.
8. Manufacturers:
 - a. Infinity Drain Ltd: www.infinitydrain.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

K. Linear Drains:

1. Body: Provide PVC, ABS, or stainless-steel with sloped channel to vertical waste pipe.
2. Clamping Ring: Stainless steel mechanism to clamp waterproof membrane to linear drain body.
3. Strainer: Removable brushed stainless steel or tile top strainer furnished by manufacturer or others.

4. Grate: Cross-hatch.
 5. Additional Components: Manufacturer's standard membrane, sealant, fasteners, and anchors.
 6. Manufacturers:
 - a. Infinity Drain Ltd: www.infinitydrain.com/#sle.
 - b. MIFAB, Inc: www.mifab.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- L. Floor Drains:
1. Manufacturers:
 - a. ACO, Inc: www.acobuildingdrainage.us/#sle.
 - b. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - c. MIFAB, Inc; FS1100-C Series: www.mifab.com/#sle.
 - d. Zurn Industries, LLC; Z415-BZ1: www.zurn.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- M. Floor Drain:
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
- N. Shower Channel Drain: Factory fabricated channel and grate with built in outlet pipe.
1. Basis of Design: ACO Polymer Products, Inc., QuARTz: www.quartzbyaco.com/#sle.
 2. Channel Edge: Plain edge.
 3. Plumbing Connector Type: Stainless steel.
 4. Channel Length: Per plans.
 5. Grate Style: Solid tray to accept tile to match floor; with drainage slot at edges.
 6. Substrate Construction: Wooden subfloor over joists.
 7. Material: Electropolished stainless steel.
 8. Outlet Pipe: 2 inch (51 mm) diameter.
 9. Manufacturers:
 - a. MIFAB, Inc: www.mifab.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- O. Prefabricated Trench Drain: Trench drain system assembled from factory fabricated, polymer concrete castings in standard lengths and variable depths, with integral joint flanges and integral grating support rails; includes joint gaskets and grating.

1. Basis of Design: ACO Polymer Products, Inc., FlowDrain: www.acousa.com/#sle.
2. Load Class: DIN 19580, Class C.
3. ADA Standards compliant.
4. Chemical Resistant.
5. Trench Width: 8 inches (203 mm).
6. Trench Section Length: Per plans.
7. Grating Support Rail: Stainless steel.
8. Accessories:
 - a. Foul air trap.
 - b. Oval to round pipe connection.
 - c. Vertical outlet strainer.

P. Floor Sink:

1. Lacquered cast iron body with dome strainer and seepage flange.
2. Manufacturers:
 - a. MIFAB, Inc; FS1720-FL Series: www.mifab.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. MIFAB, Inc; C1100-R: www.mifab.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Cleanouts at Exterior Surfaced Areas:

1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

D. Cleanouts at Interior Finished Floor Areas:

1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

E. Cleanouts at Interior Finished Wall Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- F. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Watts Regulator Company: www.wattsregulator.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Interior Hose Bibbs:

1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome-plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

C. Interior Mixing Type Hose Bibbs:

1. Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome-plated where exposed with handwheels, and vacuum breaker in compliance with ASSE 1011.

2.05 HYDRANTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Zurn Industries, LLC: www.zurn.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wall Hydrants:

1. ASSE 1019; freeze resistant, self-draining type with chrome-plated wall plate hose thread spout, handwheel, and integral vacuum breaker.

C. Floor Hydrants:

1. ASSE 1019; chrome-plated lockable recessed box, hose thread spout, lockshield and removable key, and vacuum breaker.

2.06 WASHING MACHINE BOXES AND VALVES

A. Box Manufacturers:

1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
2. Oatey Supply Chain Services, Inc: www.oatey.com/#sle.
3. Viega LLC: www.viega.us/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Valve Manufacturers:
 1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
 2. Viega LLC: www.viega.us/#sle.
 3. Zurn Industries, LLC: www.zurn.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch (50 mm) waste, slip in finishing cover.

2.07 REFRIGERATOR VALVE AND RECESSED BOX

- A. Box Manufacturers:
 1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
 2. Oatey Supply Chain Services, Inc: www.oatey.com/#sle.
 3. Viega LLC: www.viega.us/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Valve Manufacturers:
 1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
 2. Viega LLC: www.viega.us/#sle.
 3. Zurn Industries, LLC: www.zurn.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.08 BACKWATER VALVES

- A. Manufacturers:
 1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 2. Savko Plastic Pipe & Fittings, Inc: www.savko.com/#sle.
 3. Zurn Industries, LLC: www.zurn.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Cast Iron Backwater Valves: ASME A112.6.4; lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.
- C. Plastic Backwater Valves: ABS body and valve, extension sleeve, and access cover.

2.09 BACKFLOW PREVENTERS

A. Manufacturers:

1. Apollo Valves: www.apollovalves.com/#sle.
2. MIFAB, Inc; FRP: www.mifab.com/#sle.
3. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
4. Zurn Industries, LLC; 375XL: www.zurn.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Reduced Pressure Backflow Preventer Assembly:

1. ASSE 1013 and NSF 61 compliant reinforced-nylon body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, integral male test fittings, and non-threaded vent outlet.
2. Size: 3/4 to 2 inch (20 to 50 mm, DN) assembly with threaded gate valves.
3. Maximum Working Parameters: 175 psi (1,207 kPa) at 180 degrees F (82.2 degrees C).
4. Accessories: Provide air gap fitting, lead-free Y-strainer, and test cocks.

2.10 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

2.11 SUMPS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Zurn Industries, LLC: www.zurn.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Precast concrete with required openings and drainage fittings.

C. Cover: 3/8 inch (9 mm) thick checkered steel plate with gasket seal frames and anchor bolts.

2.12 SANITARY WASTE INTERCEPTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. MIFAB, Inc: www.mifab.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Oil Interceptors:

1. Construction:
 - a. Material: Epoxy coated fabricated steel.
 - b. Rough-in: On floor.
 - c. Accessories: Integral deep seal trap, removable integral flow control, adjustable draw-off assembly, sediment bucket.
 - d. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port, recessed for floor finish.
2. Unit Rating: Per plans.
3. Manufacturers:
 - a. MIFAB, Inc; Super Max Oil Interceptor: www.mifab.com/#sle.
 - b. MIFAB, Inc; Big Max Oil Interceptor: www.mifab.com/#sle.
 - c. MIFAB, Inc; Lil Max Oil Interceptor: www.mifab.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Grease Interceptors:

1. Construction:
 - a. Material: Epoxy-coated fabricated steel.
 - b. Rough-in: On floor.
 - c. Accessories: Multi-weir baffle assembly, integral deep seal trap, removable integral flow control, sediment bucket.
 - d. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port, recessed for floor finish.
2. Unit Rating: Per plans.
3. Manufacturers:
 - a. MIFAB, Inc; Super Max Grease Interceptor: www.mifab.com/#sle.
 - b. MIFAB, Inc; Big Max Grease Interceptor: www.mifab.com/#sle.

- c. MIFAB, Inc; Lil Max Grease Interceptor: www.mifab.com/#sle.
- d. MIFAB, Inc; MI-G Grease Interceptor: www.mifab.com/#sle.
- e. MIFAB, Inc; XL-MI-G Grease Interceptor: www.mifab.com/#sle.
- f. Substitutions: See Section 01 60 00 - Product Requirements.

D. Sand/Sediment Interceptors:

- 1. Epoxy coated cast iron body and secured cover with removable stainless steel sediment bucket.

2.13 MIXING VALVES

A. Thermostatic Mixing Valves:

- 1. Manufacturers:
 - a. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
 - b. ESBE: www.esbe.se/en.
 - c. Honeywell International Inc: www.honeywellhome.com/#sle.
 - d. Leonard Valve Company: www.leonardvalve.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Valve: Chrome-plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
- 3. Accessories:
 - a. Check valve on inlets.
 - b. Volume control shut-off valve on outlet.
 - c. Stem thermometer on outlet.
 - d. Strainer stop checks on inlets.
- 4. Cabinet: 16 gauge, 0.0598 inch (1.52 mm) prime-coated steel, for recessed mounting with keyed lock.

2.14 RELIEF VALVES

A. Manufacturers:

- 1. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
- 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
- 3. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.15 AIR VENTS

A. Manufacturers:

1. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 3. Taco, Inc: www.taco-hvac.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Manual Type: Short vertical sections of 2 inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber.
- C. Float Type:
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.
 2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.
- D. Washer Type:
1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.16 FLOOR DRAIN TRAP SEALS

- A. Manufacturers:
1. Green Drains; GD4: www.greendrains.com/#sle.
 2. MIFAB, Inc; MI-GARD: www.mifab.com/#sle.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

2.17 ELECTRONIC TRAP-SEAL PRIMERS

- A. Manufacturers:
1. MIFAB, Inc; MI-100: www.mifab.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Enclosed electronic trap seal primer system with timer.

2.18 DOMESTIC WATER DISTRIBUTION MANIFOLDS

- A. Manufacturers:
1. Viega LLC; ManaBloc: www.viega.us/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Domestic water distribution system with integrated quarter-turn shutoff valves for each plumbing fixture.

2.19 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
 - 1. Manufacturers:
 - a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Roof Drain Outlet Pipe Connection: Drain seal to connect roof drain to drain piping.
 - 1. Products:
 - a. Menzies Metal Products; Blue Drain Seal: www.menzies-metal.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for piping, cables, and roofing system to be installed; designed to accommodate existing penetrations where applicable.
 - 1. Products:
 - a. Menzies Metal Products; Plumbing Stack Aluminum Welded: www.menzies-metal.com/#sle.
 - b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
 - c. Menzies Metal Products; Gas Retro Box: www.menzies-metal.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Plumbing Ventilation Thru Roof Accessories - Retrofit:
 - 1. Plumbing Pipe Extension Kit: Extends roof plumbing pipes above minimum clearance from roof surface per local codes and Authority Having Jurisdiction (AHJ).
 - a. Products:
 - 1) Menzies Metal Products; Plumbing Pipe Extension Kit: www.menzies-metal.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Retrofit Cap: Spun aluminum cap for use with aluminum or PVC plumbing stack.
 - a. Products:
 - 1) Menzies Metal Products; Econo Cap Spun Aluminum: www.menzies-metal.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Vandal Resistant Cap: Spun aluminum cap for use with aluminum or PVC plumbing stack. Cap designed to be secured with pop-rivets to prevent removal.
 - a. Products:
 - 1) Menzies Metal Products; Vandalproof Cap: www.menzies-metal.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.20 FIRE-RATED ENCLOSURES

- A. Manufacturers:
 - 1. Fire Rated Product Specialties Corp: www.frpsonline.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or washing machine outlets.
- H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch (20 mm) minimum, and minimum 18 inches (450 mm) long.

END OF SECTION

SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 05 53 - Identification for HVAC Piping and Equipment: Piping identification.
- C. Section 23 07 16 - HVAC Equipment Insulation.
- D. Section 23 07 19 - HVAC Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. FM (AG) - FM Approval Guide; Current Edition.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
 - 1. Minimum three years experience.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Manufacturers:
 - 1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Vertical Piping:
 - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- D. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- G. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.
- H. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external pipe diameter.

3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

A. Manufacturers:

1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
2. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.
3. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. Fire Resistant: 1 hour, UL (DIR) approved.
 - e. High Temperature, up to 400 degrees F (204 degrees C).
 - f. Low temperature, down to minus 67 degrees F (minus 55 degrees C).
5. Glass-reinforced plastic pressure end plates.

C. Sealing Compounds:

1. Provide packing and sealing compound to fill pipe to sleeve thickness.
2. Combined packing and seal compound is to match partition fire-resistance hourly rating.

D. Pipe Sleeve Material:

1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
2. Masonry Structures: Sheet metal or fiber.

E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

F. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch (76.2 mm) thick.

G. Pipeline-Casing Seals:

1. Coated boltless casing-spacer for 4 inch (100 mm) carrier pipe.

2. Coated boltless modular seal for 6 inch (150 mm) carrier pipe.
3. Carbon steel band with risers for 12 inch (305 mm) carrier pipe.
4. End Seals: 1/8 inch (3.1 mm), pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations:
 1. Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber in compliance with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

G. Manufactured Sleeve-Seal Systems:

1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components.
- B. Retrofit piping cover system.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2022.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- E. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- I. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.

- L. FM (AG) - FM Approval Guide; Current Edition.
- M. MFMA-4 - Metal Framing Standards Publication; 2004.
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- O. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL (DIR) - Online Certifications Directory; Current Edition.
- Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.05 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 channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
 - 1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
 - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- D. Installer's Qualifications: Include evidence of compliance with specified requirements.

- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Installer Qualifications for Field-Welding.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Prefabricated Trapeze-Framed Metal Strut Systems:
 - 1. Manufacturers:
 - a. ABB Installation Products: electrification.us.abb.com/#sle.

- b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Custom Strut and Roll Forming, LLC: www.customstrut.com/#sle.
 - d. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - e. Gripple, Inc; Fast Track - Standard: www.gripple.com/#sle.
 - f. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.
 - h. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
 3. MFMA-4 compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
 4. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
 6. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
 7. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
- C. Prefabricated Trapeze-Framed Fiberglass Strut Systems:
1. Manufacturers:
 - a. Enduro Composites: www.endurocomposites.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 59, prefabricated continuous-slot fiberglass strut channel, associated fittings, and related accessories.
 3. Channel Material: Use polyester resin or vinyl ester resin.
 4. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 1 inch (25 mm) height.
 5. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
- D. Strut Channels:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.

- c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
 - 3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
- E. Channel Nuts:
- 1. Manufacturers:
 - a. FNW; 7821: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring.
- F. Hanger Rods:
- 1. Threaded zinc-plated steel unless otherwise indicated.
 - 2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch (13 mm) diameter.
 - b. Piping up to 1 inch (25 mm, DN): 1/4 inch (6 mm) diameter.
 - c. Piping larger than 1 inch (25 mm, DN): 3/8 inch (10 mm) diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch (10 mm) diameter.
- G. Steel Cable:
- 1. Manufacturers:
 - a. Ductmate Industries, Inc, a DMI Company; Clutcher Cable Hanging System: www.ductmate.com/#sle.
 - b. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- H. Cable Hanging System Kits:
- 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. Ductmate Industries, Inc: ductmate.com/#sle.
 - c. Gripple, Inc: www.gripple.com/#sle.

- d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- 2. Provide cable-wire in bulk or precut lengths with respective cable hangers as required to hold minimum weight of 120 lb (54.4 kg).
- 3. Accessories: Provide brackets, clip or c-clip hangers, covers, and y-hook hangers.
- I. Thermal Insulated Pipe Supports:
 - 1. Manufacturers:
 - a. Buckaroos, Inc: www.buckaroos.com/#sle.
 - b. KB Enterprises: www.snappitz.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch (15 to 750 mm, DN) iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
 - 3. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
 - b. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - c. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 60 mil (1.524 mm).
 - e. Connections: Brush on welding adhesive.
 - 4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
 - 5. Products:
 - a. Buckaroos, Inc; CoolDry: www.buckaroos.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- J. Pipe Supports:
 - 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2. Liquid Temperatures Up To 122 degrees F (50 degrees C):
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 3. Operating Temperatures from 122 to 446 degrees F (50 to 230 degrees C):
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
 - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 Types 35 through 38.
- K. Roller Chairs:
1. Manufacturers:
 - a. ASC Engineered Solutions: www.asc-es.com/#sle.
 - b. FNW; 7901: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
 3. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
 4. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.
- L. Pipe Stanchions:
1. Manufacturers:
 - a. Anvil International; H-Block: www.anvilintl.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
 4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- M. Beam Clamps:
1. Manufacturers:
 - a. FNW; 7201: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
3. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
4. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
5. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
6. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
7. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
8. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
9. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

N. Riser Clamps:

1. Manufacturers:
 - a. Substitutions: See Section 01 60 00 - Product Requirements.
 - b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
5. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
6. UL (DIR) listed: Pipe sizes 1/2 to 8 inch (15 to 200 mm, DN).

O. U-Bolts:

1. Manufacturers:
 - a. FNW; 7610: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 Type 24, carbon steel u-bolt for pipe support or anchoring.

P. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

Q. Strut Clamps:

1. Manufacturers:
 - a. FNW; 7815: www.fnw.com/#sle.
 - b. Gripple Inc; GCS: www.gripple.com/#sle.

- c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
 - 3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil (26,398,000 V/m).
 - 4. Service Temperature Range: Minus 65 to 275 degrees F (Minus 53.8 to 135 degrees C).
- R. Insulation Clamps:
- 1. Manufacturers:
 - a. FNW; 7897: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Two bolt-type clamps designed for installation under insulation.
 - 3. Material: Carbon steel with epoxy copper or zinc finish.
- S. Pipe Hangers:
- 1. Split Ring Hangers:
 - a. Manufacturers:
 - 1) FNW; 7001: www.fnw.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
 - c. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 - d. Provide hanger rod and nuts of the same type and material for a given pipe run.
 - e. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
 - 2. Band Hangers, Adjustable:
 - a. Manufacturers:
 - 1) Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. MSS SP-58 Type 7 or 9, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 - 3. J-Hangers, Adjustable:

- a. Manufacturers:
 - 1) FNW; 7025: www.fnw.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. MSS SP-58 Type 5, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 - c. Felt-Lining: Provide for uninsulated pipe to reduce noise and prevent static issues.
4. Swivel Ring Hangers, Adjustable:
- a. Manufacturers:
 - 1) FNW; 7010: www.fnw.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. MSS SP-58 Type 10, epoxy-painted, zinc-colored.
 - c. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - d. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
 - e. Felt-Lining: Provide for uninsulated pipe to reduce noise and prevent static issues.
5. Clevis Hangers, Adjustable:
- a. Manufacturers:
 - 1) FNW; 7005: www.fnw.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.
 - c. Felt-Lined: MSS SP-58 Type 1, zinc-plated, silicone-free carbon steel.
 - d. Light-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
 - e. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
 - f. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch (65 to 200 mm, DN).
 - g. FM (AG) listed: Pipe sizes 2-1/2 to 8 inch (65 to 200 mm, DN).
- T. Nonmetallic Pipe Hangers:
- 1. Manufacturers:
 - a. DecoShield Systems, Inc; Snap-2 Hangers: www.decoshield.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

U. Intermediate Pipe Guides:

1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Pipe Diameter 6 inch (150 mm, DN) and Smaller: Provide minimum clearance of 0.16 inch (4 mm).
3. Pipe Sizes 8 inch (200 mm, DN): 0.625 inch (16 mm) U-bolt with double nuts providing minimum clearance of 0.28 inch (7 mm).
4. Pipe Size 10 inch (250 mm, DN): 0.75 inch (19 mm) U-bolt.
5. Pipe Sizes 12 to 16 inch (300 to 400 mm, DN): 0.875 inch (24 mm) U-bolt.
6. Pipe Sizes 18 to 30 inch (450 to 750 mm, DN): 1 inch (25 mm) U-bolt.
7. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

V. Pipe Alignment Guides: Galvanized steel.

1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Pipe Sizes 8 inch (200 mm, DN) and Smaller: Spider or sleeve type.
3. Pipe Sizes 10 inch (250 mm, DN) and Larger: Roller type.
4. Pipe Sizes 18 to 30 inch (450 to 750 mm, DN): 1 inch (25 mm) U-bolt.

W. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

X. Nonpenetrating Rooftop Supports for Low-Slope Roofs:

1. Manufacturers:
 - a. Anvil International; H-Block: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Erico International Corporation, a brand of Pentair: www.erico.com/#sle.
 - d. PHP Systems/Design: www.phpsd.com/#sle.
 - e. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.

2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
5. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.

Y. Pipe Shields for Insulated Piping:

1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. FNW; 7750: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 Type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel
3. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch (321 mm).
 - d. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - e. Maximum Service Temperature: 178 degrees F (81 degrees C).
 - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

Z. Anchors and Fasteners:

1. Manufacturers - Mechanical Anchors:
 - a. FNW; 7502: www.fnw.com/#sle.
 - b. Hilti, Inc: www.us.hilti.com/#sle.
 - c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - d. Powers Fasteners, Inc: www.powers.com/#sle.
 - e. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Hilti, Inc: www.us.hilti.com/#sle.

- b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 6. Hollow Masonry: Use toggle bolts.
 7. Hollow Stud Walls: Use toggle bolts.
 8. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
 9. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
 10. Sheet Metal: Use sheet metal screws.
 11. Wood: Use wood screws.
 12. Plastic and lead anchors are not permitted.
 13. Powder-actuated fasteners are permitted only as follows:
 - a. Where approved by Architect.
 - b. Use only threaded studs; do not use pins.
 14. Hammer-driven anchors and fasteners are permitted only as follows:
 - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
 - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
 15. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm) minimum base metal thickness.
 - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
 16. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

AA. Pipe Installation Accessories:

1. Copper Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Thermal Insulated, Surface-Mounted Pipe Supports:
 - a. Manufacturers:
 - 1) FNW; 7701: www.fnw.com/#sle.
 - 2) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
 - 4) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. Material: Carbon steel with epoxy copper or zinc finish.
 - c. Weather and UV light resistant foam, plastic, or rubber material with built-in strut. Maximum Load: 50 lb (22.7 kg) for single pipe or multiple landed on top strut.
3. Overhead Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
4. Plenum Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
5. Telescoping Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
6. Inserts and Clamps:
 - a. Manufacturers:

- 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
- 2) Substitutions: See Section 01 60 00 - Product Requirements.
- 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.02 RETROFIT PIPING COVER SYSTEM

A. Manufacturers:

1. DecoShield Systems, Inc: www.decoshield.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. General Requirements:

1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.

C. Materials:

1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
3. Unit Length: 7.5 feet (2.29 m).
4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Field-Welding (where approved by Architect).
- H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- I. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch (80 mm) high concrete pad.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- K. Secure fasteners according to manufacturer's recommended torque settings.
- L. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.
- D. Vibration-isolated and/or seismically engineered roof curbs.

1.02 RELATED REQUIREMENTS

- A. Section 01 45 33 - Code-Required Special Inspections and Procedures.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.03 DEFINITIONS

1.04 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Manufacturer's detailed field testing and inspection procedures.
- F. Field quality control test reports.

1.07 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
- D. Equipment Isolation: As indicated on drawings.
- E. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet (15.2 m) of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.

- c. For piping over 2 inch (50 mm) located below or within 50 feet (15.2 m) of noise-sensitive areas indicated.
 - 2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
 - b. Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.
 - 3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
 - 4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
- F. Thrust Restraint Applications:
- 1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg (0.5 kPa) or greater total static pressure.
 - 2. Minimum Static Deflection: Same as static deflection of equipment.
 - 3. Limit lateral movement to 0.25 inch (6 mm) or less unless otherwise indicated.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

- A. Manufacturers:
- 1. Vibration-Isolated Equipment Support Bases:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.vec-co-nyc.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Structural Steel Bases:
- 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 - 2. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
- C. Vibration-Isolated Concrete Inertia Bases:
- 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 - 2. Minimum Base Depth: 6 inches (152 mm).
 - 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.

4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete.
6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
7. Pump Applications: Size and configure bases for piping elbow supports as required.

2.03 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:

- a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
- b. Mason Industries: www.mason-ind.com/#sle.
- c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
- d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Nonseismic Applications:

1. Resilient Material Isolator Pads:

- a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
- b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
- c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.

2. Resilient Material Isolator Mounts, Nonseismic:

- a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
- 3. Open (Unhoused) Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
- 4. Housed Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
 - b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
 - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - d. Furnished with integral leveling device for positioning and securing supported equipment.
- 5. Restrained Spring Isolators, Nonseismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
 - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
- 6. Resilient Material Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
- 7. Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection

and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.

- b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

9. Thrust Restraints:

- a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

2.04 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

A. Manufacturers:

1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:

- a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
- b. Mason Industries: www.mason-ind.com/#sle.
- c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
- d. Substitutions: See Section 01 60 00 - Product Requirements.

- 2. Source Limitations: Furnish vibration-isolated roof curbs and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Vibration Isolation Curbs:

1. Nonseismic Curb Rail:

- a. Location: Between existing roof curb and rooftop equipment.
- b. Construction: Aluminum.
- c. Integral vibration isolation to comply with requirements of this section.
- d. Weather exposed components consist of corrosion resistant materials.

2. Nonseismic Curb:

- a. Location: Between structure and rooftop equipment.
- b. Construction: Aluminum.
- c. Integral vibration isolation to comply with requirements of this section.
- d. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 45 33 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- D. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.

4. Thrust Restraints:
 - a. Adjust restraint movement under normal operating static pressure.
5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
7. Adjust isolators to be free of isolation short circuits during normal operation.
8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- D. Vibration Isolation Systems:
 1. Verify isolator static deflections.
 2. Verify required clearance beneath vibration-isolated equipment support bases.
 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Pipe markers.
- F. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.

- E. Dampers: Ceiling tacks, where located above lay-in ceiling.
- F. Ductwork: Stencilled painting.
- G. Heat Transfer Equipment: Nameplates.
- H. Instrumentation: Tags.
- I. Major Control Components: Nameplates.
- J. Piping: Pipe markers.
- K. Pumps: Nameplates.
- L. Relays: Tags.
- M. Small-sized Equipment: Tags.
- N. Tanks: Nameplates.
- O. Thermostats: Nameplates.
- P. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- Q. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.
 - 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Plastic: Comply with ASTM D709.

2.03 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
 - 2. Brady Corporation: www.bradycorp.com/#sle.
 - 3. Brimar Industries, Inc: www.pipemarker.com/#sle.

4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 6. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.04 ADHESIVE-BACKED DUCT MARKERS

- A. Manufacturers:
1. Brimar Industries, Inc: www.pipemarket.com/#sle.
 2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch (0.76 mm); printed with UV and chemical resistant inks.
- C. Style: Individual Label.
- D. Color: Yellow/Black.

2.05 STENCILS

- A. Manufacturers:
1. Brady Corporation: www.bradycorp.com/#sle.
 2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 3. Insite Solutions, LLC: www.stop-painting.com/#sle.
 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Stencils: With clean cut symbols and letters of following size:
1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
 2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
 3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.

4. 8 to 10 inch (200-250 mm) Outside Diameter of Insulation or Pipe: 24 inch (600 mm) long color field, 2-1/2 inch (65 mm) high letters.
5. Over 10 inch (250 mm) Outside Diameter of Insulation or Pipe: 32 inch (800 mm) long color field, 3-1/2 inch (90 mm) high letters.
6. Ductwork and Equipment: 2-1/2 inch (65 mm) high letters.

C. Stencil Paint: Semi-gloss enamel, colors complying with ASME A13.1.

2.06 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradycorp.com/#sle.
2. Brimar Industries, Inc: www.pipemarker.com/#sle.
3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Color: Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil, 0.004 inch (0.10 mm) thick, manufactured for direct burial service.

F. Ammonia Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

1. Products:

- a. Kolbi Pipe Marker Co; Ammonia Pipe Markers: www.kolbipipemarkers.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

G. Color code as follows:

1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
2. Toxic and Corrosive Fluids: Orange with black letters.
3. Compressed Air: Blue with white letters.

2.07 CEILING TACKS

A. Manufacturers:

1. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- C. Color code as follows:
1. HVAC Equipment: Yellow.
 2. Fire Dampers and Smoke Dampers: Red.
 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces appropriately for stencil painting.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- F. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
 1. Identify service, flow direction, and pressure.
 2. Install in clear view and align with axis of piping.
 3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.
- C. Field quality-control testing of Laboratory fume hoods.
- D. Measurement of final operating condition of HVAC systems.
- E. Commissioning activities.

1.02 RELATED REQUIREMENTS

- A. Section 01 91 13 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 23 08 00 - Commissioning of HVAC.

1.03 PRICE AND PAYMENT PROCEDURES

- A. Allowance includes testing, adjusting, and balancing of mechanical systems.

1.04 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods; 2016, with Errata.
- C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
- D. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems; 2019, with Errata (2022).
- E. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit to the Commissioning Authority.

3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 4. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 5. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Quality-control Testing of Laboratory Fume Hoods:
1. Product Data sheets for all equipment proposed for use in on-site as-installed testing.
 2. Sample Test Report.
 3. List of laboratory fume hoods to be tested. Submit a minimum of one week prior to commencement of testing.
 4. Test data demonstrating that each type of fume hood provided for the project has been successfully tested in the factory.
- E. Field Logs: Submit at least twice a week to the Commissioning Authority.
- F. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Submit to the the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 3. 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.
 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. 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. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.

9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
 12. Hydronic systems are flushed, filled, and vented.
 13. Pumps are rotating correctly.
 14. Proper strainer baskets are clean and in place.
 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

3.04 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.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 FUME HOOD TESTING (ON SITE)

- A. General: Test fume hoods as installed to assess airflow velocity, airflow visualization, and level of containment. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for 100% of the hoods provided in the Project.
- B. Testing to be performed by firm certified by National Environmental Balancing Bureau - NEBB (FHT).
- C. Preparation: Visit the project site to confirm that construction activities related to the fume hood system(s) and equipment are complete. Review design documents and Contractor's submittals. Verify that mechanical ventilation systems serving the space are functioning and operating in the normal mode. Notify Owner in writing, if conditions exist which preclude proper fume hood testing. Starting of testing constitutes acceptance of site conditions.
- D. Testing Requirements:
 - 1. Perform the following tests, in order:
 - a. Airflow Velocity Test.
 - b. Airflow Visualization Test.
 - c. Tracer Gas Containment Test.
 - 2. If more than one test procedure is selected, proceed to the next test only if any unsafe condition discovered during current test has been successfully rectified.
 - 3. Airflow Velocity Test: Comply with Section 9 of NEBB (FHT) Fume Hood Testing Standard - current edition.
 - 4. Airflow Visualization Test: Comply with Section 10 of NEBB (FHT) Fume Hood Testing Standard - current edition.
 - 5. Tracer Gas Containment Test:
 - a. Conduct a static mode test of the hood and laboratory configuration. Conduct testing in accordance with ASHRAE Std 110, except as modified herein:
 - 1) Test hood with simulated scientific apparatus set-up within the hood. Apparatus to consist of: two (2) each 1 gal. (3.78 L) round paint cans, one (1) 1' by 1' by 1' (305 mm by 305 mm by 305 mm) cardboard box, and three (3) each 6" by 6" by 12" high (152 mm by 152 mm by 305 mm high) cardboard boxes. Position these items from 6 to 10 inches (152 to 254 mm) behind the sash, randomly distributed, and supported off of the work surface by 2 inch by 2 inch by 2 inch (51 mm by 51 mm by 51 mm) block of any material.

- 2) 6 liters per minute release rate for tracer gas.
 - 3) Conduct only at the center position for the manikin.
 - 4) Each tracer gas test duration to be 5 minutes.
 - 5) Acceptable test results will be 0.05 PPM or better.
 - 6) At the conclusion of each 5-minute test there will be three rapid walk-by at 1' (305 mm) behind the manikin. Each walk-by to be spaced 30 seconds apart. If a rise in test gas concentration occurs, it cannot exceed 0.10 ppm and must return to 0.05 ppm within 15 seconds.
 - 7) There must be a minimum of three and a maximum of five people in the space in which the fume hood is located during the test procedure.
 - 8) Representatives of the Architect, Engineer, Owner, and Contractor must witness the tests.
 - 9) Test of Alarm: Shut off the fume hood exhaust and verify that the individual fume hood alarm activates.
 - 10) Test individual controls: Test any controls that are provided at the fume hood such as unoccupied cycle override, alarm override, etc.
6. Reporting Requirements: Comply with Section 5 of NEBB (FHT) Fume Hood Testing Standard - current edition. Organize and include, at a minimum, the following information:
- a. Report Title.
 - b. Report Certification.
 - c. Table of Contents.
 - d. Report Summary/ Remarks.
 - e. Appropriate Forms.
 - f. Instrument Calibration.
 - g. List of Abbreviations Used.
 - h. A room layout drawing for each tested item. Identify: walls; doors; fume hood(s); other present environmental enclosures (e.g. biological safety cabinet(s), laminar flow hood(s), canopy hood(s), etc.); location and airflow pattern of all air supply, return, and exhaust grilles, registers and diffusers.

3.07 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

- F. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- G. 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.
- H. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- I. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- J. 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.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries.
- L. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- N. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.08 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.

3.09 COMMISSIONING

- A. See Sections 01 91 13 - General Commissioning Requirements and 23 08 00 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
 - 2. Water side systems.

- D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- E. Re-check a random sample equivalent to 10 percent of the final TAB report data as directed by Commissioning Authority.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - c. Temperatures: Deviation of more than one degree F (0.5 degree C).
 - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- F. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
 - 3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.10 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Plumbing Pumps.
 - 2. HVAC Pumps.
 - 3. Water Tube Boilers.

4. Packaged Steel Water Tube Boilers.
5. Packaged Steel Fire Tube Boilers.
6. Forced Air Furnaces.
7. Direct Fired Furnaces.
8. Reciprocating Water Chillers.
9. Air Cooled Water Chillers.
10. Centrifugal Water Chillers.
11. Absorption Water Chillers.
12. Induced Draft Cooling Tower.
13. Blow Through Cooling Tower.
14. Air Cooled Refrigerant Condensers.
15. Packaged Roof Top Heating/Cooling Units.
16. Computer Room Air Conditioning Units.
17. Air Coils.
18. Terminal Heat Transfer Units.
19. Air Handling Units.
20. Fans.
21. Air Terminal Units.

3.11 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. V-Belt Drives:

1. Identification/location.
2. Required driven RPM.

3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C. Pumps:

1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

D. Combustion Equipment:

1. Boiler manufacturer.
2. Model number.
3. Serial number.
4. Firing rate.
5. Overfire draft.
6. Gas meter timing dial size.
7. Gas meter time per revolution.
8. Gas pressure at meter outlet.
9. Gas flow rate.
10. Heat input.
11. Burner manifold gas pressure.
12. Percent carbon monoxide (CO).
13. Percent carbon dioxide (CO₂).

14. Percent oxygen (O₂).
15. Percent excess air.
16. Flue gas temperature at outlet.
17. Ambient temperature.
18. Net stack temperature.
19. Percent stack loss.
20. Percent combustion efficiency.
21. Heat output.

E. Air Cooled Condensers:

1. Identification/number.
2. Location.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Entering DB air temperature, design and actual.
7. Leaving DB air temperature, design and actual.
8. Number of compressors.

F. Chillers:

1. Identification/number.
2. Manufacturer.
3. Capacity.
4. Model number.
5. Serial number.
6. Evaporator entering water temperature, design and actual.
7. Evaporator leaving water temperature, design and actual.
8. Evaporator pressure drop, design and actual.
9. Evaporator water flow rate, design and actual.
10. Condenser entering water temperature, design and actual.
11. Condenser pressure drop, design and actual.
12. Condenser water flow rate, design and actual.

G. Cooling Tower:

1. Tower identification/number.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Rated capacity.
6. Entering air WB temperature, specified and actual.
7. Leaving air WB temperature, specified and actual.
8. Ambient air DB temperature.
9. Condenser water entering temperature.
10. Condenser water leaving temperature.
11. Condenser water flow rate.
12. Fan RPM.

H. Heat Exchangers:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Steam pressure, design and actual.
8. Primary water entering temperature, design and actual.
9. Primary water leaving temperature, design and actual.
10. Primary water flow, design and actual.
11. Primary water pressure drop, design and actual.
12. Secondary water leaving temperature, design and actual.
13. Secondary water flow, design and actual.
14. Secondary water pressure drop, design and actual.

I. Cooling Coils:

1. Identification/number.
2. Location.
3. Service.

4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Water flow, design and actual.
11. Water pressure drop, design and actual.
12. Entering water temperature, design and actual.
13. Leaving water temperature, design and actual.
14. Saturated suction temperature, design and actual.
15. Air pressure drop, design and actual.

J. Heating Coils:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

K. Electric Duct Heaters:

1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Design kW.

6. Number of stages.
7. Phase, voltage, amperage.
8. Test voltage (each phase).
9. Test amperage (each phase).
10. Air flow, specified and actual.
11. Temperature rise, specified and actual.

L. Induction Units:

1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Size.
6. Design air flow.
7. Design nozzle pressure drop.
8. Final nozzle pressure drop.
9. Final air flow.

M. Air Moving Equipment:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

N. Return Air/Outside Air:

1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

O. Exhaust Fans:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

P. Air Monitoring Stations:

1. Identification/location.
2. System.
3. Size.
4. Area.

5. Design velocity.
6. Design air flow.
7. Test velocity.
8. Test air flow.

Q. Flow Measuring Stations:

1. Identification/number.
2. Location.
3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Design pressure drop.
9. Actual/final pressure drop.
10. Actual/final flow rate.
11. Station calibrated setting.

R. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

S. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.

3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

END OF SECTION

SECTION 23 07 13 DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Weather barrier coatings.
- D. Jacketing and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- E. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017.
- F. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020a.
- G. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- H. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- J. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- K. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- L. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).
- M. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers; 2015.

- N. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2017 (Reapproved 2023).
- O. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- P. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- Q. ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
- R. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- T. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.
- U. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- V. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- W. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- X. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.
- Y. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- Z. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - 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 necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.04 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.

1.05 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.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 CELLULAR MELAMINE

- A. Manufacturers:
 - 1. TECHLITE: www.techlite.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Flexible preformed open-cell polymeric foam tubing, slit lengthwise for installation, complying with applicable requirements of ASTM C1410.
 - 1. K (Ksi) Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
 - 2. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 3. Maximum Service Temperature: 350 degrees F (176 degrees C).
 - 4. Density: 0.56 pcf (8.97 kg/cu m).
 - 5. Factory-Applied Jacketing Material: Paper/Foil/Scrim.
 - a. Color: White, Yellow, Red, Blue, Black, and Green.
 - 6. Jacketing material to be field-applied.

2.03 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville: www.jm.com/#sle.
 - 3. JP Lamborn Co; Thermal Sleeve MT: www.jpflex.com/#sle.
 - 4. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
 - 5. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K (Ksi) value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 1,200 degrees F (649 degrees C).
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Outdoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- G. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter (1.29 mm diameter).

2.04 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. K (Ksi) Value: 0.24 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F (232 degrees C).
 - 3. Maximum Water Vapor Absorption: 5.0 percent.
 - 4. Maximum Density: 8.0 pcf (128 kg/cu m).
- C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
3. Secure with pressure-sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

E. Protective Coating:

1. Manufacturers:
 - a. Design Polymeric; DP 2510 Water Based, Low VOC, Duct Liner Protective Coating: www.designpoly.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements

F. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
2. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.

1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
2. Maximum Service Temperature: 180 degrees F (82 degrees C).
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

1. Manufacturers:
 - a. Design Polymeric; DP 5050 Water Based, High Strength, Weather Barrier Coating: www.designpoly.com/#sle.
 - b. Vimasco Corporation: www.vimasco.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements

2.06 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
 - 1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; Childers - CP Series Weather Barrier Coating: www.fosterproducts.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 - 3. Water Vapor Permeance: Greater than 1.0 perm (57 ng/(Pa s m)) in accordance with ASTM E96/E96M.
 - 4. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 - 5. Color: As selected by Architect.

2.07 JACKETING AND ACCESSORIES

- A. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 - 1. Lagging Adhesive:
 - a. Manufacturers:
 - 1) Design Polymerics; DP 3050 Water Based, Premium Quality, Lagging Adhesive, and Vapor Retarder: www.designpoly.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements
- B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square (2.45 kg/sq m).
- C. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch (0.41 mm) with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch (0.40 mm) sheet.
 - 3. Finish: Smooth.
 - 4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 5. Fittings: 0.016 inch (0.40 mm) thick die-shaped fitting covers with factory-attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
- D. Aluminum-Foil Laminate Jacket:
 - 1. Manufacturers:
 - a. Ideal Tape Co., Inc: www.idealtape.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
 3. Finish: Aluminum smooth.
 4. Comply with ASTM C1775.
- E. Aluminum-Foil Laminate Jacket:
1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; Foster - Vapor-Fas: www.fosterproducts.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- F. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.
1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
 2. Thickness: 34 mil, 0.034 inch (0.86 mm).
 3. Finish: Embossed.
 4. Color: Silver.
 5. Water Vapor Transmission: 0.002 perm inch (0.0029 ng/(Pa s m)), maximum, when tested in accordance with ASTM E96/E96M.
 6. Mold Resistance: Pass when tested in accordance with ASTM C1338.
 7. Emissivity: 0.30 when tested in accordance with ASTM C1371.
 8. Manufacturers:
 - a. Polyguard Products; Alumaguard: www.polyguardproducts.com.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements
- G. Reinforced Tape:
1. Manufacturers:
 - a. Ideal Tape Co., Inc: www.idealtape.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. FSK tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
 3. Comply with UL 723 or ASTM E84.
 4. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 5. Finish: Match insulation.
- H. Plain Foil Tape:
1. Manufacturers:

- a. Ideal Tape Co., Inc: www.idealtape.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Aluminum foil with pressure-sensitive adhesive on paper release liner.
- 3. Finish: Plain foil.
- I. UL181 Tape for Rigid and Flexible Ductwork:
 - 1. Manufacturers:
 - a. Ideal Tape Co., Inc: www.idealtape.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Comply with UL 181A for rigid ductwork.
 - 3. Comply with UL 181B for flexible ductwork.
 - 4. Aluminum foil coated with pressure-sensitive adhesive on paper release liner.
 - 5. Foil tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
 - 6. Finish: Printed with UL Listing for identification.

2.08 DUCT LINER

- A. Manufacturers:
 - 1. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
 - 2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 3. Johns Manville: www.jm.com/#sle.
 - 4. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 5. Owens Corning Corporation; QuietR Rotary Duct Insulation: www.ocbuildingspec.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Note: Choose the liner type - Elastomeric Foam or Glass Fiber.
- C. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
 - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 2. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - 3. Fungal Resistance: No growth when tested according to ASTM G21.
 - 4. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F (0.045 at 24 degrees C).
 - 5. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch (13 mm) Thickness: 0.30.

- b. 1 inch (25 mm) Thickness: 0.40.
 - c. 1-1/2 inches (40 mm) Thickness: 0.50.
 - d. 2 inch (50 mm) Thickness: 0.60.
- 6. Erosion Resistance: Does not show evidence of breaking away, flaking off, or delamination at velocities of 10,000 fpm (50.8 m/s) when tested in accordance with ASTM C1071.
- 7. Connection: Waterproof vapor barrier adhesive.
- D. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with ASTM C916.
- E. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
 - 1. Fungal Resistance: No growth when tested according to ASTM G21.
 - 2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F (0.045 at 24 degrees C).
 - 3. Service Temperature: Up to 250 degrees F (121 degrees C).
 - 4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm (25.4 m/s), minimum.
 - 5. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch (13 mm) Thickness: 0.30.
 - b. 1 inch (25 mm) Thickness: 0.45.
 - c. 1-1/2 inches (40 mm) Thickness: 0.60.
 - d. 2 inch (50 mm) Thickness: 0.70.
- F. Adhesive: Waterproof, fire-retardant type, ASTM C916.
 - 1. Manufacturers:
 - a. Design Polymeric; DP 2502 Water Based, Low VOC, Duct Liner Adhesive: www.designpoly.com/#sle.
 - b. Elgen Manufacturing Company, Inc; Water Based Liner Adhesive: www.elgenmfg.com/#sle.
 - c. Vimasco Corporation: www.vimasco.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements
- G. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.
 - 1. Manufacturers:
 - a. Elgen Manufacturing Company, Inc; Peel and Press Insulation Hangers: www.elgenmfg.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated Ducts Conveying Air Above Ambient Temperature:
 - 1. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor) ((below 3 meters above finished floor)): Finish with canvas jacket sized for finish painting.
- F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- G. Slope exterior ductwork to shed water.
- H. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.
 - 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- I. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 90 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.

3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.03 HYDROUS CALCIUM SILICATE INSULATION

A. Manufacturers:

1. Johns Manville Corporation: www.jm.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.

1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 149 degrees C) when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1200 degrees F (649 degrees C).
3. Density: 15 pcf (240 kg/cu m).

C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

D. Insulating Cement: ASTM C449.

E. High Temperature Adhesive: Fire-retardant, sodium silicate based adhesive with fibers treated in compliance with ASTM D93.

1. Manufacturers:

- a. Vimasco Corporation: www.vimasco.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

END OF SECTION

**SECTION 23 23 00
REFRIGERANT PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure regulators.
- H. Pressure relief valves.
- I. Filter-driers.
- J. Solenoid valves.
- K. Expansion valves.
- L. Receivers.
- M. Flexible connections.
- N. Engineered wall seals and insulation protection.
- O. Exterior penetration accessories.

1.02 RELATED REQUIREMENTS

- A. Section 23 07 16 - HVAC Equipment Insulation.

1.03 REFERENCE STANDARDS

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers; 2005.
- B. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers; 2009.
- C. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers; 2009.
- D. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers; 2013 (Reapproved 2014).
- E. AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.
- F. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.

- G. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2019.
- H. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- I. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- J. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- K. ASME B31.9 - Building Services Piping; 2020.
- L. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- M. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.
- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- O. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- P. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- Q. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- R. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- S. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2020.
- T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- U. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.
- V. 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.
- W. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- X. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- Y. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- Z. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- AA. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- BB. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

CC. ICC (IMC)-2018 - International Mechanical Code; 2018.

DD. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

EE. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

FF. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide general assembly of specialties, including manufacturer's catalogue information. Provide manufacturer's catalog data including load capacity.
- C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- D. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- E. Design Data: Submit design data indicating pipe sizing. Indicate load-carrying capacity of trapeze, multiple pipe, and riser support hangers.
- F. Test Reports: Indicate results of leak test, acid test.
- G. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
- H. Submit welders certification of compliance with ASME BPVC-IX.
- I. Designer's qualification statement.
- J. Installer's qualification statement.
- K. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- L. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 3 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure integrity of system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
 - 3. Use line size on leaving side of liquid solenoid valves.
- D. Valves:
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gauge taps at compressor inlet and outlet.
 - 3. Use gauge taps at hot gas bypass regulators, inlet and outlet.
 - 4. Use check valves on compressor discharge.
 - 5. Use check valves on condenser liquid lines on multiple condenser systems.
- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
 - 1. Use line size strainer upstream of each automatic valve.
 - 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 - 3. On steel piping systems, use strainer in suction line.
 - 4. Use shut-off valve on each side of strainer.
- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- H. Filter-Driers:
 - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
 - 2. Use a filter-drier on suction line just ahead of compressor.
 - 3. Use sealed filter-driers in lines smaller than 1/2 inch (13 mm) outside diameter.
 - 4. Use sealed filter-driers in low temperature systems.
 - 5. Use sealed filter-driers in systems utilizing hermetic compressors.
 - 6. Use replaceable core filter-driers in lines of 1/2 inch (13 mm) outside diameter or greater.

7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
 8. Use filter-driers for each solenoid valve.
 - I. Solenoid Valves:
 1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
 2. Use in liquid line of single or multiple evaporator systems.
 3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
 - J. Receivers:
 1. Use on systems with long piping runs.
 - K. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.
- 2.02 REGULATORY REQUIREMENTS
- A. Comply with ASME B31.9 for installation of piping system.
 - B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
 - C. Welders Certification: In accordance with ASME BPVC-IX.
 - D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.
- 2.03 PIPING
- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 1. Fittings: ASME B16.22 wrought copper.
 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
 3. Mechanical Press Sealed Fittings: Double pressed type complying with UL 207 and ICC (IMC)-2018.
 - a. Manufacturers:
 - 1) RLS, LLC; RLS Cu (Copper): www.rlspressfittings.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - B. Copper Tube to 7/8-inch (22 mm) OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 1. Fittings: ASME B16.26 cast copper.
 2. Joints: Flared.
 3. Mechanical Press Sealed Fittings: Double pressed type complying with UL 207 and ICC (IMC)-2018.
 - a. Manufacturers:
 - 1) FNW; Copper Press: www.fnw.com/#sle.
 - 2) RLS, LLC; RLS Cu (Copper): www.rlspressfittings.com/#sle.

3) Substitutions: See Section 01 60 00 - Product Requirements.

C. Steel Pipe: ASTM A53/A53M, Schedule 40, black.

1. Fittings: ASTM A234/A234M, wrought steel welding type.
2. Joints: Welded in accordance with AWS D1.1/D1.1M.

D. Steel Pipe Sizes 12 Inch (300 mm) and Over: ASTM A53/A53M, 0.375 inch (10 mm) wall, black.

1. Fittings: ASTM A234/A234M, wrought steel welding type.
2. Joints: Welded in accordance with AWS D1.1/D1.1M.

E. Pipe Supports and Anchors:

1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
12. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 - e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.

f. Manufacturers:

- 1) PHP Systems/Design: www.phpsd.com/#sle.
- 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.04 REFRIGERANT

- A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
- B. Refrigerant: R-134a, tetrafluoroethane as defined in ASHRAE Std 34.

2.05 MOISTURE AND LIQUID INDICATORS

A. Manufacturers:

1. Henry Technologies: www.henrytech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of 500 psi (3450 kPa).

2.06 VALVES

A. Manufacturers:

1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Henry Technologies: www.henrytech.com/#sle.
3. Flomatic Valves: www.flomatic.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, soldered or flared ends, with positive backseating; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).

C. Packed Angle Valves:

1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, soldered or flared ends; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).

D. Ball Valves:

1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 300 degrees F (149 degrees C).

E. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi (3450 kPa).

2.07 STRAINERS

A. Manufacturers:

1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Straight Line or Angle Line Type:

1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi (2960 kPa).

2.08 CHECK VALVES

A. Manufacturers:

1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Globe Type:

1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F (149 degrees C) and maximum working pressure of 425 psi (2930 kPa).

C. Straight Through Type:

1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 200 degrees F (93 degrees C).

2.09 PRESSURE REGULATORS

A. Manufacturers:

1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi (0 to 550 kPa) range, for maximum working pressure of 450 psi (3100 kPa).

2.10 PRESSURE RELIEF VALVES

- A. Manufacturers:
 1. Hansen Technologies Corporation: www.hantech.com/#sle.
 2. Henry Technologies: www.henrytech.com/#sle.
 3. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi (1620 kPa).

2.11 FILTER-DRIERS

- A. Manufacturers:
 1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
 3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Performance:
 1. Flow Capacity - Liquid Line: As indicated in schedule, minimum, rated in accordance with AHRI 710 (I-P) (AHRI 711 (SI)).
 2. Flow Capacity - Suction Line: As indicated in schedule, minimum, rated in accordance with AHRI 730 (I-P).
 3. Water Capacity: As indicated in schedule, rated in accordance with AHRI 710 (I-P) (AHRI 711 (SI)).
 4. Pressure Drop: 2 psi (14 kPa), maximum, when operating at full connected evaporator capacity.
 5. Design Working Pressure: 350 psi (2410 kPa), minimum.
- C. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- D. Construction: UL listed.
 1. Replaceable Core Type: Steel shell with removable cap.
 2. Sealed Type: Copper shell.
 3. Connections: As specified for applicable pipe type.

2.12 SOLENOID VALVES

A. Manufacturers:

1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Valve: AHRI 760 I-P, pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi (3450 kPa).

C. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.13 EXPANSION VALVES

A. Manufacturers:

1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with nonreplaceable capillary tube and remote sensing bulb and remote bulb well.

C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F (6 degrees C) superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.14 ELECTRONIC EXPANSION VALVES

A. Manufacturers:

1. Flomatic Valves: www.flomatic.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Valve:

1. Brass body with flared or soldered connection, needle valve with floating needle and machined seat, stepper motor drive.

C. Evaporation Control System:

1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
- D. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.15 RECEIVERS

A. Manufacturers:

1. Henry Technologies: www.henrytech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Internal Diameter 6 inch (150 mm) and Smaller:

1. AHRI 495, UL listed, steel, brazed; 400 psi (2760 kPa) maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.

C. Internal Diameter Over 6 inch (150 mm):

1. AHRI 495, welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; 400 psi (2760 kPa) with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.16 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Circuit Hydraulics, Ltd: www.circuit-hydraulics.co.uk/#sle.
2. Flexicraft Industries: www.flexicraft.com/#sle.
3. Penflex: www.penflex.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches (230 mm) long with copper tube ends; for maximum working pressure of 500 psi (3450 kPa).

2.17 ENGINEERED WALL SEALS AND INSULATION PROTECTION

A. Manufacturers:

1. Airex Manufacturing, Inc: www.airexmfg.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.

1. Pipe Penetration Wall Seal: Airex Titan Outlet.

2. Refrigeration Pipe Insulation Protection System: Airex E-Flex Guard.
 3. Pipe Penetration Wall Seal and Insulation Protection System: Airex Pro-System Kit.
- C. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Wall Outlet Size, Stucco and Masonry Applications: 7-1/2 inch wide by 10 inch high (190.5 mm wide by 254 mm high).
 - a. Elastomeric Sleeve Diameter: 1-11/16 inch (43 mm).
 2. Outlet Cover Color: Gray.
 3. Water Penetration: Comply with ASTM E331.
 4. Air Leakage: Comply with ASTM E283/E283M.
 5. Air Permeance: Comply with ASTM E2178.
- D. Insulation Protection System: Mechanical line insulation and PVC cover.
1. PVC Insulation Cover Color: Black with full-length velcro fastener.
 2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
 3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
 4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
 5. Flame Spread and Smoke Development Rating of 25/450: Comply with ASTM E84.
 6. Adhesive free.

2.18 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
1. Products:
 - a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
1. Products:
 - a. Alta Products, LLC; Sigrist Pipe Chase Housing, Curbs, and Exit Seals: www.altaproductsllc.com/#sle.
 - b. Menzies Metal Products: www.menzies-metal.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain-end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.5.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting.
- N. Insulate piping and equipment.
- O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- T. Fully charge completed system with refrigerant after testing.
- U. Provide electrical connection to solenoid valves.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Test refrigeration system in accordance with ASME B31.5.
- C. Pressure test system with dry nitrogen to 200 psi (1380 kPa). Perform final tests at 27 inches (92 kPa) vacuum and 200 psi (1380 kPa) using halide torch. Test and repair piping until no leakage.

3.04 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 inch (13 mm), 5/8 inch (16 mm), and 7/8 inch (22 mm) OD: Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6.3 mm).
 - 2. 1-1/8 inch (29 mm) OD: Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6.3 mm).
 - 3. 1-3/8 inch (35 mm) OD: Maximum span, 7 feet (2100 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 4. 1-5/8 inch (41 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 5. 2-1/8 inch (54 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 6. 2-5/8 inch (67 mm) OD: Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 7. 3-1/8 inch (79 mm) OD: Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9.5 mm).
 - 8. 3-5/8 inch (92 mm) OD: Maximum span, 11 feet (3.4 m); minimum rod size, 1/2 inch (12.7 mm).

9. 4-1/8 inch (92 mm) OD: Maximum span, 12 feet (3.6 m); minimum rod size, 1/2 inch (12.7 mm).

B. Hanger Spacing for Steel Piping.

1. 1/2 inch (15 mm), 3/4 inch (20 mm), and 1 inch (25 mm): Maximum span, 7 feet (2100 mm); minimum rod size, 1/4 inch (6.3 mm).
2. 1-1/4 inches (32 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
3. 1-1/2 inches (40 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
4. 2 inches (50 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9.5 mm).
5. 2-1/2 inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
6. 3 inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9.5 mm).
7. 4 inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (12.7 mm).

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.
- C. Nonmetal ducts.
- D. Air plenums and casings.
- E. Ducts for kitchen exhaust applications.
- F. Ducts for laboratory and industrial-grade applications.
- G. Prefabricated ventilation subducts.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 09 91 13 - Exterior Painting: Weld priming, weather resistant, paint or coating.
- C. Section 09 91 23 - Interior Painting: Weld priming, paint or coating.
- D. Section 11 40 00 - Foodservice Equipment: Kitchen range hoods.
- E. Section 23 01 30.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.
- F. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- G. Section 23 33 00 - Air Duct Accessories.
- H. Section 23 33 19 - Duct Silencers.
- I. Section 23 36 00 - Air Terminal Units.
- J. Section 23 37 00 - Air Outlets and Inlets: Fabric air distribution devices.

1.03 REFERENCE STANDARDS

- A. ANSI Z9.5 - Laboratory Ventilation; 2022.
- B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASHRAE Std 126 - Method of Testing HVAC Air Ducts; 2020.
- D. ASME AG-1 - Code on Nuclear Air and Gas Treatment; 2023.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
- G. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2026.
- I. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- J. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- L. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- M. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- N. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- O. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems; 2020.
- P. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- Q. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- R. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- S. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- T. ISO 6944-1 - Fire Containment -- Elements of Building Construction -- Part 1: Ventilation Ducts; 2008, with Amendment (2015).
- U. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals; 2019.
- V. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- W. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2021.
- X. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids; 2020.
- Y. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- Z. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- AA. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2021.
- BB. SMACNA (FRP) - Thermoset FRP Duct Construction Manual; 2016.

- CC. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
- DD. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.
- EE. SMACNA (Phenolic) - Phenolic Duct Construction Standards; 2015.
- FF. SMACNA (PVC) - Thermoplastic Duct (PVC) Construction Manual; 1995.
- GG. SMACNA (RIDC) - Rectangular Industrial Duct Construction Standards; 2007.
- HH. SMACNA (ROUND) - Round Industrial Duct Construction Standards; 2013.
- II. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- JJ. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- KK. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
- LL. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.
- MM. UL 2518 - Standard for Safety Air Dispersion Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).
- E. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
- F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.
- C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts.
- D. Duct Shape and Material in accordance with Allowed Static Pressure Range:
 - 1. Round: Plus or minus 2 in-wc (500 Pa) of galvanized steel.
 - 2. Rectangular: Plus or minus 1/2 in-wc (125 Pa) of galvanized steel.
 - 3. Flat Oval: Plus 2 in-wc (500 Pa) of galvanized steel.
 - 4. Fibrous Glass Duct-board: Plus or minus 1/2 in-wc (125 Pa).
 - 5. Flexible Duct (Fabric and wire): Plus or minus 1/2 in-wc (125 Pa).
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:
 - 1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
 - a. Supply Air: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
 - b. Outside Air Intake: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
 - c. Return and Relief Air: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
 - d. General Exhaust Air: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
 - e. Emergency Generator: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
 - f. Evaporative Condenser: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
 - g. Heating or Combustion Air: 1/2 in-wc (125 Pa) pressure class, galvanized steel.
 - h. Transfer-air and Sound Booths: 1/2 in-wc (125 Pa) pressure class, fibrous glass.
 - i. Buried Duct for Supply and Return Air:
 - 1) 1/2 in-wc (125 Pa) pressure class, galvanized steel.
 - 2) 2 in-wc (500 Pa) pressure class, fabricate using two sheet-metal gauges heavier material than indicated.
 - j. Buried Slab-Ventilation Duct: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS, with G90/Z275 coating designed for installation in cast-in-place concrete floor assemblies.
 - 1) Fittings: Elbows, End caps, Connecting couplings, Spin-in-collar, Soffit-discharge head, Support Brackets, and Wall discharge head.
 - 2. Low Pressure Service: Up to 2 in-wc (500 Pa):
 - a. Seal: Class C, apply to seal off transverse joints.

- b. Leakage:
 - 1) Rectangular: Class 24 or 24 cfm/100 sq ft (680 Lpm/9.3 sq m).
 - 2) Round: Class 12 or 12 cfm/100 sq ft (340 Lpm/9.3 sq m).
 - 3. Low Pressure Service: From 2 in-wc (500 Pa) to 3 in-wc (750 Pa):
 - a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
 - b. Leakage:
 - 1) Rectangular: Class 12 or 12 cfm/100 sq ft (340 Lpm/9.3 sq m).
 - 2) Round: Class 6 or 6 cfm/100 sq ft (170 Lpm/9.3 sq m).
 - 4. Medium and High Pressure Service: Above 3 in-wc (750 Pa):
 - a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
 - b. Leakage:
 - 1) Rectangular: Class 6 or 6 cfm/100 sq ft (170 Lpm/9.3 sq m).
 - 2) Round: Class 3 or 3 cfm/100 sq ft (85 Lpm/9.3 sq m).
- F. Duct Fabrication Requirements:
 - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 - 2. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
 - 3. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
 - 4. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
 - 5. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
 - 6. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
 - 7. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
 - 8. 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.

2.02 METAL DUCTS

- A. Material Requirements:
 - 1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

2. Ungalvanized Steel: ASTM A1008/A1008M Designation CS (commercial steel), cold-rolled.
 3. Aluminum: ASTM B209/B209M, aluminum sheet, alloy 3003-H14.
 4. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
 5. Stainless Steel: ASTM A666, Type 304.
- B. Metal Duct Coating Requirements:
1. Antimicrobial Coating: Factory- or field-applied in accordance with manufacturer's instructions.
 - a. Manufacturers:
 - 1) MKT Metal Manufacturing: www.mktduct.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 2. Specialty Coatings for Metal Ducts: Factory- or field-applied in accordance with manufacturer's instructions.
 - a. Application: Corrosion resistance.
 - b. Manufacturers:
 - 1) MKT Metal Manufacturing: www.mktduct.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 3. PVC Coating for Steel Duct: 4 mils (0.1 mm) polyvinyl chloride plastic on both sides.
- C. Fire Rated Ducts:
1. Two-hour, Fire Rated Duct:
 - a. UL labeled, construct of 18-gauge, 0.0516-inch (1.31 mm) galvanized steel.
 - b. R-Value: 4.5 when tested in accordance with ASTM C177.
 - c. Manufacturers:
 - 1) DuraSystems Barriers Inc; DuraDuct GNX: www.durasystems.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 2. Three-hour, Fire Rated Duct:
 - a. UL labeled, construct of 22-gauge, 0.033-inch (0.85 mm) galvanized steel.
 - b. Manufacturers:
 - 1) DuraSystems Barriers Inc; DuraDuct 3HR: www.durasystems.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- D. Rectangular Metal Duct:
1. Rectangular Double Wall Insulated: Rectangular spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.

- a. Insulation:
 - 1) Thickness: 1 inch (25 mm).
 - 2) Material: Fiberglass.
- E. Flat-Oval Metal Ducts:
 - 1. Flat-Oval Single Wall Duct: Machine made from a round spiral lock seam duct.
 - a. Fittings: Manufacture at least two gauges heavier metal than the duct.
 - b. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
 - c. Manufacturers:
 - 1) EHG, a DMI Company: www.ehgduct.com/#sle.
 - 2) Linx Industries, Inc a DMI Company: www.li-hvac.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Flat-Oval Double Wall Insulated Duct: Machine made from round spiral lock seam duct.
 - a. Fittings: Manufacture with solid inner wall.
 - b. Inner Wall: Perforated galvanized steel.
 - c. Insulation:
 - 1) Thickness: 1 inch (25 mm) fiberglass.
- F. Round Metal Ducts:
 - 1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
 - a. Manufacturers:
 - 1) EHG, a DMI Company: www.ehgduct.com/#sle.
 - 2) Elgen Manufacturing Company, Inc; Snap Lock Pipes and Fittings: www.elgenmfg.com/#sle.
 - 3) Linx Industries, Inc, a DMI Company: www.li-hvac.com/#sle.
 - 4) MKT Metal Manufacturing: www.mktduct.com/#sle.
 - 5) Nordfab Ducting: www.nordfab.com/#sle.
 - 6) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Round Double Wall Insulated Duct: Round spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
 - a. Insulation:
 - 1) Thickness: 1 inch (25 mm).
 - 2) Material: Fiberglass.
 - b. Manufacturers:

- 1) MKT Metal Manufacturing; Weatherguard: www.mktduct.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
3. Round Connection System: Interlocking duct connection system per SMACNA (DCS).
 - a. Manufacturers:
 - 1) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 2) Nordfab Ducting: www.nordfab.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
- G. Round Spiral Duct:
1. Round spiral lock seam duct with galvanized steel outer wall.
 2. Manufacturers:
 - a. EHG, a DMI Company: www.ehgduct.com/#sle.
 - b. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - c. GSI, a DMI Company: www.greenseamind.com/#sle.
 - d. Linx Industries, Inc, a DMI Company: www.li-hvac.com/#sle.
 - e. MKT Metal Manufacturing: www.mktduct.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Connectors, Fittings, Sealants, and Miscellaneous:
1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
 2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
 - a. Manufacturers:
 - 1) Carlisle HVAC Products; Nexus Flange Connectors with Sealant Pocket: www.carlislehvac.com/#sle.
 - 2) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 3) Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - 4) MKT Metal Manufacturing: www.mktduct.com/#sle.
 - 5) Substitutions: See Section 01 60 00 - Product Requirements.
 3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - b. VOC Content: Not more than 250 g/L, excluding water.

- c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- d. For Use with Flexible Ducts: UL labeled.
- e. Manufacturers:
 - 1) Carlisle HVAC Products; Hardcast Versa-Grip 181 Water Based Fiber Reinforced Duct Sealant: www.carlislehvac.com/#sle.
 - 2) Design Polymerics; DP 1010 Water Based Smooth Duct Sealant, Premium Quality: www.designpoly.com/#sle.
 - 3) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 4) Elgen Manufacturing Company, Inc; Duct Sealer: www.elgenmfg.com/#sle.
 - 5) H.B. Fuller Construction Products, Inc: www.fosterproducts.com/#sle.
 - 6) Substitutions: See Section 01 60 00 - Product Requirements.
- 4. Gasket Tape:
 - a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
 - b. Manufacturers:
 - 1) Design Polymerics; DP 1040 100 Percent Solids, High Pressure/High-Velocity Butyl Gasket Tape: www.designpoly.com/#sle.
 - 2) Elgen Manufacturing Company, Inc; 440 Butyl Gasket Tape: www.elgenmfg.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
- 5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- 6. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:
 - a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 - f. Other Types: As required.
 - g. Manufacturers:
 - 1) Powers Fasteners, Inc: www.powers.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- I. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form a spiral helix.

1. Insulation: R6 insulation with polyethylene vapor barrier film.
 2. Pressure Rating: 10 in-wc (2.50 kPa) positive and 5 in-wc (1.25 kPa) negative.
 3. Maximum Velocity: 5500 fpm (27.9 m/sec).
 4. Temperature Range: Minus 20 degrees F to 250 degrees F (Minus 28 degrees C to 121 degrees C).
 5. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 1: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- J. Acoustic Flexible Ducts: UL 181, Class 1, spun-bond nylon, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: Fiberglass insulation with metallic vapor barrier.
 2. Inner Core: Spun-bonded, nonwoven inner core.
 3. Pressure Rating: 6 in-wc (1.5 kPa) positive and 5 in-wc (1.25 kPa) negative.
 4. Maximum Velocity: 4000 fpm (20.3 m/sec).
 5. Temperature Range: Minus 20 degrees F to 250 degrees F (Minus 28 degrees C to 121 degrees C).
 6. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 6: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- K. Medium Pressure Flexible Ducts: UL 181, Class 1, aluminized laminate, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: Fiberglass insulation with metallic vapor barrier.
 2. Inner Core: Tri-laminate of polyester, fiberglass, and aluminum foil.
 3. Pressure Rating: 15 in-wc (3.74 kPa) positive and 5 in-wc (1.25 kPa) negative.
 4. Maximum Velocity: 5500 fpm (27.9 m/sec).
 5. Temperature Range: Minus 20 degrees F to 250 degrees F (Minus 28 degrees C to 121 degrees C).
 6. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 5: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- L. High Pressure Flexible Ducts: UL 181, Class 1, aluminized tri-laminate, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: Fiberglass insulation with metallic vapor barrier.
 2. Inner Core: Tri-laminate of polyester, fiberglass, and aluminum foil.
 3. Pressure Rating: 20 in-wc (5 kPa) positive and 5 in-wc (1.25 kPa) negative.

4. Maximum Velocity: 5500 fpm (27.9 m/sec).
 5. Temperature Range: Minus 20 degrees F to 250 degrees F (Minus 28 degrees C to 121 degrees C).
 6. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 3: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- M. High Pressure Flexible Ducts: UL 181, Class 1, PVC-coated, fiberglass cloth fabric, mechanically fastened and rolled using galvanized steel to form a spiral helix.
1. Insulation: Fiberglass insulation with metallic vapor barrier.
 2. Inner Core: PVC-coated, fiberglass cloth fabric.
 3. Pressure Rating: 25 in-wc (6.23 kPa) positive and 5 in-wc (1.25 kPa) negative.
 4. Maximum Velocity: 5500 fpm (27.9 m/sec).
 5. Temperature Range: Minus 20 degrees F to 250 degrees F (Minus 28 degrees C to 121 degrees C).
 6. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 4: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 FLEXIBLE DUCTS

- A. Flexible Air Ducts:
1. UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound spring steel wire.
 2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 3. Pressure Rating: From 10 in-wc (2.5 kPa) positive to 1 in-wc (250 Pa) negative.
 4. Maximum Velocity: 4,000 fpm (20.3 m/s).
 5. Temperature Range: Minus 20 to 210 degrees F (Minus 28 to 99 degrees C).
 6. Manufacturers:
 - a. JP Lamborn Co; Silver Jacket MHP: www.jpflex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Flexible Air Ducts:
1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 3. Pressure Rating: From 10 in-wc (2.5 kPa) to 1 in-wc (250 Pa) negative.
 4. Maximum Velocity: 4,000 fpm (20.3 m/s).
 5. Temperature Range: Minus 20 to 210 degrees F (Minus 28 to 99 degrees C).

C. Flexible Air Ducts:

1. UL 181, Class 1, polyethylene film supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
3. Pressure Rating: From 10 in-wc (2.50 kPa) to 5 in-wc (1.25 kPa) negative.
4. Maximum Velocity: 5,500 fpm (27.9 m/s).
5. Temperature Range: Minus 20 to 250 degrees F (Minus 28 to 121 degrees C).
6. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 1: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

D. Flexible Air Ducts:

1. UL 181, Class 0, interlocking spiral of aluminum foil.
2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
3. Pressure Rating: 8 in-wc (2.0 kPa) positive or negative.
4. Maximum Velocity: 5,000 fpm (25.4 m/s).
5. Temperature Range: Minus 20 to 250 degrees F (Minus 28 to 99 degrees C).

E. Vapor Barrier Insulated Flexible Air Ducts:

1. UL 181, Class 1, two-ply polyester or vinyl film supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with polyethylene vapor barrier core.
3. Pressure Rating: From 10 in-wc (2.5 kPa) positive to 1 in-wc (250 Pa) negative.
4. Maximum Velocity: 4,000 fpm (20.3 m/s).
5. Temperature Range: Minus 10 to 160 degrees F (Minus 23 to 71 degrees C).
6. Manufacturers:
 - a. JP Lamborn Co; Black Jacket PR: www.jpflex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

F. UV-Inhibited Flexible Air Ducts:

1. UL 181, Class 1, UV-inhibited black polymer film supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
3. Pressure Rating: From 10 in-wc (2.5 kPa) positive to 0.5 in-wc (175 Pa) negative.
4. Maximum Velocity: 4,000 fpm (20.3 m/s).
5. Temperature Range: Minus 20 to 175 degrees F (Minus 28 to 79 degrees C).
6. Manufacturers:

- a. Quietflex Manufacturing Company; UV-Inhibited: <https://quietflex.com/#sle>.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

G. Uninsulated Flexible Air Ducts:

- 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
- 2. Pressure Rating: From 10 in-wc (2.5 kPa) to 1 in-wc (250 Pa) negative.
- 3. Maximum Velocity: 4,000 fpm (20.3 m/s).
- 4. Temperature Range: Minus 20 to 210 degrees F (Minus 28 to 99 degrees C).
- 5. Manufacturers:
 - a. JP Lamborn Co; Non-Insulated MNI: www.jplflex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

H. Acoustic Flexible Air Ducts:

- 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
- 2. Insulation: Fiberglass insulation with metallic vapor barrier.
- 3. Inner Core: Spun-bonded, nonwoven inner core.
- 4. Pressure Rating: From 6 in-wc (1.5 kPa) to 5 in-wc (1.25 kPa) negative.
- 5. Maximum Velocity: 4,000 fpm (20.3 m/s).
- 6. Temperature Range: Minus 20 to 250 degrees F (Minus 28 to 121 degrees C).
- 7. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 6: www.flexmasterusa.com/#sle.
 - b. JP Lamborn Co; Acoustic Duct AMF: www.jplflex.com/#sle.
 - c. Quietflex Manufacturing Company; QAS: <https://quietflex.com/#sle>.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

I. Antimicrobial Flexible Air Ducts:

- 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
- 2. Insulation: Fiberglass insulation with reinforced vapor barrier.
- 3. Inner Core: Microbial growth resistant inner core treated with Agion silver.
- 4. Pressure Rating: From 10 in-wc (2.5 kPa) to 1 in-wc (250 Pa) negative.
- 5. Maximum Velocity: 4,000 fpm (20.3 m/s).
- 6. Temperature Range: Minus 20 to 210 degrees F (Minus 28 to 99 degrees C).

7. Manufacturers:
 - a. JP Lamborn Co; Antimicrobial Duct AMBlue II: www.jplflex.com/#sle.
 - b. Quietflex Manufacturing Company; AMGFlex: <https://quietflex.com/#sle>.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- J. Flexible Air Ducts with Rip-Resistant Scrim:
 1. UL 181, Class 1, aluminum laminate and polyester vapor barrier with rip-resistant scrim reinforcement supported by helically wound spring steel wire.
 2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 3. Pressure Rating: From 10 in-wc (2.5 kPa) to 0.5 in-wc (175 Pa) negative.
 4. Maximum Velocity: 4,000 fpm (20.3 m/s).
 5. Temperature Range: Minus 20 to 175 degrees F (Minus 28 to 79 degrees C).
 6. Manufacturers:
 - a. Quietflex Manufacturing Company; Rip Stop: <https://quietflex.com/#sle>.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- K. Flexible Air Ducts with Rip-Resistant Scrim and Collared Ends:
 1. UL 181, Class 1, aluminum laminate and polyester vapor barrier with rip-resistant scrim reinforcement and collared ends supported by helically wound spring steel wire.
 2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 3. Pressure Rating: From 10 in-wc (2.5 kPa) to 0.5 in-wc (175 Pa) negative.
 4. Maximum Velocity: 4,000 fpm (20.3 m/s).
 5. Temperature Range: Minus 20 to 175 degrees F (Minus 28 to 79 degrees C).
 6. Manufacturers:
 - a. Quietflex Manufacturing Company; Collared Rip Stop: <https://quietflex.com/#sle>.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- L. High Pressure Flexible Air Ducts:
 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 2. Insulation: Fiberglass insulation with reinforced vapor barrier.
 3. Inner Core: Microbial growth resistant inner core treated with Agion silver.
 4. Pressure Rating: From 16 in-wc (4.0 kPa) positive to 2 in-wc (500 Pa) negative.
 5. Maximum Velocity: 4,000 fpm (20.3 m/s).
 6. Temperature Range: Minus 20 to 210 degrees F (Minus 28 to 99 degrees C).

7. Manufacturers:
 - a. Quietflex Manufacturing Company; HPDFlex: <https://quietflex.com/#sle>.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

M. Medium Pressure Flexible Air Ducts:

1. UL 181, Class 1, aluminized laminate supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with metallic vapor barrier.
3. Inner Core: Tri-laminate of polyester, fiberglass, and aluminum foil.
4. Pressure Rating: From 10 in-wc (2.50 kPa) to 10 in-wc (2.50 kPa) negative.
5. Maximum Velocity: 5,500 fpm (27.9 m/s).
6. Temperature Range: Minus 20 to 250 degrees F (Minus 28 to 121 degrees C).
7. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 5: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

N. High Pressure Flexible Air Ducts:

1. UL 181, Class 1, aluminized laminate supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with metallic vapor barrier.
3. Inner Core: Tri-laminate of polyester, fiberglass, and aluminum foil.
4. Pressure Rating: From 20 in-wc (5.00 kPa) to 5 in-wc (1.25 kPa) negative.
5. Maximum Velocity: 5,500 fpm (27.9 m/s).
6. Temperature Range: Minus 20 to 250 degrees F (Minus 28 to 121 degrees C).
7. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 3: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

O. High Pressure Flexible Air Ducts:

1. UL 181, Class 1, PVC-coated, fiberglass cloth fabric supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with metallic vapor barrier.
3. Inner Core: PVC-coated, fiberglass cloth fabric.
4. Pressure Rating: From 20 in-wc (5 kPa) to 5 in-wc (1.25 kPa) negative.
5. Maximum Velocity: 5,500 fpm (27.9 m/s).
6. Temperature Range: Minus 20 to 250 degrees F (Minus 28 to 121 degrees C).
7. Manufacturers:

- a. Flexmaster USA, a brand of Masterduct, Inc; Type 4: www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- P. Flexible Insulated Sleeve with Rip-Resistant Scrim for Uninsulated Hard Air Duct or Pipe:
 - 1. UL 181, Class 1, aluminum laminate and polyester vapor barrier with rip-resistant scrim reinforcement.
 - 2. Insulation: Fiberglass insulation with polyethylene vapor barrier core.
 - 3. Exterior Color: Silver.
 - 4. Temperature Range: Minus 20 to 175 degrees F (Minus 28 to 79 degrees C).
 - 5. Manufacturers:
 - a. Quietflex Manufacturing Company; Rip Stop Insulated Sleeve: <https://quietflex.com/#sle>.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 NON-METAL DUCTS

- A. Air Dispersion (Sock) Ducts:
 - 1. 1/4 to 3.1 in-wc (62 to 772 Pa) static, linear-vent type with hangers, supports and appurtenances as listed per UL 2518.
 - 2. Manufacturers:
 - a. DuctSox Corporation: www.ductsox.com/#sle.
 - b. Fabricair, Inc: www.fabricair.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fibrous Glass Ducts:
 - 1. 1 inch (25 mm) thick rigid glass fiber with aluminum foil, glass scrim, and Kraft or plastic jacket vapor barrier; maximum 0.23 K value at 75 degrees F (0.034 KSI at 24 degrees C).
 - 2. Fabricate ductwork, fittings, supports, hangers, and appurtenances per SMACNA (FGD) and UL 181.
 - 3. Machine-fabricate fibrous glass ducts and fittings. Make only minor on-site manual adjustments.
 - 4. Staple duct joints and tape with 3 inch (75 mm) wide heat-activated chemical bonding tape.
 - 5. Do not use fibrous glass ducts within 12 inches (300 mm) of electric or fuel-fired heaters.
 - 6. Maximum stress exerted on structural steel members: 22,000 psi (152 MPa).
 - 7. Maximum Air Service Capacity:
 - a. Pressure: Plus or minus 2 in-wc (500 Pa).
 - b. Temperature: Up to 250 degrees F (121 degrees C).
 - c. Air Velocity: Up to 2,400 fpm (13.92 m/s).
- C. Thermoset Fiber Glass Reinforced Plastic (FRP) Ducts:

1. Glass fiber reinforced plastic with minimum wall thickness of 3/16 inch (5 mm).
2. Manufacturers:
 - a. Substitutions: See Section 01 60 00 - Product Requirements.

D. Phenolic Ducts:

1. Rigid thermoset phenolic resin with 1 mil (25.4 micron) aluminum foil dual-facing. Reinforced with a 0.2 inch (5 mm) glass scrim.
2. Panel Wall Thickness: Minimum 0.875 inch (22 mm).
3. Finish: UV resistant glass reinforced polyester/epoxy (GRP/GRE) cladding system.
4. Manufacturers:
 - a. Kingspan Insulation LLC; The Kingspan KoolDuct System: www.kingspaninsulation.us/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 AIR PLENUMS AND CASINGS

A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.

B. Minimum Fabrication Requirements:

1. Fabricate acoustic plenum or casing with reinforcing turned inward.
2. Provide 16-gauge, 0.059-inch (1.52 mm) sheet steel back facing and 22-gauge, 0.029-inch (0.76 mm) perforated sheet steel front facing with 3/32 inch (2.4 mm) diameter holes on 5/32 inch (4 mm) centers.
3. Construct panels 3 inches (75 mm) thick, packed with 4.5 pcf (72 kg/cu m) minimum glass fiber insulation media, on inverted channel of 16-gauge, 0.059-inch (1.52 mm) sheet steel.
4. Mount floor-mounted plenum or casings on 4-inch (100 mm) high concrete curbs. At floor, rivet panels on 8-inch (200 mm) centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch (1.31 mm) expanded metal mesh supported at 12-inch (300 mm) centers, turned up 12 inches (300 mm) at sides with sheet metal shields.

C. Access Doors:

1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
3. Provide clear wire glass observation ports, minimum 6 by 6 inch (150 by 150 mm) size.

D. Thermal Panels:

1. Material: Steel-faced composite panel with noncombustible structural high density mineral fiber core for plenum fabrication.
 - a. Facing: Galvanized steel (G90), 24 gauge, 0.0275 inch (0.701 mm).
 - b. Finish: Unpainted.
 - c. Core: Mineral wool board.

- d. Structural: Nonload bearing.
- 2. Panel Thickness: 2.5 inches (63 mm).
- 3. R-Value: 12 when tested in accordance with ASTM C177.
- 4. Manufacturers:
 - a. DuraSystems Barriers Inc; DuraTherm: www.durasystems.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Fire-Rated Metal Panels:
 - 1. Fire Rating: 120 minutes when tested in accordance with ASTM E119.
 - 2. Material: Steel-faced composite panel with noncombustible structural high density mineral fiber core, UL or ETL labeled, nonload bearing fire separations.
 - a. Facing: Galvanized steel (G90), 24 gauge (0.0275 inch) (0.701 mm).
 - b. Finish: Unpainted.
 - c. Core: Mineral wool board.
 - d. Structural: Nonload bearing.
 - 3. Sound Transmission Class: 30 when tested in accordance with ASTM E90.
 - 4. Manufacturers:
 - a. DuraSystems Barriers Inc; DuraWall: www.durasystems.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 DUCTS FOR KITCHEN EXHAUST APPLICATIONS

- A. Provide ductwork, fittings, and appurtenances per NFPA 96, SMACNA (KVS), UL 1978, and UL 2221 requirements and guidelines.
- B. Class 1 duct for air with gas and grease particle exhaust at an air velocity of 1,500 to 2,500 fpm (7.6 to 12.7 m/s).
- C. Where ducts are not self-draining back to equipment, provide low-point drain pocket with the copper drain pipe to a sanitary sewer.
- D. Design, fabricate, and install liquidtight preventing exhaust leakage into building.
- E. Dishwasher Exhaust Duct:
 - 1. Duct Size: 1/2 in-wc (125 Pa) pressure class stainless steel.
 - 2. Fabricate using single wall, 20-gauge, 0.035-inch (0.95 mm) Type 304 stainless steel with external welded joints.
 - 3. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
 - 4. Manufacturers:

- a. AMPCO by Hart & Cooley, Inc; Model N: www.ampcostacks.com/#sle.
- b. Selkirk Corporation; Model G: www.selkirkcommercial.com/#sle.
- c. Substitutions: See Section 01 60 00 - Product Requirements.

F. Kitchen Hood and Grease Exhaust Duct:

- 1. Fabricate in accordance with ductwork manufacturer's instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.
- 2. Round, Single-Wall, Premanufactured Grease Exhaust Duct:
 - a. UL Listed and labeled to UL 1978.
 - b. Construct of 20-gauge, 0.035-inch (0.95 mm) Type 304 stainless steel.
 - c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
 - d. Minimum horizontal slope of 1/16 inch per foot (0.52 cm per m) per manufacturers listing to UL 1978.
 - e. Manufacturers:
 - 1) AMPCO by Hart & Cooley, Inc; Model N: www.ampcostacks.com/#sle.
 - 2) Selkirk Corporation; Model G: www.selkirkcommercial.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
- 3. Rectangular, Single-Wall, Premanufactured Grease Exhaust Duct:
 - a. UL Listed and labeled to UL 1978.
 - b. Construct of 16-gauge, 0.059-inch (1.52 mm) sheet steel using continuous external welded joints in rectangular sections.
 - c. Construct of 18-gauge, 0.050-inch (1.27 mm) stainless steel using continuous external welded joints in rectangular sections.
 - d. Manufacturers:
 - 1) DuraSystems Barriers Inc; DuraDuct SED: www.durasystems.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- 4. Round, Double-Wall, Premanufactured Grease Exhaust Ducts:
 - a. UL Listed and labeled to UL 1978.
 - b. Nominal 1 inch (25.4 mm) thick, body soluble fiber insulation that fills annular space between inner liner of 20-gauge, 0.035 inch (0.95 mm) Type 304 stainless steel and outer jacket of 24-gauge, 0.023-inch (0.61 mm) aluminized steel.
 - c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
 - d. Minimum horizontal slope of 1/16 inch per foot (0.52 cm per m) per manufacturer's listing to UL 1978.
- 5. Zero Clearance, 2-Hour Fire-Rated, Round, Double-Wall, Premanufactured Grease Duct:

- a. UL Listed and labeled to UL 1978 and UL 2221.
 - b. Nominal 3 inches (76.2 mm) thick, high density body soluble fiber insulation between 20-gauge, 0.035-inch (0.95 mm) Type 304 stainless steel liner, and 24-gauge, 0.0239-inch (0.61 mm) aluminized steel sheet outer jacket.
 - c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
 - d. Through-penetration firestop listed to UL 1479 or ASTM E814.
 - e. Minimum horizontal slope of 1/16 inch per foot (0.52 cm per m) per manufacturers listing to UL 1978.
6. Zero Clearance, 2-Hour Fire-Rated, Rectangular, Double-Wall, Premanufactured Grease Duct:
- a. Listed when tested in accordance with UL 1978 and ASTM E2336.
 - b. Construct of 16-gauge, 0.059-inch (1.52 mm) sheet steel using continuous external welded joints in rectangular sections.
 - c. Construct of 18-gauge, 0.050-inch (1.27 mm) stainless steel using continuous external welded joints in rectangular sections.
 - d. Liquidtight with continuous external weld for seams and joints.
 - e. Where ducts are not self-draining back to equipment, provide low-point drain pocket with copper drain pipe to sanitary sewer.
 - f. Through-penetration firestop listed to UL 1479 or ASTM E814.
 - g. Manufacturers:
 - 1) DuraSystems Barriers Inc; DuraDuct KEX: www.durasystems.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
7. Grease Exhaust Duct Access Doors:
- a. Listed when tested in accordance with UL 1978.
 - b. Provide with preinsulated door to comply with ASTM E2336.
 - c. Install hinged access doors where indicated or required for access for cleaning and inspection of duct.
 - d. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
 - e. Manufacturers:
 - 1) Fire Shield, LLC; Easy Access Grease Duct Door: www.fireshieldlv.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.07 DUCTS FOR LABORATORY AND INDUSTRIAL-GRADE APPLICATIONS

A. Duct Class:

- 1. Class 1: Gases at a minimum conveying velocity of 1,000 to 2,000 fpm (5 to 10 m/s).

2. Class 2: Very fine, light dust in light concentrations with light abrasion at a minimum conveying velocity of 2,500 to 3,000 fpm (13 to 15 m/s).
3. Class 3: Average dry dust in moderate concentrations with high abrasion at a minimum conveying velocity of 3,500 to 4,000 fpm (18 to 20 m/s).
4. Class 4: Heavy dusts in high concentrations with high abrasion at a minimum conveying velocity of 4,000 to 4,500 fpm (20 to 23 m/s).
5. Class 5: Corrosive fumes in light concentrations at a minimum conveying velocity of 1,000 to 2,000 fpm (5 to 10 m/s).

B. Sectional Shape and Material Requirements:

1. Round Metal Duct:
 - a. Manufacturers:
 - 1) Nordfab Ducting: www.nordfab.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - b. Pressure Class: Plus or minus 2 in-wc (500 Pa).
 - c. Pressure Capacity Range:
 - 1) Round: Minus 30 to 50 in-wc (Minus 7.5 to 12.5 kPa).
 - 2) Rectangular: Minus 150 to 150 in-wc (Minus 37.4 to 37.4 kPa).
 - d. Maximum Air Service Temperature:
 - 1) 250 degrees F (121 degrees C): Aluminum, duct class 1.
 - 2) 400 degrees F (205 degrees C): Galvanized steel.
 - 3) 650 degrees F (345 degrees C): Hot-rolled carbon steel.
 - 4) 800 degrees F (427 degrees C): Stainless steel, type 304.
 - e. Minimum Duct Thickness: Duct Class 1, 2 and 5; 18 gauge, 0.048 inch (1.2 mm).
 - f. Compliance: Provide ductwork, fittings, supports, hangers, and appurtenances:
 - 1) Round: SMACNA (ROUND) construction standard.
 - 2) Rectangular: SMACNA (RIDC) construction standard.
2. Round Thermoplastic (PVC I) Duct:
 - a. Class 5 Air Duct Capacity:
 - 1) Pressure Class: Minus 2 in-wc (500 Pa).
 - 2) Pressure: Plus or minus 10 in-wc (2.5 kPa).
 - 3) Maximum Temperature: 100 degrees F (37.8 degrees C).
 - b. Protection: Apply ultraviolet protection for segments exposed to direct sunlight.

- c. Compliance: Provide reinforced ductwork, fittings, supports, hangers, and appurtenances in compliance with SMACNA (PVC).
 - 3. Round Thermoset (FRP) Duct:
 - a. Class 5 Air Duct Capacity:
 - 1) Pressure Class: Minus 10 in-wc (2.5 kPa).
 - 2) Pressure: Plus or minus 30 in-wc (7.5 kPa).
 - 3) Maximum Temperature: 180 degrees F (82 degrees C).
 - b. Protection: Apply weather resistant and ultraviolet protection coatings for segments exposed to direct sunlight.
 - c. Compliance: Provide ductwork, fittings, supports, hangers, and appurtenances per SMACNA (FRP).
 - 4. Round Phenolic Duct:
 - a. Class 1 Air Duct Capacity:
 - 1) Pressure Class: Minus 2 in-wc (500 Pa).
 - 2) Pressure: Minus 3 in-wc (750 Pa) to 4 in-wc (1,000 Pa).
 - 3) Temperature: Minus 15 to 185 degrees F (Minus 26 to 85 degrees C).
 - 4) Maximum Air Velocity: 5,000 fpm (25.4 m/s).
 - b. Protection: Apply weather resistant and ultraviolet protection coatings for segments exposed to direct sunlight.
 - c. Compliance: Provide ductwork, fittings, seal-class A, supports, hangers, closure systems, and appurtenances per SMACNA (Phenolic) standards.
- C. Laboratory Exhaust Applications:
- 1. Dust Collector Exhaust: Round thermoplastic (PVC) ductwork.
 - 2. Bio-Safety Cabinet Exhaust:
 - a. Class 1, round galvanized steel ductwork.
 - b. Coordinate duct, fittings, hangers, and appurtenances to cabinet unit.
 - c. Antimicrobial Treatment: Provide EPA-registered antimicrobial coating or touch-up paint tested in accordance with ASTM E84.
 - 3. Fume Hood Cabinet Exhaust:
 - a. Minimum 20-gauge, 0.035-inch (0.95 mm) Type 316 stainless steel, unless noted otherwise.
 - 1) Fabricate in accordance with ductwork manufacturer's instructions; test duct system to sustain positive and negative pressures in accordance with ASHRAE Std 126 and ASME AG-1.
 - 2) Single-wall, factory built, general use vent system.
 - (a) Seal joints during installation with factory-supplied overlapping V-bands and sealant.

- b. Chemicals: Round, class 1 asphalt-coated steel.
- c. Radioisotope: Class 5, round, 316L polished welded stainless steel ductwork.
- d. Hydrofluoric Acid: Class 5, round thermoplastic (PVC I).
- e. Perchloric Acid: Vertically-installed, round, class 5, thermoplastic (CPVC) ductwork. Provide equidistantly-aligned bulkheads to hold field-terminated internal water spray nozzles.
- f. Provide ductwork and appurtenances in accordance with NFPA 91 requirements except where NFPA 45 applications take precedence.
- g. Coordinate duct, fittings, hangers, and accessories to comply with ANSI Z9.5.
- h. Design, fabricate, and install liquidtight preventing exhaust leakage into the building.
- i. Operating Range: 10 in-wc (2.50 kPa).
- j. Seal joints during installation with factory-supplied flanges and airtight gasketing.
- k. Provide with factory installed and pressure tested access doors.
- l. Manufacturers:
 - 1) DuraSystems Barriers Inc; DuraDuct LXD: www.durasystems.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.08 PREFABRICATED VENTILATION SUBDUCTS

A. Single-Wall, Round Ventilation Duct with Integral Subduct Risers:

- 1. Prefabricated, single-wall duct with integral low-profile 22-inch (55.8 cm) high subduct risers.
- 2. Construction: Minimum 20-gauge, 0.035-inch (0.95 mm) aluminized steel.
 - a. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
- 3. Manufacturers:
 - a. AMPCO; Model N: www.ampcostacks.com/#sle.
 - b. LFSystems, a Division of RM Manifold Group: www.lfsystems.net/#sle.
 - c. Selkirk Corporation; Model G: www.selkirkcommercial.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Double-Wall, Round, 2-Hour Fire-Rated Ventilation Duct with Integral Subduct Risers:

- 1. Prefabricated, double-wall duct with integral low-profile 22-inch (55.8 cm) high subduct risers.
- 2. UL Listed and labeled to ISO 6944-1.
- 3. Nominal 3 inches (76.2 mm) thick, high density body soluble fiber insulation that fills annular space between inner liner of 20-gauge, 0.035-inch (0.95 mm) aluminized steel and outer jacket of 24-gauge, 0.0239-inch (0.61 mm) aluminized steel.
- 4. Seal joints during installation with factory-supplied overlapping V-bands and sealant.

5. Through-penetration firestop listed to UL 1479 or ASTM E814.
 6. Manufacturers:
 - a. AMPCO; Model IVSI-Z3: www.ampcostacks.com/#sle.
 - b. LFSsystems, a Division of RM Manifold Group: www.lfsystems.net/#sle.
 - c. Selkirk Corporation; IPS-Z3: www.selkirkcommercial.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Accessories:
1. Support plates and rings.
 2. Cleanout access at shaft base.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.
- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Buried Supply Duct: Insulate duct runs over 70 feet (20 m) long with 1 inch (25 mm) thick insulation covered with plastic vapor barrier.
- G. Buried Metal Ductwork: Paint according to SMACNA (DCS).
- H. Buried Metal Ductwork Without Factory Jacket: Paint with one coat and seams and joints with additional coat of asphalt base protective coating.
- I. Buried Metal Ductwork: Encase according to SMACNA (DCS).
 1. Provide adequate tie-down points to prevent ducts from floating during concrete placement.
 2. Introduce no heat into ducts for 20 days following the placement of concrete.
- J. Fibrous Glass Ducts: Install per SMACNA (FGD). Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.
- K. Flexible Ducts: Connect to metal ducts with adhesive.
- L. Kitchen Range Hoods: Install and fit-out with respective ductwork and accessories to interconnect exhaust system.
- M. Kitchen Hood Exhaust: Provide residue traps at the base of vertical risers with provisions for the cleanout.

- N. PVC Coated Metal Ductwork: Tape with PVC tape.
- O. Underground Ducts: Slope to plenums or low pump-out points at 1:500. Provide access doors for inspection.
- P. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- Q. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- R. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- S. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with a crimp in the direction of airflow.
- T. Use double nuts and lock washers on threaded rod supports.
- U. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible duct. Do not use flexible duct to change direction.
- V. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.
- W. Set plenum doors at 6 to 12 inches (150 to 300 mm) above floor. Arrange door swings so that fan static pressure holds door in closed position.
- X. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- Y. Louver Fit-out:
 - 1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.
 - 2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.
- Z. Plenums and Casings:
 - 1. Mount floor-mounted casings on 4 inch (100 mm) high concrete curbs.
 - 2. At floor, rivet panels on 8 inch (200 mm) centers to angles.
 - 3. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch (1.31 mm) expanded metal mesh supported at 12-inch (300 mm) centers, turned up 12 inches (300 mm) at sides with sheet metal shields.
- AA. Fire Partitions: Provide firestopping sealing.
- BB. Duct Accessories, Terminal Units, Inlets, and Outlets: Interconnect as indicated.
- CC. Duct Insulation: Provide duct insulation.
- DD. Painting: Provide surface finish as indicated on drawings.

3.02 CLEANING

- A. Clean thoroughly each duct system.

- B. Clean duct system by forcing air at high velocity through duct to remove accumulated dust. Clean half the system at a time to obtain sufficient air. Protect equipment that could be harmed by excessive dirt with temporary filters or bypass during cleaning.

END OF SECTION

**SECTION 23 33 00
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Backdraft dampers - fabric.
- D. Industrial blast-suppression dampers.
- E. Fiberglass backdraft dampers.
- F. Combination fire and smoke dampers.
- G. Combination fire and smoke dampers - corridor dampers.
- H. Duct access doors.
- I. Duct test holes.
- J. Fire dampers.
- K. Flexible duct connectors.
- L. Smoke dampers.
- M. Smoke and fire-smoke damper test module.
- N. Volume control dampers.
- O. Fiberglass control dampers.
- P. Low leakage (Class 1A) control dampers.
- Q. Air measuring control dampers.
- R. Miscellaneous Products:
 - 1. Damper operators.
 - 2. Damper position switch.
 - 3. Fire-rated enclosures.
 - 4. Internal strut end plugs.
 - 5. Duct opening closure film.
 - 6. Airflow meters, fixed-resistance type.
 - 7. Airflow meters, thermal-dispersion type.

1.02 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings.
- B. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.
- C. Section 25 35 13 - Integrated Automation Actuators and Operators: Damper operators.
- D. Section 25 35 16 - Integrated Automation Sensors and Transmitters: Damper position switch.
- E. Section 25 35 23 - Integrated Automation Control Dampers: Product furnishing.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2022).
- C. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2022).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- I. NFPA 92 - Standard for Smoke Control Systems; 2021.
- J. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- K. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- M. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- N. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- O. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- P. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
- Q. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- R. UL 555C - Standard for Safety Ceiling Dampers; Current Edition, Including All Revisions.
- S. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

- T. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
- U. 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.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
- D. Project Record Drawings: Record actual locations of access doors and test holes.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane): www.carlislehvac.com/#sle.
 - 2. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - 3. Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.
 - 4. Ruskin Company: www.ruskin.com/#sle.
 - 5. Titus HVAC, a brand of Johnson Controls: www.titus-hvac.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 - 2. Nailor Industries, Inc: www.nailor.com/#sle.

3. Ruskin Company: www.ruskin.com/#sle.
 4. United Enertech: www.unitedenertech.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gravity Backdraft Dampers, Size 18 by 18 inches (450 by 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.03 BACKDRAFT DAMPERS - FABRIC

- A. Manufacturers:
1. Metal Form Manufacturing, Inc: www.mfmca.com/#sle.
 2. American Warming and Ventilating, a brand of Mestek, Inc: www.awv.com/#sle.
 3. Vent Products Company, Inc: www.ventproducts.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabric Backdraft Dampers: Factory-fabricated.
1. Frame: Galvanized steel, 18-gauge, 0.0478-inch (1.21 mm) minimum base sheet thickness.
 2. Blades: Neoprene coated fabric material.
 3. Birdscreen: 1/2 inch (12 mm) nominal mesh of galvanized steel or aluminum.
 4. Maximum Velocity: 1000 fpm (5 mps) face velocity.

2.04 INDUSTRIAL BLAST-SUPPRESSION DAMPERS

- A. Manufacturers:
1. Ruskin Company: www.ruskin.com/#sle.
 2. United Enertech: www.unitedenertech.com/#sle.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Frame:
1. Orientation: Horizontal.
 2. Material: 10 gauge, flanged galvanized steel.
 3. Free-area Shape: Circular cross section with grooved line position indicator on shaft-end
- C. Blade:
1. Type: Single-blade round.
 2. Material: 10 gauge, galvanized steel with rubber-based gasket.
 3. Axle: Same blade material with lubricated ball-bearings and axle seals to isolate contaminated air streams at high temperatures.
- D. Identification Tag: Custom octagon type, stainless steel, engraved.

1. Information: Show cfm (L/sec) with fail setting and part number.
 2. Fastened: Beaded chain, stainless steel.
- E. Certification: AMCA 500-D certified for use as bubble-tight (i.e., zero leak or zero flow) for duct pressures up to 10 in-wc (2.5 kPa) when fully closed and able to withstand airflow velocities up to 3,500 fpm (17.8 m/sec) when fully open. Show certification stamp on product sheet and damper-applied tag.
- F. Temperature Service Range: Minus 25 to 185 degrees F (Minus 32 to 85 degrees C).
- G. Actuators:
1. Configuration: Factory-mounted, electrically-operated with built-in manual handwheel.
 2. Torque Loading: Provide multiple units for damper torques beyond rated single actuator capacity with jackshaft for arrays or custom larger sizes.
- H. Other Requirements:
1. Paint Finish: Standard.
 2. Rust Inhibitor Coating: Moisture and salt water-resistant.
 3. Sleeve or Flange: Factory-mounted standard.

2.05 FIBERGLASS BACKDRAFT DAMPERS

- A. Manufacturers:
1. Ruskin Company: www.ruskin.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fiberglass Material Construction: ASTM E84, flame retardant, vinyl ester based resin.
- C. Counterbalanced assembly, 18 inches (450 mm) round, flanged. Fiberglass-made frame with single butterfly blade. Steel-fabricated axle with graphite-filled PTFE sleeve bearings located out of airstream, and metal paint finish.
- D. Counterbalanced assembly, 18 by 18 inches (450 by 450 mm) in size, flanged. Fiberglass-made frame with multiple v-groove-shaped blades. Stainless steel axle with molded PTFE bearings located out of airstream, elastomeric blade seals, and standard exterior coating.
- E. Identification Tag: Custom octagon type, stainless steel, engraved.
1. Information: Show cfm (L/sec) with fail setting and part number.
 2. Fastened: Beaded chain, stainless steel.
- F. Maximum Operating Pressure: 10 in-wc (7.5 kPa).
- G. Maximum Temperature Service: 200 degrees F (94 degrees C).

2.06 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:

1. AireTechnologies, Inc, a DMI Company: www.airetechnologies.com/#sle.
 2. Lloyd Industries, Inc: www.firedamper.com/#sle.
 3. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 4. Nailor Industries, Inc: www.nailor.com/#sle.
 5. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
 6. Pottorff: www.pottorff.com/#sle.
 7. Ruskin Company: www.ruskin.com/#sle.
 8. United Enertech: www.unitedenertech.com/#sle.
 9. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch (12.7 mm) actuator shaft.
- E. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
- F. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- G. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.
- H. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.
1. Manufacturers:
 - a. Ruskin Company: www.ruskin.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 COMBINATION FIRE AND SMOKE DAMPERS - CORRIDOR DAMPERS

- A. Manufacturers:
1. Ruskin Company: www.ruskin.com/#sle.
 2. United Enertech: www.unitedenertech.com/#sle.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch (12.7 mm) actuator shaft.
- E. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
- F. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- G. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.
- H. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.

2.08 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Acudor Products Inc, a Division of Nelson Industrial Inc: www.acudor.com/#sle.
 - 2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 3. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - 4. Lloyd Industries, Inc: www.firedamper.com/#sle.
 - 5. MKT Metal Manufacturing: www.mktduct.com/#sle.
 - 6. Nailor Industries, Inc: www.nailor.com/#sle.
 - 7. Ruskin Company: www.ruskin.com/#sle.
 - 8. SEMCO LLC: www.semcohvac.com/#sle.
 - 9. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick-fastening locking devices. For insulated ducts, install minimum 1-inch (25 mm) thick insulation with sheet metal cover.
 - 1. Less Than 12 inches (300 mm) Square: Secure with sash locks.
 - 2. Up to 18 inches (450 mm) Square: Provide two hinges and two sash locks.
 - 3. Up to 24 by 48 inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.
 - 5. High Temperature Duct Access Doors:
 - a. Comply with NFPA 96.

- b. Comply with UL 1978.
- c. Manufacturers:
 - 1) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.09 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
 - 1. Manufacturers:
 - a. Carlisle HVAC Products; Dynair Test Port with Red Cap with O-Ring Seal: www.carlislevac.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.10 FIRE DAMPERS

- A. Manufacturers:
 - 1. AireTechnologies, Inc, a DMI Company: www.airetechnologies.com/#sle.
 - 2. Lloyd Industries, Inc: www.firedamper.com/#sle.
 - 3. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 - 4. Nailor Industries, Inc: www.nailor.com/#sle.
 - 5. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
 - 6. Panasonic Corporation of North America; Flex Damper: www.panasonic.com/#sle.
 - 7. Pottorff: www.pottorff.com/#sle.
 - 8. Ruskin Company: www.ruskin.com/#sle.
 - 9. United Enertech: www.unitedenertech.com/#sle.
 - 10. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Ceiling (Radiation) Dampers: Galvanized steel, 22-gauge, 0.0299-inch (0.76 mm) frame and 16-gauge, 0.0598-inch (1.52 mm) flap, two layers of 0.125-inch (3.2 mm) thick ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
 - 1. Boot Fitting: Factory-provided el type (90 degree). Include field-provided collar.
 - 2. Box Fitting: Factory-provided 26 gauge, 0.0179 inch (0.45 mm) with field-provided collar.

3. Rated for three hour service in compliance with UL 555C.
4. Manufacturers:
 - a. Ruskin Company: www.ruskin.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch (0.76 mm) frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.
- E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch (250 Pa) pressure-class ducts up to 12 inches (300 mm) in height.
- F. Multiple Blade Dampers: 16-gauge, 0.0598-inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- G. Fusible Links: UL 33, separate at 160 degrees F (71 degrees C) with adjustable link straps for combination fire/balancing dampers.
- H. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.

2.11 FLEXIBLE DUCT CONNECTORS

- A. Manufacturers:
 1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com/#sle.
 2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 3. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. 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/sq yd (1.0 kg/sq m).
 - a. Net Fabric Width: Approximately 2 inches (50 mm) wide.
 2. Metal: 3 inches (75 mm) wide, 24 gauge, 0.0239 inch (0.61 mm) thick galvanized steel.
- D. Lead Vinyl Sheet: Minimum 0.55 inch (14 mm) thick, 0.87 lbs per sq ft (4.2 kg/sq m), 10 dB attenuation in 10 to 10,000 Hz range.
- E. Maximum Installed Length: 14 inch (356 mm).

2.12 SMOKE DAMPERS

- A. Manufacturers:

1. AireTechnologies, Inc, a DMI Company: www.airetechnologies.com/#sle.
 2. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 3. Nailor Industries, Inc: www.nailor.com/#sle.
 4. Ruskin Company: www.ruskin.com/#sle.
 5. United Enertech: www.unitedenertech.com/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- C. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- D. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.13 SMOKE AND FIRE-SMOKE DAMPER TEST MODULE

- A. Addressable fire alarm system proprietary controller module preconfigured for remote testing of dedicated smoke damper or combination fire-smoke damper.
- B. Provide module, accessories, and connectivity to meet NFPA 80 and NFPA 105 requirements.
- C. Products:
1. Ruskin Company; ADC105: www.ruskin.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.14 VOLUME CONTROL DAMPERS

- A. Products for Automatic Controls.
- B. Manufacturers:
1. AireTechnologies, Inc, a DMI Company: www.airetechnologies.com/#sle.
 2. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 3. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 4. MKT Metal Manufacturing: www.mktduct.com/#sle.
 5. Nailor Industries, Inc: www.nailor.com/#sle.
 6. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
 7. Ruskin Company: www.ruskin.com/#sle.
 8. United Enertech: www.unitedenertech.com/#sle.
 9. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Fabricate in accordance with SMACNA (DCS) and as indicated.

D. Splitter Dampers:

1. Material: Same gauge as duct to 24 inches (600 mm) size in either direction, and two gauges heavier for sizes over 24 inches (600 mm).
2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
3. Operator: Minimum 1/4 inch (6 mm) diameter rod in self aligning, universal joint action, flanged bushing with set screw.

E. Single Blade Dampers:

1. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
2. Blade: 24 gauge, 0.0239 inch (0.61 mm), minimum.

F. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches (200 by 1825 mm). Assemble center- and edge-cripped blades in prime-coated or galvanized-channel frame with suitable hardware.

1. Blade: 18 gauge, 0.0478 inch (1.21 mm), minimum.

G. End Bearings: Except in round ducts 12 inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

1. Manufacturers:
 - a. Carlisle HVAC Products; Dynair End Bearing Leak Resistant Sets: www.carlislehvac.com/#sle.
 - b. Elgen Manufacturing Company, Inc; Snap-In Bushing: www.elgenmfg.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

H. 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 (750 mm) provide regulator at both ends.
4. Manufacturers:
 - a. Carlisle HVAC Products; Dynair Double Shear Rattle Free Quadrants 1/2 inch: www.carlislehvac.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

I. Constant Airflow Regulators:

1. General Requirements:
 - a. Provide bi-directional, air balancing regulator for pressure independent air volume control.
 - b. Complies with UL 2043 for heat and smoke release.
 - c. Complies with AMCA 500-D for the allowable leakage rates.

- d. Airflow regulator to be field adjustable.
- 2. Construction:
 - a. Nominal Diameter: 4 inch (104 mm).
 - b. Frame: Thermoplastic resin in compliance with UL 94.
 - c. Blade: Thermoplastic resin in compliance with UL 94.
 - d. Bearings: Hydraulic blade dampener.
 - e. Outer Seal: Removable rubber gasket-type around circumference of damper.
 - f. Spring: Stainless steel leaf-type.
 - g. Temperature Range: 25 to 150 degrees F (Minus 4 to 65 degrees C) .
 - h. Operating Range: 0.2 to 2 in-wc (50 to 498 Pa).
- 3. Accessories:
 - a. Provide airflow regulators with rectangular to round transitions.
- 4. Manufacturers:
 - a. Automatic Airflow Balancing, a brand of Metal Industries Inc: www.airflowbalancing.com/#sle.
 - b. Ruskin Company: www.ruskin.com/#sle.
 - c. United Enertech: www.unitedenertech.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.15 FIBERGLASS CONTROL DAMPERS

- A. Manufacturers:
 - 1. Ruskin Company: www.ruskin.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fiberglass Material Construction: ASTM E84, flame retardant, vinyl ester based resin.
- C. Round: Fiberglass frame, counterclockwise inlet-vane blades, and axle assembly with molded PTFE bearings, flanged, and control shaft extended 6 inches (15.2 cm) beyond frame. Finished with standard exterior coating.
- D. Rectangular: Fiberglass frame, airfoil-shaped opposed blades and axle assembly with molded PTFE bearings, flanged and stainless steel control linkage out of the airstream. Finished with standard exterior coating.
- E. Identification Tag: Custom octagon type, stainless steel, engraved.
 - 1. Information: Show cfm (L/sec) with fail setting and part number.
 - 2. Fastened: Beaded chain, stainless steel.
- F. Maximum Operating Pressure: 10 in-wc (7.5 kPa).
- G. Maximum Temperature Service: 200 degrees F (94 degrees C).

2.16 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

- A. Manufacturers:
 - 1. Ruskin Company; CD50: www.ruskin.com/#sle.
 - 2. United Enertech: www.unitedenertech.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Maximum Leakage Allowed: 3 cfm/sq ft at 1 in-wc (15.2 L/sec/sq m at 0.25 kPa).
- C. Frame:
 - 1. Material: 20-gauge galvanized steel.
 - 2. Free-area: Single cross section.
 - 3. Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.
- D. Blade:
 - 1. Type: Single-blade rectangle shape.
 - 2. Operation: Opposed type.
 - 3. Maximum Individual Blade Height: 8 inches (203 mm).
 - 4. Material: 12-gauge galvanized steel.
 - 5. Authority: Opposed type, 5 to 50 percent (typically 10 percent).
- E. Insulation: Water-resistant sound absorbing material.
- F. Temperature Service Range: Minus 25 to 185 degrees F (Minus 32 to 85 degrees C).
- G. Other Requirements:
 - 1. Paint Finish: Standard.
 - 2. Rust Inhibitor Coating: Moisture and salt water-resistant.
 - 3. Sleeve or Flange: Factory-mounted standard.
 - 4. Duct Transition Fitting: Round.
 - 5. Custom: Include bird screen and insect screen.

2.17 AIR MEASURING CONTROL DAMPERS

- A. Manufacturers
 - 1. Ebtron, Inc: www.ebtron.com/#sle.
 - 2. Greenheck Fan Corporation: www.greenheck.com/#sle.
 - 3. Ruskin Company: www.ruskin.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Factory-Mounted Assembly Requirements:

1. Damper Unit or Multi-Unit:

- a. Construction: Flanged-to-duct frame made of extruded aluminum with V or 3V blades for low to medium pressure applications, zinc-plated steel hardware, frame-mounted shaft bearings, frame-assembly sleeve, and silicone seals at frame and blade ends.
- b. Leakage: Class 1A rated for 3 cfm/sf at 1 in-wc (15.2 L/sec/sq m at 0.25 kPa).
- c. Control: Opposed blade modulation by damper actuator(s) from air measuring sensor transmitter-controller unit.
- d. Other Requirements:
 - 1) Rust Inhibitor Coating: Moisture and salt water-resistant.
 - 2) Duct Transition Fittings: As indicated on drawings.

2. Air Measuring Sensor Transmitter-Controller:

- a. Type: Externally-powered, multi-point, multi-probe airflow and temperature monitoring using sensor array of thermal dispersion type wired to externally-mounted transmitter-controller.
- b. Air Velocity Monitoring Range: 0 to 2000 fpm (0 to 10.1 m/s), bidirectional. Factory configure monitor calculate airflow and differential pressure from listed range.
- c. Temperature Monitoring Range: 32 to 104 degrees F (0 to 40 degrees C).
- d. Transmitter: Five percent accuracy, adjustable zero and span, 10 to 1 turndown, 0.1 percent of calibrated span linearity, 30 to 50 millisecond response time, minimum overpressure of 150 percent over highest range value, alphanumeric indicating display, wired or wireless connectivity for configuration, and terminal strip within enclosed electronic components.
- e. Controller: Configure to control hardware-linked damper actuator(s) based on locally typed or software-defined setpoint. Access for user to do local or remote proportional, integrative, and derivative control-loop tuning.
- f. Hardwired External Damper Actuator Output: Two-wire, 4 to 20 mA.
- g. BTU Metering: Provide temperature sensor for field mounting upstream or downstream of heating or cooling source.
- h. BAS, SCADA, or other Integrated Automation System Output: Two-wire, 4 to 20 mA.
- i. BAS, SCADA, or other Integrated Automation System Link: ASHRAE Std 135 BACnet MS/TP.

3. Damper Actuator(s), Factory-Installed:

- a. Motor: Maintenance-free brushless DC powered, selectable clock wise (CW) counter-clock wise (CCW) direction, 60 second stroke, and adjustable mechanical end stops within 95-degree stroke range.
- b. Actuator Type: Modulated operation using incoming input signal with electronic overload protection, double-insulated electrical protection, and fail-safe control using built-in energy storage battery for return under 20 seconds.

- c. Position Feedback: 0 to 5 VDC signal wired into transmitter-controller.
 - d. Flexible conduit with interface cables prewired into transmitter-controller to receive matching output signal and matching power feed.
- C. Service Temperature Range: Minus 20 to 160 degrees F (Minus 28.8 to 71.1 degrees C).
- D. Enclosure Rating for Transmitter-Controller and Damper Actuator(s):
 - 1. General: UL 50 or UL 50E listed for use in non-hazardous locations.
 - 2. Indoors and Plenums: NEMA EN 10250, Type 1.
 - 3. Mechanical Rooms: NEMA EN 10250, Type 2.
 - 4. Outdoors: NEMA EN 10250, Type 4X with built-in heaters sized maintain temperature 10 percent above minimum requirements when exposed to extreme ambient conditions.

2.18 MISCELLANEOUS PRODUCTS

- A. Damper Operators: Provide electric operators.
- B. Damper position switch.
- C. Fire-Rated Enclosures:
 - 1. Manufacturers:
 - a. Fire Rated Product Specialties Corp: www.frpsonline.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Provide as required to preserve fire resistance rating of building elements.
- D. Internal Strut End Plugs: Combination end-mounting and sealing plugs for metal conduit used as internal reinforcement struts for metal ducts; plug crimped inside conduit with outside gasketed washer seal.
 - 1. Manufacturers:
 - a. Carlisle HVAC Products; Dynair Internal Duct Reinforcement - Conduplugs: www.carlislehvac.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
 - 1. Thickness: 2 mils (0.6 mm).
 - 2. High tack water based adhesive.
 - 3. UV stable light blue color.
 - 4. Elongation Before Break: 325 percent, minimum.
 - 5. Manufacturers:
 - a. Carlisle HVAC Products; Dynair Duct Protection Film: www.carlislehvac.com/#sle.
 - b. Elgen Manufacturing Company, Inc; Shrink Wrap with PSA: www.elgenmfg.com/#sle.

- c. Substitutions: See Section 01 60 00 - Product Requirements.

F. Airflow Meters, Fixed-Resistance Type:

- 1. Manufacturers:
 - a. Air Monitor, a Brand of Onicon, Inc: www.onicon.com/#sle.
 - b. KMC Controls; Conquest Airflow Measurement System: www.kmccontrols.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Sensor Type: Provide duct-inserted probe, duct-inserted pitot-tube assembly, and wall-mounted assembly for outside air with built-in transmitter.
- 3. Flow Range: Equivalent velocity pressure required to match scheduled flow range with 100-to-1 signal turndown ratio.
- 4. Accuracy: Two percent over a 30 to 50 millisecond response time, adjustable.
- 5. Linearity: 0.1 percent of calibrated span.
- 6. Minimum Overpressure: 150 percent over highest range value.
- 7. Output: Two-wire, 4 to 20 mA.
- 8. Access Box: NEMA EN 10250, Type 1 with hinged cover housing and cable access ports.
- 9. Energy Metering: Provide external module unless device fitted with additional electronics to link both upstream and downstream temperature signals to meter load in Btu/h (kW).
- 10. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
- 11. Accessories: Include barbed fittings, 3-way valve per pressure port, and pressure snubber per port unless factory fitted into transmitter.

G. Airflow Meters, Thermal-Dispersion Type:

- 1. Manufacturers:
 - a. Ebtron: www.ebtron.com/#sle.
 - b. Greystone Energy Systems, Inc: www.greystoneenergy.com/#sle.
 - c. Ruskin Company: www.ruskin.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Basis of Design: Ruskin Company: www.ruskin.com/#sle.
 - a. Advanced Thermal Dispersion Airflow and Temperature Measuring Probe: TDP05K.
- 3. Configuration: Duct or plenum inserted assembly using up to eight water-resistant thermal dispersion sensors per metal probe wired into external access box holding self-diagnosing sensor interface electronics with respective field wire and cable landing terminals.
- 4. Monitoring Range:
 - a. Air Velocity: 0 to 5,000 fpm (0 to 25 m/sec) converted to airflow using section area.

- b. Temperature: Minus 20 to 120 degrees F (Minus 29 to 49 degrees C).
- 5. Accuracy: Plus or minus 2 percent with a plus or minus 0.25 percent repeatability over listed range. Includes means to zero, adjust, and calibrate outputs.
- 6. Access Box: NEMA EN 10250, Type 4x with hinged cover housing and cable access ports.
- 7. Interface: Fitted with 16 character, 2-line, backlit, alphanumeric display and labeled pad-type surface membrane buttons.
- 8. Controller: Fitted with factory-installed module to handle up to 16 external ancillary probes to form an extended measuring probe array for custom duct or plenum sizes.
- 9. Outputs: Two-wire, 4 to 20 mA, for airflow and temperature signals, configurable.
- 10. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS).
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch (200 by 200 mm) size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch (100 by 100 mm) size access door for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- J. For fans developing static pressures of 5.0 inches (1250 Pa) and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

- K. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.
- L. Use splitter dampers only where indicated.
- M. Provide balancing dampers on high velocity systems where indicated. See Secti
- N. 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 26 00 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

- A. Drawings are necessarily diagrammatic by their nature and are not intended to show every connection in detail or every pipe or conduit in its exact location. Carefully investigate structural and finish conditions and coordinate the separate trades in order to avoid interference between the various phases of Work. Organize and lay out Work so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Install all Work parallel or perpendicular to building lines unless otherwise noted.
- B. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Owner's Project Manager for Owner's interpretations.
- C. Coordinate the actual locations of electrical outlets and equipment with building features and equipment as indicated on architectural, structural, mechanical, and plumbing Drawings. Review any proposed changes in electrical wiring devices or equipment location with the Owner's Project Manager. Owner may direct relocation of outlets before installation, up to five (5) feet from the position indicated, without additional cost. Remove and relocate outlets placed in an unsuitable location when requested by the Owner, at no additional cost to the Owner.
- D. All dimensional information related to new structures shall be taken from the appropriate Drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the Site.
- E. Existing Structures: The building floor slabs, structure, and outer walls are generally existing to remain. The only existing penetrations are openings were indicated on the Drawings. This Contract requires the Contractor to core drill all other floor or wall penetrations as required. All floor penetrations shall include a sleeve that extends two (2) inches above the floor. Bus duct penetrations shall have a minimum 4-inch-high curb as per NEC requirement or per drawing, whichever is higher.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the Contract Documents.

1.04 DEFINITIONS

- A. Concealed: Concealed areas are those areas that cannot be seen by building occupants.
- B. Exposed: Exposed areas are all areas that are exposed to view by building occupants, including areas below counter tops, inside cabinets and closets, inside all equipment rooms, and areas outside the building exterior envelope, exposed to the outdoors.

1.05 QUALITY ASSURANCE

- A. Regulations: Work, materials and equipment shall comply with the latest rules and regulations specified in National Fire Protection Association (NFPA).
- B. Discrepancies: The Drawings and Specifications are intended to comply with listed codes, ordinances, regulations, and standards. Where discrepancies occur, immediately notify the Owner's Project Manager in writing, and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation at no additional cost to the Owner. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.
- C. Contractor Qualifications: An acceptable Contractor for the Work under this Division must have personnel with experience, training, and skill to provide a practical working system. The Contractor shall furnish acceptable evidence of having installed not less than three systems of size and type comparable to this Project. All personnel installing equipment under this Division shall possess valid City of Houston and State of New Mexico licenses for their skill level. Each Journeyman shall supervise no more than two apprentice helpers. Refer also to Owner's Special Conditions.

1.06 SUBMITTALS

- A. Product Data: Provide coordination Drawings with submittals as required by Division 01.
- B. Record Documents: In addition to hard copy format, all material submitted as final record products, including approved Shop Drawings and submittals, shall be submitted to the Owner in its original electronic file format on compact disc or DVD. Material may be scanned into electronic file format where necessary.

1.07 DELIVERY, STORAGE AND HANDLING

- A. All equipment and materials shall be delivered to the Project Site clean and sealed for protection.
- B. Moisture: During construction, protect switchgear, transformers, motors, control equipment, and other items from insulation moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps, or other suitable means. Apply protection immediately upon receiving the products and maintain continually.
- C. Damage: Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is enough cause for rejection of the apparatus or material in question.
- D. Finish: Protect factory finish from damage during construction operations until acceptance of the Project. Restore any finishes that become stained or damaged to Owner's satisfaction.

PART 1 PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Conditions: Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified. Products shall be U.S. made. Owner reserves the right to approve or disapprove foreign-made products.
- C. NEC and UL: Products shall conform to requirements of the National Electrical Code. Where Underwriters' Laboratories have set standards, listed products, and issued labels, products used shall be listed and labeled by UL.
- D. Space Limitations: Equipment selected shall conform to the building features and shall be coordinated with all components. Do not provide equipment that will not meet arrangement and space limitations. Contractor shall submit room layouts with submitted items shown drawn to scale. Submittals will be rejected without floor plan Drawings showing submitted items.
- E. Factory Finish: Equipment shall be delivered with a hard surface, factory-applied finish so that no additional field painting is required except for touch-up.
- F. Series Ratings: Overcurrent devices shall have fully rated interrupting capacity. Series rating of devices is unacceptable.

2.02 EQUIPMENT AND DEVICE MARKING

- A. Conduit marking. Externally mark all conduits for feeders, branch circuits using the same circuit designations as indicated on construction drawings and final as-built documents. Such marks shall be made at the point of origin and destination of the conduits, using permanent marker.
- B. Nameplates shall be black laminated rigid phenolic with white core. Emergency nameplates shall be red laminated phenolic with white cores. Nameplate minimum size shall be 1-inch-high by 3 inches long with 3/16-inch-high engraved white letters. Supply blank nameplates for spare units and spaces.
- C. Nameplate Fasteners: Fasten nameplates to the front of equipment only by means of stainless steel self-tapping screws. Stick-ones or adhesives are not acceptable unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.
- D. Nameplate Information: The general naming convention shall consist of the following segments:
 - 1. Building name in abbreviated form where equipment is located.
 - 2. Building floor where electrical equipment is located.
 - 3. System voltage: M (medium voltage), H (277/480V) or L (120/208V);
 - 4. Individual equipment identification: A, B, C, etc.
- E. In general, provide the following information for the types of electrical equipment as listed:
 - 1. Switchgears, Switchboards, Distribution Panels and Motor Control Centers: On mains, identify the piece of equipment, the source, and voltage characteristics (i.e., 480/277V 3PH 4W). For each branch circuit protective device, identify the load served.

2. Transformers, Individual Starters, Contactors, Disconnect Switches, Transfer Switches and Similar Equipment: Identify the device designation, voltage characteristics source and load served.
 3. Panelboards: Identify panelboard designation, voltage characteristics, and source designation.
 4. Outlet Boxes: Identify Panel and Circuit Number.
- F. Panelboards: Prepare a neatly typed circuit directory printed on 80 weight paper. This directory shall be installed behind clear heat-resistant plastic in a metal frame tack welded to the inside of the door for each panelboard. Identify circuits by equipment served and by building room numbers where room numbers exist. Indicate spares and spaces with light, erasable pencil marking. Adhesive mounted directory pocket is not acceptable. Removing and attaching panel schedules from the Drawings is not acceptable.
- G. Panelboards, Pull, Junction and Outlet Boxes:
1. With ½ inch high permanent lettering, identify conduits connected to panelboards, pull, junction and outlet boxes with the complete circuit number of the conductors contained therein. Neutral conductors shall be identified by wire marker tags in the panelboards, pull, junction and outlet boxes. Where multiple circuits are contained in a box, identify the circuit conductors with permanent tags which indicate circuit designation.
 2. Emergency circuit junction boxes and their covers shall be painted red. Circuit identification shall be marked on the junction box cover. Emergency Circuit Junction Boxes are associated with Panel 'EM'.
 3. Fire alarm circuits (only) shall be marked with half red covers and "Fire Alarm" marked on the face. Emergency Circuit Junction Boxes are associated with Panel 'EM'.
- H. Equipment and raceways over 600 Volts: Provide "WARNING - HIGH VOLTAGE - KEEP OUT" signs on all equipment. With 2-inch-high lettering, mark all exposed raceways containing conductors operating in excess of 600 volts every 100 feet and at each wall or floor penetration with the words "WARNING - HIGH VOLTAGE".
- I. Power receptacles, wall switches and dedicated outlets. Identify circuits as per Specification Section 26 27 26.
- J. Dedicated outlets: Dedicated is understood to be specific equipment listed by equipment number in the panel schedules or identified on the Drawings. Dedicated also includes computer outlets.
- K. Remote Drivers: For remote drivers not within five (5) feet of their associated lighting fixture, provide appropriate permanent lettering on both the ballasts and the light fixture to identify which are mated to the other.

PART 2 EXECUTION

3.01 DEMOLITION

- A. Unless otherwise noted, remove all electrical materials and equipment from areas indicated for demolition. Removal of equipment shall not interfere with existing operations.
- B. Remove conduit and wire back to panelboards or to nearest junction box that is not being removed and needs to remain in service. Wire shall be removed back to point of origin. Turn off circuit breakers or switches serving abandoned circuits and tag breaker or switch and label in panel schedule as "Spare".
- C. Materials and equipment to be removed, except items specifically noted to be relocated or delivered to the Owner, become property of the Contractor, and shall be immediately removed from the Project Site. If the

Owner identifies other items during construction, those items become Owner property and will be turned over to the Owner.

- D. Electrical services and controls to items being removed shall be disconnected and removed from the Project Site as indicated on the drawings.
- E. All fluorescent lighting fixtures being removed from the Project Site that will not be turned over to the Owner shall have any PCB-containing ballasts removed from the fixtures for environmental disposal. Ballasts shall remain intact with wire leads at least twelve (12) inches long.
- F. Contractor shall ensure that light switches within the Work area remain operational. Where temporary 120-volt light strings are installed, a switch shall be provided for the light strings near the Project entry door.
- G. Contractor shall coordinate with Fire Department before disconnect existing fire alarm system and telephone D-Mark. In the event where the existing fire alarm system is un operational before end of workday the contractor shall provide a 24-Hour fire watch.

3.02 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements, referenced standards, and conform to codes and ordinances of authorities having jurisdiction.
- B. Installation shall be in accordance with manufacturer's published recommendations.
- C. Cooperation with Other Trades: Cooperate with trades of adjacent, related or affected materials or operations, and with trades performing continuations of this Work in order to effect timely and accurate placing of Work and to coordinate, in proper and correct sequence, the Work of such trades.
- D. Workmanship: Work shall be performed by competent workers skilled in their trade. This installation must be complete.
- E. Housekeeping Pads: Unless otherwise noted. Install 6-inch-thick concrete foundation pads for indoor floor-mounted equipment, except where direct floor mounting is required. Pour pads on roughened floor slabs, sized so that outer edges extend a minimum of 3 inches beyond equipment. Trowel pads smooth and chamfer edges to a 1-inch bevel. Secure equipment to pads as recommended by the manufacturer.
- F. Setting of Equipment: Equipment must be leveled and set plumb. Sheet metal enclosures mounted against a wall must be separated from the wall not less than 1/4 inch by means of corrosion-resistant spacers or by 3 inches of air for freestanding units. Use corrosion resistant bolts, nuts, and washers to anchor equipment. Provide Drawings and layout Work showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions, and chases in enough time to be coordinated with Work under other divisions.
- G. Sealing of Equipment: Seal openings into equipment to prevent entrance of animals, birds, and insects.
- H. Motors: Electrical Work includes the electrical connection of all motors, except those that are wired as a part of equipment.
- I. Concealed Work: Conceal all electrical Work in walls, floors, chases, under floors, underground, and above ceilings except:
 - 1. Where shown or specified to be exposed. Exposed is open to view.
 - 2. Where exposure is necessary to the proper function.

- J. Application: Unless otherwise indicated, power will be utilized as follows:
1. 480 volts, three phases: Motors $\frac{3}{4}$ horsepower and larger and electric heating equipment.
 2. 120 volts, single phase: Motors $\frac{1}{2}$ horsepower and smaller.
 3. 120 volts, single phase: Lighting and task lighting.
 4. 277 volts, single phase: Lighting and electric heating equipment.
 5. 120 volts, single phase: Convenience outlets.
- K. Transformers: Use transformers to change the service to the required utilization voltages.
- L. Provide final electrical connections to equipment furnished under other divisions and by the Owner. Furnish detailed Shop Drawings of equipment indicating the exact number and location of rough-in points. Such final Shop Drawings may indicate adjustments in total number and exact location of rough-in points, and in equipment dimensions. Adjusting field conditions is considered a part of the Work required.
1. Roughing-in: When roughing-in electrical branch circuits to various items of equipment, terminate at proper points as indicated on detailed equipment Shop Drawings or as directed by Owner. Do not rely on Drawings accompanying these Specifications for rough-in locations, only for general routing of circuiting.
 2. Final Connections: Laboratory casework, medical equipment, and food service equipment will include service fittings such as switches, duplex receptacles, lighting fixtures, etc., on the casework or equipment. Provide branch circuit connections to meet service fitting requirements.
- M. Refer to Divisions 07 and 09 for sealing and firestopping requirements where raceways penetrate smoke, fire, and sound rated walls.
- N. All unused openings such as but not limited to, knockouts on panels and boxes, surface wireway openings, busway openings, circuit breaker empty slots shall be covered with approved cover plates.
- O. Temporary power equipment and distribution for construction shall not occupy building spaces or block pathways that are designated for permanent installation of other trades according to design drawings.

END OF SECTION

SECTION 26 05 00
COMMON ELECTRICAL WORK REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL

- A. This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1, Division 23, Division 27, Division 28, Division 33, and Division 34. Refer to Section 01 00 00 – Bid Depository Sections where applicable for bid depository.

SUMMARY

- A. This Section includes the following:
1. Raceways.
 2. Cabinets and Pull boxes
 3. Building wire and connectors.
 4. Supporting devices for electrical components.
 5. Electrical identification.
 6. Electricity-metering components.
 7. Concrete equipment bases.
 8. Electrical demolition.
 9. Cutting and patching for electrical construction.
 10. Touchup painting.
 11. Sleeves
 12. Fire Barriers

CARE, OPERATION AND START-UP

- A. Instruct Owner's Representative and operating personnel in the operation, care and maintenance of systems, system equipment and components.
- B. Operating instructions to include following:
1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 3. Safety precautions.
 4. Procedures to be followed in event of equipment failure.
 5. Other items of instruction as recommended by manufacturer of each system or item of equipment.

- C. Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance, and calibrate components and instruct operating personnel.
- D. Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with all aspects of its care and operation.

SUBMITTALS

- A. Submit drawings on equipment to be purchased used or project. Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
- B. Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- C. Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

PERMITS, FEES, AND INSPECTION

- A. Submit to Electrical Inspection Division and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- B. Pay associated fees.
- C. Owner's Representative will provide drawings and specifications required by Electrical Inspection Division and Supply Authority at no cost.
- D. Notify Owner's Representative of changes required by Electrical Inspection Division prior to making changes.
- E. Furnish Certificates of Acceptance from Electrical Inspection Division or authorities having jurisdiction on completion of work to Owner's Representative.

CO-ORDINATION

- A. Co-ordinate work with work of other divisions to avoid conflict.
- B. Locate distribution systems, equipment, and materials to provide minimum interference and maximum usable space.
- C. Locate all existing underground services and make all parties aware of their existence and location.
- D. Where interference occurs, Owner's Representative must approve relocation of equipment and materials regardless of installation order.
- E. Notwithstanding the review of shop drawings, this division may be required to relocate electrical equipment which interferes with the equipment of other trades, due to lack of co-ordination by this Division. The cost of this relocation shall be the responsibility of this Division. The Owner's Representative shall decide the extent of relocation required.

CUTTING AND PATCHING

- A. Inform all other divisions in time, concerning required openings. Where this requirement is not met, bear the cost of all cutting. Openings of 8 inches or smaller shall be the responsibility of Division 26. Openings larger

than 8 inches shall be the responsibility of Division 1. Obtain written approval of Structural engineer before drilling any beams or floors.

PROTECTION

- A. Protect exposed live equipment during construction for personnel safety.
- B. Shield and mark all live parts "LIVE 120 VOLTS", or with appropriate voltage in English.
- C. Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

RECORD DRAWINGS

- A. Obtain and pay for three sets of white prints. As the job progresses, mark these prints to accurately indicate installed work. Always have the white prints available for inspection at the site and present for scrutiny at each job meeting.
- B. Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run-in relation to the structure and building.
- C. Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.
- D. Submit record drawings at end of construction or as designated by architect.

INSPECTION OF WORK

- A. The Owner, Owner Representative, and local authority will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of his work in conformity with the construction documents and with the requirements of the inspection authority.

SCHEDULING OF WORK

- A. Work shall be scheduled in phases as per other divisions of the architectural specifications.
- B. Become familiar with the phasing requirements for the work and comply with these conditions.
- C. No additional monies will be paid for contractor's requirement to comply with work phasing conditions.

FIRE RATING OF PENETRATIONS

- A. Maintain fire ratings around conduits passing through floors, ceilings, and fire rated walls.
- B. Use 3M brand, Hilti, or equal fire barrier products at each penetration to provide a UL Listed penetration.
- C. Acceptable products for fire barrier products shall be 3M #CP25 fire barrier caulk, #303 putty, #FS 195 wrap and #CS195 sheet.
- D. Acceptable manufacturers: Hilti, Nelson, Fire Stop Systems, 3M or approved equal. Material of same manufacturer to be used throughout project.

PART 2 - PRODUCTS

13.01 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- A. Supplier and installer responsibility are indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings, where applicable.
- B. Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 25 and shown on mechanical drawings. Division 25 – EMCS Controls Contractor is responsible for all conduit, wiring and connections below 50V which are related to control systems in Division 25 and shall comply with the requirements of Division 26 for standard of quality.

MATERIALS AND EQUIPMENT

- A. Provide materials and equipment in accordance with Division 01 - Common Product Requirements.
- B. Equipment and material to be CSA certified. Where there is no alternative to supplying equipment, which is not CSA certified, obtain special approval from Electrical Inspection Division.
- C. Factories assemble control panels and component assemblies.

FINISHES

- A. Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - 1. Paint all expose conduit, j-boxes, and hanger to match wall color.

WARNING SIGNS

- A. As specified and to meet requirements of Electrical Inspection Department and Owner's Representative.
- B. Provide Lock-Out tags per OSHA.

WIRING TERMINATIONS

- A. Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

EQUIPMENT IDENTIFICATION

- A. Identify electrical equipment with nameplates and labels as follows:
 - 1. Nameplates: Lamicoid 1/8-inch-thick plastic engraving sheet, black, white face, black, white core, mechanically attached with self-tapping screws, no self-tape or glue will be acceptable
 - 2. Sizes as follows:
 - a. NAMEPLATE SIZES
 - 1) ¼" x 2" 1-line ¼" high letters
 - 2) ½" x 3" 1-line ¼" high letters
 - 3) ½" x 3" 2 lines 1/8" high letters

- B. Labels:

1. Embossed plastic labels with $\frac{1}{4}$ " high letters unless specified otherwise.
- C. Wording on nameplates and labels to be approved by Owner's Representative prior to manufacture.
- D. Allow for average of twenty-five (25) letters per nameplate and label.
- E. Identification to be English (and Spanish where applicable).
- F. Nameplates for terminal cabinets and junction boxes to indicate system name and voltage characteristics.
- G. Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- H. Terminal cabinets and pull boxes: indicate system name and voltage.
- I. Transformers: Equipment Tag, indicate capacity, primary and secondary voltages, and transformer number.

WIRING IDENTIFICATION

- A. Identify wiring with permanent indelible identifying markings, either numbered or colored plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- B. Maintain phase sequence and color coding throughout.
- C. Color code: National Electrical Code.

PART 3 - EXECUTION

20.01 NAMEPLATES AND LABELS

- A. Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

LOCATION OF OUTLETS

- A. Locate outlets in accordance with Section 26 27 26 – Wiring Devices.
- B. Do not install outlets back-to-back in wall; allow minimum 6" horizontal clearance between boxes.
- C. Change location of outlets at no extra cost or credit, providing distance does not exceed 10 feet, and information is given before installation.
- D. Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

CONDUIT AND CABLE INSTALLATION

- A. Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 2 inch.
- B. If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- C. Install cables, conduits, and fittings to be embedded or plastered over, neatly, and close to building structure so furring can be kept to a minimum.

MOUNTING HEIGHTS

- A. Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.
- B. If mounting height of equipment is not specified or indicated, verify before proceeding with installation, mounting heights to meet all ADA standards.
- C. Install electrical components at following heights unless indicated otherwise.
 - 1. Local switches: 48 inches.
 - 2. Wall receptacles: 18 inches
 - 3. Above top of continuous baseboard heater: 44 inches.
 - 4. Above top of counters or counter splash backs. 44 inches
 - 5. Panelboards: as required by Code or as indicated.
 - 6. Telephone and interphone outlets: 18 inches
 - 7. Wall mounted telephone and interphone outlets: 48 inches

FIELD QUALITY CONTROL

ALL ELECTRICAL WORK TO BE CARRIED OUT BY QUALIFIED, LICENSED ELECTRICIANS OR APPRENTICES AS PER THE CONDITIONS OF THE RESPECTING MANPOWER VOCATIONAL TRAINING AND QUALIFICATION. EMPLOYEES REGISTERED IN A PROVINCIAL APPRENTICE'S PROGRAM SHALL BE PERMITTED, UNDER THE DIRECT SUPERVISION OF A QUALIFIED LICENSED ELECTRICIAN, TO PERFORM SPECIFIC TASKS – THE ACTIVITIES PERMITTED SHALL BE DETERMINED BASED ON THE LEVEL OF TRAINING ATTAINED AND THE DEMONSTRATION OF ABILITY TO PERFORM SPECIFIC DUTIES.

- A. The work of this division to be carried out by a contractor who holds a valid Electrical Master and Contractor License as issued by governing authorize.
- B. Load Balance:
 - 1. Measure phase current to panelboard with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record operating under normal load. State hour and date on which each load was measured, and voltage at time of test changes.
 - 2. Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

CLEANING

- A. Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- B. Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

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.

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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Architect before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 48 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

- E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner before partially or completely disabling system.
 - 2. Notify local fire service.
 - 3. Make notifications at least 24 hours in advance.
 - 4. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner at least 24 hours before partially or completely disabling system.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. 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.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- 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.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. 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. Underground feeder and branch-circuit cable.
- C. Service entrance cable.
- D. Metal-clad cable.
- E. Manufactured wiring systems.
- F. Wiring connectors.
- G. Electrical tape.
- H. Oxide inhibiting compound.
- I. Wire pulling lubricant.
- J. Cable ties.
- K. Firestop sleeves.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 05 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.03 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 B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2021).
- F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2018.
- G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- I. FM 3971 - Fire Protective Coatings and Wraps for Grouped Cables; 2019.
- J. IEEE 383 - IEEE Standard for Qualifying Electric Cables and Splices for Nuclear Facilities; 2015.
- K. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- L. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; 2012.
- M. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
- N. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2007.
- O. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- P. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- Q. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- R. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- S. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- T. UL 183 - Manufactured Wiring Systems; Current Edition, Including All Revisions.
- U. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- V. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- W. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
- X. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- Y. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.
- Z. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 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 conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
 1. Exceptions:
 - a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
- C. Nonmetallic-sheathed cable is not permitted.

- D. Underground feeder and branch-circuit cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. For damp, wet, or corrosive locations as a substitute for NFPA 70, Type NMC nonmetallic-sheathed cable, when nonmetallic-sheathed cable is permitted.
- E. Service entrance cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. For overhead service drop, installed in raceway to service head.
 - b. For underground service entrance, installed in raceway.
- F. Armored cable is not permitted.
- G. Metal-clad cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - 1) Maximum Length: 6 feet (1.8 m).
 - 2. In addition to other applicable restrictions, may not be used:
 - a. Unless approved by Owner.
 - b. Where exposed to damage.
 - c. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- H. Conductor Material:
 - 1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.

- a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
 - 1) Services: Copper conductors size 1/0 AWG and larger.
 - 2) Feeders: Copper conductors size 1/0 AWG and larger.
 - b. Where aluminum conductors are substituted for copper, comply with the following:
 - 1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
 - 2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
 - 3) Provide aluminum equipment grounding conductor sized according to NFPA 70.
 - 4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.
 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
 4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.
- I. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet (46 m): 10 AWG, for voltage drop.
- J. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- K. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method: Integrally colored insulation.
 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.

- 3) Phase C: Yellow.
- 4) Neutral/Grounded: Gray.
- b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
- c. 240/120 V, 1 Phase, 3 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Neutral/Grounded: White.
- d. Equipment Ground, All Systems: Green.
- e. Isolated Ground, All Systems: Green with yellow stripe.
- f. Travelers for 3-Way and 4-Way Switching: Pink.
- g. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:

- a. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
- b. Service Wire Co: www.servicewire.com/#sle.
- c. Southwire Company: www.southwire.com/#sle.
- d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

- 1. Feeders and Branch Circuits: Stranded.
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

- 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

- a. Installed Underground: Type XHHW-2.

2.04 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

- A. Manufacturers:
 - 1. Encore Wire Corporation: www.encorewire.com/#sle.
 - 2. Service Wire Co: www.servicewire.com/#sle.
 - 3. Southwire Company: www.southwire.com/#sle.
- B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.
- C. Provide equipment grounding conductor unless otherwise indicated.
- D. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- E. Insulation Voltage Rating: 600 V.

2.05 SERVICE ENTRANCE CABLE

- A. Manufacturers:
 - 1. Copper Service Entrance Cable:
 - a. Encore Wire Corporation: www.encorewire.com/#sle.
 - b. Service Wire Co: www.servicewire.com/#sle.
 - c. Southwire Company: www.southwire.com/#sle.
- B. Service Entrance Cable for Above-Ground Use: NFPA 70, Type SE multiple-conductor cable listed and labeled as complying with UL 854, Style R.
- C. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.
- D. Conductor Stranding: Stranded.
- E. Insulation Voltage Rating: 600 V.

2.06 METAL-CLAD CABLE

- A. Manufacturers:
 - 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 - 2. Service Wire Co: www.servicewire.com/#sle.
 - 3. Southwire Company: www.southwire.com/#sle.

- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Grounding: Full-size integral equipment grounding conductor.
- G. Armor: Steel, interlocked tape.
- H. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.07 MANUFACTURED WIRING SYSTEMS

- A. Manufacturers:
 - 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 - 2. D&P Custom Lights & Wiring Systems, Inc: www.dandpcustomlights.com/#sle.
 - 3. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: www.relocwiring.com/#sle.
- B. Description: Manufactured wiring assemblies complying with NFPA 70 Article 604, and listed and labeled as complying with UL 183.
- C. Provide components necessary to transition between manufactured wiring system and other wiring methods.
- D. Branch Circuit Cables:
 - 1. Conductor Stranding (Size 10 AWG and Smaller): Solid.
 - 2. Insulation Voltage Rating: 600 V.
 - 3. Insulation: Type THHN.
 - 4. Grounding: Full-size integral equipment grounding conductor.
 - 5. Armor: Steel, interlocked tape.
- E. Connectors: Keyed and color-coded to prevent interconnection of different voltages.
- F. Fixture Leads: Type TFN insulation.

2.08 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Wiring Connectors for Terminations:

1. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
- C. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- D. Mechanical Connectors: Provide bolted type.
- E. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 1. Manufacturers:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
- F. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 1. Manufacturers:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.

2.09 ACCESSORIES

- A. Electrical Tape:
 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. American Polywater Corporation: www.polywater.com/#sle.

- c. Ideal Industries, Inc: www.idealindustries.com/#sle.
- D. Cable Ties: Material and tensile strength rating suitable for application.
 - 1. Manufacturers:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
- E. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
 - 1. Products:
 - a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
 - b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
- F. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
- G. Fire-Protective Coating for Electrical Conductors and Cables: Field-applied, intumescent or ablative coating designed to prevent ignition and propagation of fire along thermoplastic-insulated conductors and cables.
 - 1. Pass flammability tests of one of the following:
 - a. ASTM E84, Class A; maximum flame spread index of 25.
 - b. FM 3971.
 - c. IEEE 383.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated without specific routing, determine exact routing required.
 3. Arrange circuiting to minimize splices.
 4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among 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 aluminum conductors in accordance with NECA 104.
- E. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.
- F. Install metal-clad cable (Type MC) in accordance with NECA 120.
- G. 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.
- H. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- I. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- J. 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.
- K. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- N. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- P. Insulate ends of spare conductors using vinyl insulating electrical tape.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

- D. Correct deficiencies and replace damaged or defective conductors and cables.

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.
- F. Ground access wells.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA GR 1 - Ground Rod Electrodes and Ground Rod Electrode Couplings; 2017.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 99 - Health Care Facilities Code; 2018.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. 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.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding Electrode System:
1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 2. Metal Underground Water Pipe(s):

- a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
- b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
- c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
- 3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
- 4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
- 5. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet (1.5 m) outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground access well for each electrode.
- 6. 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 (6 by 50 by 300 mm) 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. Service-Supplied System Grounding:
 - 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- G. Separately Derived System Grounding:
 - 1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).

2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

H. 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 and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
8. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

I. Isolated Ground System:

1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other

connections between isolated ground system and normal equipment ground system on the load side of this connection.

J. Communications Systems Grounding and Bonding:

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.

K. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

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.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.
4. Manufacturers:
 - a. Erico International Corporation; _____: www.erico.com/#sle.

- b. Harger Lightning & Grounding; _____: www.harger.com/#sle.
- c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC; _____: www.thermoweld.com/#sle.

E. Ground Rod Electrodes:

- 1. Comply with NEMA GR 1.
- 2. Material: Copper-bonded (copper-clad) steel.
- 3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.

F. Ground Access Wells:

- 1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
- 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
- 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches (250 mm).
- 4. Cover: Factory-identified by permanent means with word "GROUND".

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.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

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 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 26 05 36 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- D. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- E. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- F. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 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 channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of 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. 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. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
 3. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - b. Erico International Corporation; _____: www.erico.com/#sle.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
1. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - b. Erico International Corporation; _____: www.erico.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- 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. Comply with MFMA-4.
 2. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - b. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
 - c. Unistrut, a brand of Atkore International Inc; _____: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch (13 mm) diameter.
 - b. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch (6 mm) diameter.
 - c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch (10 mm) diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8 inch (10 mm) diameter.
 - e. Outlet Boxes: 1/4 inch (6 mm) diameter.
 - f. Luminaires: 1/4 inch (6 mm) diameter.
- F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

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. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- 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. Box Support and Attachment: Also comply with Section 26 05 33.16.
- I. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.
- J. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.
- K. Secure fasteners according to manufacturer's recommended torque settings.
- L. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.

- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Stainless steel rigid metal conduit (RMC).
- C. Aluminum rigid metal conduit (RMC).
- D. Galvanized steel intermediate metal conduit (IMC).
- E. Stainless steel intermediate metal conduit (IMC).
- F. PVC-coated galvanized steel rigid metal conduit (RMC).
- G. Flexible metal conduit (FMC).
- H. Liquidtight flexible metal conduit (LFMC).
- I. Galvanized steel electrical metallic tubing (EMT).
- J. Stainless steel electrical metallic tubing (EMT).
- K. Aluminum electrical metallic tubing (EMT).
- L. Rigid polyvinyl chloride (PVC) conduit.
- M. Reinforced thermosetting resin conduit (RTRC).

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- F. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

- C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2020.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- G. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- J. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
- K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- M. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- P. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- Q. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
- R. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- S. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- T. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- U. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- V. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- W. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.
- X. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.06 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 1. Under Slab on Grade: Use PVC-coated galvanized steel rigid metal conduit (RMC), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 2. Exterior, Direct-Buried: Use PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 3. Exterior, Embedded Within Concrete: Use PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).

4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), or schedule 80 rigid PVC conduit where emerging from underground.
 5. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 6. Where galvanized steel electrical metallic tubing (EMT) is installed in direct contact with earth, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 7. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches (100 mm) on either side of where conduit emerges.
- D. Embedded Within Concrete:
1. Within Slab on Grade: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), PVC-coated galvanized steel rigid metal conduit (RMC), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC). Embed within structural slabs only where approved by Structural Engineer.
 2. Within Slab Above Ground: Not permitted.
 3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
- E. Concealed Within Masonry Walls: Use galvanized steel electrical metallic tubing (EMT) or stainless steel electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel electrical metallic tubing (EMT) or stainless steel electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel electrical metallic tubing (EMT) or stainless steel electrical metallic tubing (EMT).
- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC) or stainless steel rigid metal conduit (RMC).
1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.

- b. Where exposed below 20 feet (6.1 m) in warehouse areas.
- J. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or stainless steel rigid metal conduit (RMC).
- K. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel electrical metallic tubing (EMT) or stainless steel electrical metallic tubing (EMT).
- L. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or stainless steel rigid metal conduit (RMC).

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
 - 1. Where permitted, existing conduits to be reused may be used as sole equipment grounding conductor only when continuity of conduit pathway, including associated boxes and fittings, is verified; see Section 26 05 26.
- C. Electrical Service Conduits: See Section 26 21 00 for additional requirements.
- D. Fittings for Grounding and Bonding: See Section 26 05 26 for additional requirements.
- E. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- F. Provide products listed, classified, and labeled as suitable for purpose intended.
- G. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4-inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
 - 3. Flexible Connections to Luminaires: 3/8-inch (12 mm) trade size.
 - 4. Underground, Interior: 3/4-inch (21 mm) trade size.
 - 5. Underground, Exterior: 1-inch (27 mm) trade size.
- H. 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. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 3. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.

- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Calbrite, a division of Atkore International: www.calbrite.com/#sle.
 - 2. Gibson Stainless & Specialty Inc: www.gibsonstainless.com/#sle.
 - 3. Patriot Industries, a division of Patriot Aluminum Products LLC: www.patriotsas.com/#sle.
- B. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.
- C. Fittings:
 - 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
 - 2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.05 ALUMINUM RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

C. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A
2. Material: Use aluminum.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.06 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
3. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.07 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

2.08 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. ABB; Ocal: www.electrification.us.abb.com/#sle.
2. Calbond, a division of Atkore International www.calbond.com/#sle
3. Robroy Industries: www.robroy.com/#sle.

B. 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.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch (1.02 mm).

D. PVC-Coated Boxes and Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
 3. Material: Use steel or malleable iron.
 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch (1.02 mm).
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch (0.38 mm).

2.09 FLEXIBLE METAL CONDUIT (FMC)

- A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- B. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.

2.10 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.

2.11 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 2. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 3. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. 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.
 - 4. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.
- 2.12 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)
- A. Manufacturers:
 - 1. Calbrite, a division of Atkore International: www.calbrite.com/#sle.
 - B. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.
 - C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Connectors and Couplings: Use compression/gland or set-screw type.
- 2.13 ALUMINUM ELECTRICAL METALLIC TUBING (EMT)
- A. Manufacturers:
 - 1. American Conduit, a division of Hydro: www.americanconduit.com/#sle.
 - B. Description: NFPA 70, Type EMT aluminum electrical metallic tubing listed and labeled as complying with UL 797A.
 - C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; listed for use with aluminum EMT.
 - 2. Material: Use aluminum.
 - 3. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.
- 2.14 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT
- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
 - B. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.
- 2.15 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)
- A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).

- B. Supports: As recommended by manufacturer.
- C. Fittings: Same type and manufacturer as conduit to be connected.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install 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 manufacturer.
- G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- H. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - 5. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.

6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 9. Arrange conduit to provide no more than 150 feet (46 m) 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 (150 mm) between conduits and piping for other systems.
 13. Maintain minimum clearance of 12 inches (300 mm) 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 same area on common rack.
- I. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
 9. Use of spring steel conduit clips for support of conduits is not permitted.
- J. 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, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
7. Secure joints and connections to provide mechanical strength and electrical continuity.

K. 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 building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable sealing system where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. 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.
9. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.

L. Underground Installation:

1. Provide trenching and backfilling; see Section 31 23 16.13.
2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 18 inches (460 mm).
 - b. Under Slab on Grade: 12 inches (300 mm) to bottom of slab.
3. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 26 05 53.

M. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):

1. Secure conduits to prevent floating or movement during pouring of concrete.
- N. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
 4. Where conduits are subject to earth movement by settlement or frost.
- O. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at accessible point near 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.
- P. Provide grounding and bonding; see Section 26 05 26.
- 3.03 FIELD QUALITY CONTROL
- A. See Section 01 40 00 - Quality Requirements for additional requirements.
 - B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
 - C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
 - D. Correct deficiencies and replace damaged or defective conduits.
- 3.04 CLEANING
- A. Clean interior of conduits to remove moisture and foreign matter.
- 3.05 PROTECTION
- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

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 (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- C. Boxes and enclosures for integrated power, data, and audio/video.
- D. Floor boxes.
- E. Underground boxes/enclosures.
- F. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 33.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
- F. Section 26 05 33.23 - Surface Raceways for Electrical Systems:
 - 1. Accessory boxes designed specifically for surface raceway systems.
- G. Section 26 05 39 - Underfloor Raceways for Electrical Systems: Junction boxes for underfloor duct systems.
- H. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- I. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Additional requirements for locating boxes for wiring devices.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. SCTE 77 - Specification for Underground Enclosure Integrity; 2017.
- 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 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 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 cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), 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. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 13. Wall Plates: Comply with Section 26 27 26.
 14. Manufacturers:
 - a. Hubbell Incorporated; Bell Products; _____: www.hubbell-rtb.com/#sle.
 - b. Hubbell Incorporated; RACO Products; _____: www.hubbell-rtb.com/#sle.
 - c. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet (0.56 sq m) and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 5. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - b. Hoffman, a brand of Pentair Technical Products; _____: www.hoffmanonline.com/#sle.
 - c. Hubbell Incorporated; Wiegmann Products; _____: www.hubbell-wiegmann.com/#sle.
- D. Floor Boxes:

1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 27 26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
 2. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
 3. Manufacturer: Same as manufacturer of floor box service fittings.
- E. 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 (300 mm).
 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. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
 - c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
 6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Manufacturers:
 - 1) Hubbell Incorporated; Quazite Products; _____: www.hubbellpowersystems.com/#sle.
 - 2) Oldcastle Precast, Inc; _____: www.oldcastleprecast.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
 - b. Combination fiberglass/polymer concrete boxes/enclosures are not acceptable. Use all-polymer concrete boxes/enclosures.

2.02 ACCESSORIES

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

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 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 (150 mm) horizontal separation unless otherwise indicated.
 - 8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - 9. 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.
- I. 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.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) 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 (3 mm) at the edge of the box.
- L. Install boxes as required to preserve insulation integrity.
- M. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.
 2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- P. Close unused box openings.
- Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- R. Provide grounding and bonding in accordance with Section 26 05 26.
- S. 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 48
PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

1.02 RELATED SECTIONS

- A. Section 26 05 33.23 – Surface Raceways for Electrical Systems

1.03 DEFINITIONS

- A. BOCA: BOCA National Building Code, 1999.
- B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
- C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.04 SUBMITTALS

- A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.
 - 1. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by an agency approved by authorities having jurisdiction.
- B. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs, details, and calculations signed and sealed by a Professional Engineer.
 - 1. Design Calculations and Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - 2. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacing's, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
- C. Coordination Drawings: Plans and sections drawn to scale and coordinating seismic bracing for electrical components with other systems and equipment, including other seismic restraints, in the vicinity.
- D. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

1.05 QUALITY ASSURANCE

- A. Comply with seismic restraint requirements in BOCA, 1999, unless requirements in this Section are more stringent.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are like those indicated for this Project.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.
- D. Tradesman Qualification: Perform all work by skilled mechanics in a manner that satisfies the National Electrical Code and Bi-State policy and practice.
- E. Welder Qualifications: Perform welding by certified welding operators currently qualified in accordance with the testing procedures of AWS D1.1 for the weld types and positions for the fabrications and installations indicated.
- F. Regulatory Requirements: Select only drilled-In anchors with published ICBO ES Evaluation Reports indicating conformance with current applicable ICBO ES Acceptance Criteria. Comply with all findings and other limitations stipulated in the corresponding Evaluation Reports.

1.06 PROJECT CONDITIONS

- A. Acceleration Factor: $AV = 0.12$
- B. Project Seismic Hazard Exposure as Defined in BOCA: Group II.
- C. Seismic Coefficient (CC): Per BOCA Table 1610.6.4(1).
- D. Performance Criteria Factor (P): Per BOCA Table 1610.6.4(1).
- E. Attachment Amplification Factor (aC): Per BOCA Table 1610.6.4(2).

1.07 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural system and engineering features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.
- C. Drawings are diagrammatical and do not show offsets, fittings, and accessories that may be required. Carefully investigate the structural and finish conditions affecting the Work and provide required fittings and accessories.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Ship each component securely packaged and labeled for safe handling to avoid damage or distortion.
- B. Store materials in secure and dry facility and in original packaging in a manner to prevent soiling, physical damage, wetting or corrosion before installation.
- C. Where possible, maintain protective coverings until installation is complete and remove as part of final clean up.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. B-Line Systems, Inc.
 - 2. Erico, Inc.
 - 3. Thomas & Betts Corp.
 - 4. Unistrut Corporation.

2.02 MATERIALS

- A. Use preformed structural channels, tubing, supports, and hangers that is hot-dipped galvanized corrosion resistant structural grade steel conforming to ASTM A 570, Grade 33 and ASTM A 653, Grade 33 and suitable for the environment where it is installed.
- B. Provide isolating material including sleeves, washers, and pads between dissimilar materials.
- C. Hardware: Complete set of hardware, including machine bolts, washers, lock washers, nuts and lock nuts required to complete the hanger and associated support, anchor, and concrete insert installation.
 - 1. Stainless steel fasteners: Use stainless steel nuts and washers of matching alloy group and minimum proof stress equal to, or greater than, the specified minimum full-size tensile strength of the externally threaded fastener. Nuts: conform to ASTM F 594.
 - 2. Galvanized fasteners: Use hot dipped galvanized or stainless-steel material as required for compatibility with associated support, hangar, anchor or insert material.
 - 3. Threaded fastener adhesive compound: "Thread lockers" liquid as manufactured by Henkel Loctite Corporation.
- D. Use the following materials for restraints:
 - 1. Coordinate three subparagraphs below with Drawings.
 - 2. Indoor Dry Locations: Steel, zinc plated.
 - 3. Outdoors and Damp Locations: Galvanized steel.
 - 4. Corrosive Locations: Stainless steel.
- E. Conduit, cable tray and bus duct hangers:
 - 1. Finish: Hot dip galvanize hangars, rods, channels, and hardware after fabrication.
 - 2. Capacity: Total weights of conduits, cable trays or bus ducts and wires, hanger dead load, plus an additional 200 pounds.
 - 3. Hangers: Fabricate hangers from two or more steel hanger rods, horizontal member (preformed channel), U-bolts, clamps, and other attachments as necessary for securing hanger rods, conduits, cable trays and bus ducts.
 - 4. Hanger rods: stress at the root of the thread less than 9,475 psi at design load.

5. Horizontal members: Size not to exceed maximum stress of 12,650 psi at design load.

2.03 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Use Not Permitted:
 1. Lead shield anchors.
 2. Explosive fasteners.
- G. Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage and wedge dimples to prevent spinning during installation, complete with required nuts, washers, and manufacturer's installation instructions. Ensure that wedge anchors are marked with length identification markings conforming to ICBO ES AC01. Furnish anchors as manufactured by Hilti Kwik Bolt II, ITW Ramset/Red Head Trubolt Wedge, or approved equal.
 1. Interior Use in Conditioned Environments within the Building: carbon steel conforming to ASTM A 510 with zinc plating in accordance with ASTM B 633.
 2. Exposed Use in Plenums, Utility Shafts, Track Stairs, Tunnels, and Outdoor Locations: Type 316 stainless steel.
- H. Heavy-duty sleeve anchors: torque-controlled, pull-down, prestress able type with provisions for rotation prevention and resistance to vibratory and dynamic loading. Dynamic loading suitability includes resistance to fatigue, seismic, and shock loading.
 1. Interior Use in Conditioned Environments within the Building: carbon steel anchors conforming to ISO 898, Part 1, Class 8.8.
 2. Exposed Use in Plenums, Utility Shafts, Track Stairs, Tunnels, and Outdoor Locations: Type 316 stainless steel.
- I. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- J. Equipment Supports: prefabricated hot dipped galvanized channels, unless noted:
 1. Standard structural steel channels, nominal 1-1/2 inch by 1-1/2 inch, 12-gauge, cold formed, lipped channel, and designed to accept special spring-held hardened steel nuts for securing anchor bolts or hanger rods and other attachments. Provide securing equipment compatible with channel. Provide hot-dipped galvanized hanger rods and associated hardware as required.

- a. Adjust channel depth as required to satisfy the load requirements and safety factor. Two or more channels welded together to form members of greater strength is permitted.
- K. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings and matched to the type and size of anchor bolts and studs used.
- L. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings and matched to the type and size of attachment devices used.
- M. Conduit straps: one-hole or heavy-duty two-hole. Material: hot-dipped galvanized steel or malleable iron.
- N. Support Grip: Conduit-Riser Kellems support grips as manufactured by Hubbell Wire Management Products.
- O. Riser Clamps: hot-dipped galvanized steel.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install electrical materials, equipment, and accessories rigid and secure, plumb, and level, and in alignment with related and adjoining work to provide a complete and operable system. Do not weld electrical materials for attachment or support.
- B. Install exposed conduit, cable tray and bus ducts to avoid conflicts with other work. Install horizontal raceways close to the ceiling or ceiling beams and above water or other piping wherever possible.
- C. Apply galvanizing touch-up paint to all field cut channel edges. Use brush-applied touch-up paint; spray-applied galvanizing touch-up paint is not permitted.
- D. Electrical Conduit, Cable Tray and Bus Duct - Installation Requirements
 - 1. Properly support and anchor conduit to be embedded to maintain correct location and spacing and to prevent flotation during concreting operations. Provide suitable metal supports for conduits embedded and stubbing out of concrete surfaces.
 - 2. Install conduit so that moisture collecting in the conduit will be drained to the nearest outlet or pull box; provide weep holes at junction boxes where appropriate.
 - 3. Wall- or Ceiling-Conduit Support:
 - a. Maximum Spacing: 6-foot centers.
 - b. Conduits not larger than 1 inch: one-hole.
 - c. Conduits larger than 1-inch: heavy-duty two-hole.
 - d. Space conduits installed against concrete surfaces 1/4 inch away from the surface by clamp backs or other approved means.
 - 4. Suspended Conduits:
 - a. Support individual horizontal conduits larger than 1-1/2 inch in diameter by individual hangers and hot dipped galvanized steel conduit straps, associated support rod, and anchor for vertical runs.

- b. Support parallel conduits on trapeze hangers, associated support rods, and anchors. Secure each conduit to the preformed channel member by a U-bolt, one-hole strap or other specially designed and approved fastener suitable for use with the pipe hangers or channel inserts. Install conduits at least 6 inches away from parallel runs of pipes and mechanical ductwork.
 - 5. Support cable trays and bus duct on trapeze hangers, support rods and drill-in anchors. Secure each side of the cable tray and bus duct to the preformed channel member by a U-bolt or other specially designed and approved fastener suitable for use with the channel. Install cable trays and bus duct at least 6 inches away from pipes of mechanical ductwork.
 - 6. Support vertical conduit and cable tray risers with preformed channel anchored to concrete walls. Provide 1/4-inch nonmetallic spacer between channel and concrete spaces. Support cables installed in conduits at the top of each utility shaft and at the bottom of each pull box located in the utility shaft with Use riser clamps and horizontal channels made from
 - 7. Hanger rods used in connection with spring-steel fasteners, clips and clamps shall be a minimum of 1/2-inch diameter hanger rods shall be hot dipped galvanized steel rods. Do not use wire for support of conduit.
 - 8. Space supports for conduits, cable trays and bus ducts not over six feet on centers. Spacing and location of cable tray and bus fittings supports shall be as described in Section 26 05 33.23, 3.4C. Securely anchor conduits, cable trays and bus duct at each end, and run so as not to interfere with the installation and operation of equipment at the location.
 - 9. Install Kellems support grips for cables installed in utility shaft vertical trays where cables enter the shaft and at a maximum spacing of twenty-five feet on center within the shafts. Secure Kellems support grips to preformed cable tray supports using approved channel fittings suitable for the cable loads. Install Kellems conduit riser cable supports in conduits as they enter the utility shafts. Riser clamps shall rest on conduit couplings. Kellems support grips and conduit riser clamps shall be installed in accordance with the manufacturer's recommendations and instructions.
- E. Consider the Drawings as diagrammatic, showing general arrangement and location of equipment, boxes, cable tray, bus ducts, and conduits. Follow the Drawings as closely as practical; final location may be field adjusted slightly to avoid interference after prior approval in writing is obtained from the CM. Maintain maintenance aisles and clearances and coordinated with any modifications to equipment or raceway locations.
 - F. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.
 - G. Locate steel reinforcement to avoid drilling, coring, or cutting of steel reinforced before drilling into concrete with a portable detection and measurement device that provides an immediate and visible image of steel reinforcement. Notify CM of any cutting or drilling of steel reinforcement. Use rebar detection tool Ferroskan FS10 System by Hilti.

3.02 STRUCTURAL ATTACHMENTS

- A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
- B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
- C. Attachments to Existing Concrete: Use expansion anchors.
- D. Holes for Expansion Anchors in Concrete:

1. Drill at locations and to depths that avoid reinforcing bars.
 2. Cored Holes: Match tolerances of anchors and core bits were installed in cored holes.
- E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
- F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
- G. Attachments to Wood Structural Members: Install bolts through members.
- H. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.
- I. Do not install stainless steel anchors in contact with dissimilar metals.

3.03 ELECTRICAL EQUIPMENT ANCHORAGE

- A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
- B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, unit substations, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:
1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
 2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
 3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
 4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
 5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform field quality-control tests for pull-out resistance of seismic anchorage devices:
- a. Provide necessary test equipment required for reliable testing.
 - b. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - c. Schedule test with the Agency, through the CM, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - d. Obtain CM's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
 - e. Test at least four of each type and size of installed anchors and fasteners selected by Engineer.

- f. Test to 90 percent of rated proof load of device.
- g. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
- h. Record test results.

3.05 TRAINING

- A. Provide manufacturer's direct representative for on-site consultation and to train appropriate Contractor personnel during initial start-up of drilled-in anchoring. Distributor or agent not permitted. Do not proceed with installation of drilled-in anchors without complete understanding of the manufacturer's published installation instructions by installation personnel and a copy of the published procedures on-site at the time of installation.

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. Floor marking tape.
- G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 13 - Exterior Painting.
- B. Section 09 91 23 - Interior Painting.
- C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- C. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchgear:
 - 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) Use identification nameplate to identify main and tie devices.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Switchboards:
 - 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) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - c. 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.
 - 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.
- d. Transformers:
- 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify load(s) served. Include location when not within sight of equipment.
- e. 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.
- f. Centralized Emergency Lighting Inverters:
- 1) Identify input and output voltage and phase.
 - 2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
- g. Transfer Switches:
- 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
- h. Electricity Meters:
- 1) Identify load(s) metered.
2. Service Equipment:
- a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to

authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.

3. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
5. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
7. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
 - a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches (76 mm) wide, painted in accordance with Section 09 91 23 and 09 91 13.
8. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.
9. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches (89 mm by 127 mm).
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
 - c. Service Equipment: Include the following information in accordance with NFPA 70.
 - 1) Nominal system voltage.

- 2) Available fault current.
 - 3) Clearing time of service overcurrent protective device(s).
 - 4) Date label applied.
10. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
 11. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 12. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 13. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. 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. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 - d. In cable tray, at maximum intervals of 20 feet (6.1 m).
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.

D. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet (6.1 m).
2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet (6.1 m).
 - a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches (76 mm) wide.

- 1) Color Code:
- 2) Field-Painting: Comply with Section 09 91 23 and 09 91 13.
- 3) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.

E. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
 - a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 09 91 13 per the same color code used for raceways.

F. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
2. Factory Pre-Marked Wallplates: Comply with Section 26 27 26.
3. Use identification label to identify fire alarm system devices.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
2. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) 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 (25 mm) by 2.5 inches (64 mm).
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 (13 mm).
5. Color:
 - a. Normal Power System: White text on black background.
 - b. Emergency Power System: White text on red background.

D. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches (51 mm) by 4 inches (100 mm).
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch (13 mm).
 5. Color: Black text on yellow background unless otherwise indicated.
- E. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
 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 mm).
 5. Color: Black text on clear 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 (3 mm).
- F. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches (29 by 110 mm).
 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).
- D. Legend:

1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:
 - a. Emergency Power System: Text "EMERGENCY".
- E. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Non-detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 4 mil (0.1 mm).
- 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.

2.06 FLOOR MARKING TAPE

- A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches (76 mm) wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 1. Materials:
 2. Minimum Size: 7 by 10 inches (178 by 254 mm) 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 (51 mm by 102 mm) 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 (75 mm) below finished grade.
- G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Time switches.
- C. In-wall time switches.
- D. In-wall interval timers.
- E. Outdoor photo controls.
- F. Daylighting controls.
- G. Lighting contactors.
- H. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 25 36 26 - Integrated Automation Lighting Relays.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
 - 1. Includes finish requirements for wall controls specified in this section.
- G. Section 26 51 00 - Interior Lighting.
- H. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2017.
- C. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2020.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

- E. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).
- H. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.
- I. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- L. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- M. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- N. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.
- O. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- P. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
- Q. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. 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.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 - 2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Include detailed information on device programming and setup.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
- H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. 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 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
 - 2. Lutron Electronics Company, Inc; _____: www.lutron.com/#sle.
 - 3. WattStopper; _____: www.wattstopper.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
 - 5. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
 - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 - 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 - 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 - 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 - 8. Sensitivity: Field adjustable.

9. 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.
 10. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
 11. Wireless Sensors:
 - a. RF Range: 30 feet (9 m) through typical construction materials.
 - b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
 - c. Power: Battery-operated with minimum ten-year battery life.
- C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - c. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - d. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
 2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
 - a. Products:
 - 1) Lutron Maestro Series; www.lutron.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet (37.2 sq m).
 4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
 - a. Products:
 - 1) Lutron Maestro Series; www.lutron.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- D. Wall Dimmer Occupancy Sensors:
1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.

- b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
 - e. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
- E. Ceiling Mounted Occupancy Sensors:
- 1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - 2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 square meters) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - 3. Ultrasonic Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet (46.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet (92.9 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet (185.8 sq m) at a mounting height of 9 feet (2.7 m).
 - 4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - 5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:

- a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m).
- F. Directional Occupancy Sensors:
 - 1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
 - 2. Passive Infrared (PIR) Directional Occupancy Sensors:
 - a. Long Range Sensors: Capable of detecting motion within a distance of 80 feet (24 m) at a mounting height of 10 feet (3.1 m).
 - b. High Bay Sensors: Capable of detecting motion within a distance of 50 feet (15 m) at a mounting height of 30 feet (9.1 m).
 - 3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet (12 m) at a mounting height of 10 feet (3.1 m).
- G. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.
 - 1. LED Luminaire Mounted Occupancy Sensors: Dual Technology type with a field of view of 360 degrees unless otherwise indicated.
 - a. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - b. Finish: White unless otherwise indicated.
 - c. Circular Coverage Sensors: Capable of detecting motion within a distance of 40 feet (12 m) at a mounting height of 20 feet (6.1 m).
- H. Power Packs for Low Voltage Occupancy Sensors:
 - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 - 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 - 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 - 4. Load Rating: As required to control the load indicated on drawings.
- I. Power Packs for Wireless Occupancy Sensors:
 - 1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
 - 2. Input Supply Voltage: Dual rated for 120/277 V ac.
 - 3. Load Rating: As required to control the load indicated on drawings.
- J. Accessories:

1. Provide heavy duty coated steel wire protective guards compatible with specified occupancy sensors where indicated.

2.03 TIME SWITCHES

A. Manufacturers:

1. Intermatic, Inc; _____: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC; _____: www.tork.com/#sle.
3. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Digital Electronic Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
3. Schedule Capacity: Not less than 16 programmable on/off operations.
4. Provide automatic daylight savings time and leap year compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Input Supply Voltage: As indicated on the drawings.
8. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:

C. Electromechanical Time Switches:

1. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, listed and labeled as complying with UL 917.
2. Program Capability:
3. Schedule Capacity:
4. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
5. Input Supply Voltage: As indicated on the drawings.
6. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:

2.04 IN-WALL TIME SWITCHES

A. Manufacturers:

1. Intermatic, Inc; _____: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC; _____: www.tork.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.
4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Digital Electronic In-Wall Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
3. Schedule Capacity: Not less than 40 programmable on/off operations.
4. Provide power outage backup to retain programming and maintain clock.
5. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
6. Switch Configuration: Suitable for use in either SPST or 3-way application.

2.05 IN-WALL INTERVAL TIMERS

A. Manufacturers:

1. Intermatic, Inc; _____: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC; _____: www.tork.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.
4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Digital Electronic In-Wall Interval Timers:

1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
2. Program Capability: Designed to turn load off at end of preset time interval.
3. Time Interval: Field selectable range of presets available up to 12 hours.
4. Provide field selectable audible and visual indication to warn that end of interval operation is about to turn off load.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of both turning load off and resetting timer to original preset time interval.
7. Switch Configuration: Suitable for use in either SPST or 3-way application.

2.06 OUTDOOR PHOTO CONTROLS

A. Manufacturers:

1. Intermatic, Inc; _____: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC; _____: www.tork.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.
4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Stem-Mounted Outdoor Photo Controls:

1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
2. Housing: Weatherproof, impact resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles (10.8 to 53.8 lux) turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.
9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

C. Locking Receptacle-Mounted Outdoor Photo Controls

1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles (10.8 to 32.3 lux) turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.
8. Surge Protection: 160 joule metal oxide varistor.

D. Button Type Outdoor Photo Controls

1. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.
2. Housing: Weather resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles (10.8 to 32.3 lux) turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.

6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.

2.07 DAYLIGHTING CONTROLS

A. Manufacturers:

1. Hubbell Control Solutions; _____: www.hubbell.com/hubbellcontrolsolutions/en/#sle. Hubbell Control Solutions; _____: www.hubbell.com/hubbellcontrolsolutions/en/#sle. Hubbell Control Solutions; _____: www.hubbell.com/hubbellcontrolsolutions/en/#sle.
2. Lutron Electronics Company, Inc; _____: www.lutron.com/#sle.
3. WattStopper; _____: www.wattstopper.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.
5. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

C. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.

1. Sensor Type: Filtered silicon photo diode.
2. Sensor Range:
 - a. Indoor Photo Sensors: 5 to 100 footcandles (53.8 to 1,080 lx).
 - b. Outdoor Photo Sensors: 5 to 250 footcandles (53.8 to 2690 lx).
3. Finish: White unless otherwise indicated.
4. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
5. Wireless Daylighting Control Photo Sensors:
 - a. RF Range: 30 feet (9 m) through typical construction materials.
 - b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
 - c. Power: Battery-operated with minimum ten-year battery life.

2.08 LIGHTING CONTACTORS

A. Manufacturers:

1. ABB/GE; _____: www.electrification.us.abb.com/#sle.
2. Eaton Corporation; _____: www.eaton.com/#sle.
3. Rockwell Automation Inc; Allen-Bradley Products; _____: ab.rockwellautomation.com/#sle.

4. Schneider Electric; Square D Products; _____: www.schneider-electric.us/#sle.
5. Siemens Industry, Inc; _____: www.usa.siemens.com/#sle.
- B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.
- C. Short Circuit Current Rating:
- D. Enclosures:
 1. Comply with NEMA IA 10030.
 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - b. Outdoor Locations: Type 3R or Type 4.
 3. Finish: Manufacturer's standard unless otherwise indicated.

2.09 ACCESSORIES

- A. Auxiliary Contacts:
 1. Comply with NEMA IA 10039.
 2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.
- B. Pilot Devices:
 1. Comply with NEMA IA 10039; heavy-duty type.
 2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
 3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
 4. Indicating Lights: Push-to-test type unless otherwise indicated.
 5. Provide LED lamp source for indicating lights and illuminated devices.

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. Install lighting control relays furnished under Section 25 36 26
- C. 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: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches (1.2 m) above finished floor.
 - b. In-Wall Time Switches: 48 inches (1.2 m) above finished floor.
 - c. In-Wall Interval Timers: 48 inches (1.2 m) above finished floor.
 - 2. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Install lighting control devices plumb and level, and held securely in place.
- G. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
- H. Provide required supports in accordance with Section 26 05 29.
- I. 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.
- J. Occupancy Sensor Locations:

1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

K. Outdoor Photo Control Locations:

1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

M. Daylighting Control Photo Sensor Locations:

1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for proper control of respective room or area based on manufacturer's recommendations for installed devices.
2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

N. Combination Enclosed Lighting Contactors:

1. Except where indicated to be mounted adjacent to the equipment they supply, mount lighting contactors such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.
- G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.
- F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.
- G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

- A. See Section 01 91 13 - General Commissioning Requirements for commissioning requirements.

3.08 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: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of 30 Minutes of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.

4. Location: At project site.

END OF SECTION

SECTION 26 21 00
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 33.13 - Conduit for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 24 13 - Switchboards: Service entrance equipment.
 - 1. Includes utility metering transformer compartment.
 - 2. Includes non-utility electrical metering.
- H. Section 26 24 16 - Panelboards: Service entrance equipment.
- I. Section 31 23 16 - Excavation.
- J. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- K. Section 31 23 23 - Fill: Bedding and backfilling.
- L. Section 33 71 19 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.03 PRICE AND PAYMENT PROCEDURES

- A. Allowances:
 - 1. See Section 01 21 00 - Allowances, for allowances affecting this section.
- B. Unit Prices:
 - 1. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
 - 2. Primary:
 - a. Basis of Measurement: By the lineal foot (meter), for each configuration.

- b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.

1.04 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.05 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code; 2017.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. No later than Five working days following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:

1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.07 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Utility Company letter of availability for providing electrical service to project.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.
- D. Drawings prepared by Utility Company.
- E. Project Record Documents: Record actual locations of equipment and installed service routing.

1.08 QUALITY ASSURANCE

- A. Comply with the following:
 1. IEEE C2 (National Electrical Safety Code).
 2. NFPA 70 (National Electrical Code).
 3. The requirements of the Utility Company.
 4. The requirements of the local authorities having jurisdiction.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). 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 products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Utility Company: As indicated on drawings.

D. Division of Responsibility:

1. Pad-Mounted Utility Transformers:

- a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
- b. Transformers: Furnished and installed by Utility Company.
- c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
- d. Transformer Protective Bollards: Furnished and installed by Contractor per Utility Company requirements.
- e. Primary:
 - 1) Trenching and Backfilling: Provided by Utility Company.
 - 2) Conduits: Furnished and installed by Contractor.
 - 3) Conductors: Furnished and installed by Utility Company.
- f. Secondary:
 - 1) Trenching and Backfilling: Provided by Contractor.
 - 2) Conduits: Furnished and installed by Contractor.
 - 3) Conductors: Furnished and installed by Contractor (Service Point at transformer).

2. Pole-Mounted Utility Transformers:

- a. Utility Poles: Furnished and installed by Utility Company.
- b. Transformers: Furnished and installed by Utility Company.
- c. Transformer Grounding Provisions: Furnished and installed by Utility Company.
- d. Primary: Furnished and installed by Utility Company.
- e. Secondary - Overhead Service:
 - 1) Conduits/Service Masts: Furnished and installed by Contractor.
 - 2) Conductors: Furnished and installed by Contractor (Service Point at service mast).

3. Terminations at Service Point: Provided by Utility Company.

4. Metering Provisions:

- a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
- b. Metering Transformer Cabinets: Furnished and installed by Contractor per Utility Company requirements.
- c. Metering Compartments in Service Entrance Equipment: Furnished and installed by Contractor per Utility Company requirements.
- d. Metering Transformers: Furnished and installed by Utility Company.

- e. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.
 - f. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required trenching and backfilling in accordance with Section 31 23 16.13.
- E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 03 30 00.
- F. Provide required protective bollards in accordance with Utility Company requirements.
- G. Provide required support and attachment components in accordance with Section 26 05 29.
- H. Provide grounding and bonding for service entrance equipment in accordance with Section 26 05 26.
- I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 05 53.

3.04 PROTECTION

- A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General purpose transformers.
- B. K-factor transformers rated for nonlinear loads.
- C. Buck-boost transformers.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems: Flexible conduit connections.
- E. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 24 16 - Panelboards.

1.03 REFERENCE STANDARDS

- A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.
- B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.
- C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.
- F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- G. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
- J. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances 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 placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
1. Vibration Isolators: Include attachment method and rated load and deflection.
 2. K-factor Rated Transformers: Include K-factor ratings.
 3. Buck-boost Transformers: Include voltage selection tables and wiring diagrams for autotransformer configurations.
- C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.
- E. 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.
- F. Maintenance Data: Include recommended maintenance procedures and intervals.
- G. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
 - 1. Greater than 10 kVA: 104degrees F (40 degrees C) maximum.
 - 2. Less than 10 kVA: 77 degrees F (25 degrees C) maximum.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation; _____: www.eaton.com/#sle.
- B. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- C. Siemens Industry, Inc; _____: www.usa.siemens.com/#sle.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet (1,000 m).
 - 2. Ambient Temperature:
 - a. Greater than 10 kVA: Not exceeding 104 degrees F (40 degrees C).
 - b. Less than 10 kVA: Not exceeding 77 degrees F (25 degrees C).

- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hygroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Primary Voltage: 480 volts delta, 3 phase.
- C. Secondary Voltage: 208Y/120 volts, 3 phase.
- D. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- F. Winding Taps:
 - 1. Less than 3 kVA: None.
 - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
 - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
 - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- H. Sound Levels: Standard sound levels complying with NEMA ST 20
- I. Mounting Provisions:
 - 1. Less than 15 kVA: Suitable for wall mounting.

2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 3. Larger than 75 kVA: Suitable for floor mounting.
- J. Transformer Enclosure: Comply with NEMA ST 20.
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor clean, dry locations: Type 2.
 - b. Outdoor locations: Type 3R.
 2. Construction: Steel.
 - a. Less than 15 kVA: Totally enclosed, non-ventilated.
 - b. 15 kVA and Larger: Ventilated.
 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 4. Provide lifting eyes or brackets.
- K. Accessories:
1. Mounting Brackets: Provide manufacturer's standard brackets.
 2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA EN 10250, type 3R assembly.
 3. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

2.04 K-FACTOR TRANSFORMERS RATED FOR NONLINEAR LOADS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 1561, and designed to supply nonlinear loads to the degree designated by the UL defined K-factor; ratings as indicated on the drawings.
- B. Primary Voltage: 480 volts delta, 3 phase.
- C. K-factor Rating: K-4, or higher.
- D. Insulation System and Allowable Average Winding Temperature Rise: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at twice the secondary phase conductor ampacity.
- F. Winding Taps: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
- G. Neutral Bus: Sized to accommodate twice the rated secondary current.
- H. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- I. Sound Levels: Standard sound levels complying with NEMA ST 20

J. Mounting Provisions:

1. Up to 75 kVA: Suitable for wall, floor, or trapeze mounting.
2. Larger than 75 kVA: Suitable for floor mounting.

K. Transformer Enclosure: Comply with NEMA ST 20.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor clean, dry locations: Type 2.
 - b. Outdoor locations: Type 3R.
2. Construction: Steel, ventilated.
3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
4. Provide lifting eyes or brackets.

L. Accessories:

1. Mounting Brackets: Provide manufacturer's standard brackets.
2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA EN 10250, type 3R assembly.
3. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

2.05 BUCK-BOOST TRANSFORMERS

- A. Description: Self-cooled, four winding, buck-boost transformers listed and labeled as complying with UL 506 or UL 1561, and suitable for field connection as an autotransformer; ratings as indicated on the drawings.
- B. Insulation System and Allowable Average Winding Temperature Rise:
1. Less than 0.25 kVA: Class 105 degree C insulation system with 55 degrees C rise.
 2. 0.25 kVA and Larger: Class 180 degree C insulation system with 115 degree C rise.
- C. Coil Conductors: Continuous windings.
- D. Lugs: Suitable for terminating conductors sized for full rated load ampacity of transformer when operating in buck-boost configuration indicated.
- E. Mounting Provisions: Suitable for wall mounting.
- F. Transformer Enclosure: Comply with NEMA ST 20.
1. Environment Type per NEMA EN 10250: Type 3R.
 2. Construction: Steel, totally enclosed, non-ventilated.
 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.

2.06 SOURCE QUALITY CONTROL

- A. Factory test transformers according to NEMA ST 20.

- B. Sound Level Tests: Perform factory test designated in NEMA ST 20 as "design" test on each production unit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- 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 transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 05 33.13, 2 feet (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
 - 1. Provide required support and attachment in accordance with Section 26 05 29, where not furnished by transformer manufacturer.
 - 2. Provide required vibration isolation and/or seismic controls in accordance with Section 26 05 48.
 - 3. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
 - 4. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.
 - 5. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

- K. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.
- L. Identify transformers in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

3.04 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 24 13 SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- F. Section 26 28 13 - Fuses: Fuses for fusible switches.
- G. Section 26 43 00 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- G. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- H. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less; 2013.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 891 - Switchboards; Current Edition, Including All Revisions.
- O. UL 977 - Fused Power-Circuit Devices; Current Edition, Including All Revisions.
- P. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances 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. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:

1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
3. Obtain Utility Company approval of switchboard prior to fabrication.
4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 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 switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, 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 switchboards and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 4. Include documentation of listed series ratings upon request.
 5. Include documentation demonstrating selective coordination upon request.
 6. Identify mounting conditions required for equipment seismic qualification.
- D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.
- E. Field Quality Control Test Reports.
- F. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
- G. 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. Enclosure Keys: Two of each different key.
- 1.06 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). 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 switchboard internal components, enclosure, and finish.
- 1.08 FIELD CONDITIONS
- A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards:
1. Eaton Corporation; _____: www.eaton.com/#sle.
 2. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

3. Siemens Industry, Inc: www.usa.siemens.com/#sle.

- B. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- D. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 SWITCHBOARDS

- A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- D. Front-Connected Switchboards:
 - 1. Main Device(s): Individually-mounted.
 - 2. Feeder Devices: Panel/group-mounted.
 - 3. Gutter Access: Bolted covers.
- E. Rear-Connected Switchboards:
 - 1. Main Device(s): Individually-mounted.
 - 2. Feeder Devices: Individually-mounted.
 - 3. Arrangement: Rear accessible, front and rear aligned.
 - 4. Rear Access: Bolted covers.
- F. Service Entrance Switchboards:
 - 1. Listed and labeled as suitable for use as service equipment according to UL 869A.
 - 2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
 - 3. Comply with Utility Company requirements for electrical service.
- G. Service Conditions:
 - 1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude: Less than 6,600 feet (2,000 m).
 - b. Ambient Temperature:

- 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
 - 2) Switchboards Containing Fusible Switches: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- H. Short Circuit Current Rating:
1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. Minimum Rating: 65,000 rms symmetrical amperes.
 3. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
 4. Label equipment utilizing series ratings as required by NFPA 70.
- I. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- J. Bussing: Sized in accordance with UL 891 temperature rise requirements.
1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
 2. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 3. Phase and Neutral Bus Material: Aluminum.
 4. Ground Bus Material: Aluminum.
- K. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
 - 1) Provide mechanical lugs unless otherwise indicated.
- L. Enclosures:
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 2. Finish: Manufacturer's standard unless otherwise indicated.

3. Outdoor Enclosures:
 - a. Enclosure Type: Non-walk-in type unless otherwise indicated.
 - b. Color: Manufacturer's standard.
 - c. Access Doors: Lockable, with all locks keyed alike.

M. Future Provisions:

1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

N. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list switchboards as a complete assembly including surge protective device.

O. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

1. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.

P. 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.

Q. Instrument Transformers:

1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Devices:

1. Fusible Switches:

- a. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA BS 31047, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
- b. Fuse Clips: As required to accept indicated fuses.
- c. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

2. Fused Power-Circuit Devices:

- a. Description: Quick-make, quick-break, dead-front bolted-pressure contact switches and high-pressure butt contact switches listed and labeled as complying with UL 977; ratings, configurations, and features as indicated on the drawings.
- b. Bolted-Pressure Contact Switches: Devices with additional pressure or clamping action provided at both ends of switch blades when blades are in the fully closed position.
- c. High-Pressure Butt Contact Switches: Devices with butt-type contacts and spring-charged mechanism.
- d. Fuse Clips: As required to accept Class L fuses.
- e. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- f. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

B. Circuit Breakers:

1. Interrupting Capacity:

- 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.
- c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating 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) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
- c. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

2.04 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:

1. Dielectric tests.
2. Mechanical operation tests.
3. Grounding of instrument transformer cases test.
4. Electrical operation and control wiring tests, including polarity and sequence tests.
5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchboards.
- 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 switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch (10 mm) between switchboard and wall.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install switchboards plumb and level.
- G. Unless otherwise indicated, mount switchboards on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with Section 03 30 00.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. Install all field-installed devices, components, and accessories.
- J. Provide fuses complying with Section 26 28 13 for fusible switches as indicated.
- K. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- M. Provide filler plates to cover unused spaces in switchboards.
- N. Identify switchboards in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- C. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- D. Inspect and test in accordance with NETA ATS, except Section 4.
- E. Perform inspections and tests listed in NETA ATS, Section 7.1.
- F. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- G. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
- H. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- I. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- J. Test shunt trips to verify proper operation.
- K. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

- A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces 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. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of one hour of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

3.07 PROTECTION

- A. Protect installed switchboards from subsequent construction operations.

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 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- F. Section 26 22 00 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
- G. Section 26 28 13 - Fuses: Fuses for fusible switches and spare fuse cabinets.
- H. Section 26 43 00 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- F. NEMA PB 1 - Panelboards; 2011.
- G. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- L. UL 67 - Panelboards; Current Edition, Including All Revisions.
- M. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- N. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- O. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- P. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- Q. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 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 panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.

3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 4. Include documentation of listed series ratings upon request.
 5. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Panelboard Keys: Two of each different key.
 3. See Section 26 28 13 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
 2. Panelboards Containing Fusible Switches: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation; _____: www.eaton.com/#sle.
- B. Schneider Electric; Square D Products; _____: www.schneider-electric.us/#sle.
- C. Siemens Industry, Inc; _____: www.usa.siemens.com/#sle.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- 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.
 - 2. Label equipment utilizing series ratings as required by NFPA 70.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 - 3. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
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.
 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
 - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- N. Load centers are not acceptable.
- O. Provide the following features and accessories where indicated or where required to complete installation:
 1. Feed-through lugs.
 2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Aluminum.
 - 2. Ground Bus Material: Aluminum.
- D. Circuit Breakers:
 - 1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
 - 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
 - 3. Provide electronic trip circuit breakers where indicated.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures unless otherwise indicated.
 - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate 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 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Phase and Neutral Bus Material: Aluminum.
 - 3. Ground Bus Material: Aluminum.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Switches:

1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA BS 31047, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
2. Fuse Clips: As required to accept indicated fuses.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
4. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

B. 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) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
 - a. 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. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

7. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
8. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

2.06 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 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 (2000 mm) above the floor or working platform.
- I. Mount floor-mounted power distribution panelboards on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.
- J. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- K. 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.

2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- L. Install all field-installed branch devices, components, and accessories.
- M. Provide fuses complying with Section 26 28 13 for fusible switches as indicated.
- N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- O. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- P. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 05 73.
- Q. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- R. Provide filler plates to cover unused spaces in panelboards.
- S. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 1. Emergency and night lighting circuits.
 2. Fire detection and alarm circuits.
- T. Identify panelboards in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
- E. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- F. Test GFCI circuit breakers to verify proper operation.
- G. Test AFCI circuit breakers to verify proper operation.
- H. Test shunt trips to verify proper operation.
- I. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.
- J. 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 27 26 WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.
- E. Floor box service fittings.
- F. Poke-through assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 09 69 00 - Access Flooring.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 05 33.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
- E. Section 26 05 39 - Underfloor Raceways for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 05 83 - Wiring Connections: Cords and plugs for equipment.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.
- L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.
- M. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- N. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the 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. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify Architect 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.

1.05 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. 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. Operation and Maintenance Data:
 - 1. GFCI Receptacles: Include information on status indicators.
 - 2. Surge Protection Receptacles: Include information on status indicators.
- E. Project Record Documents: Record actual installed locations of wiring devices.
- 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. Screwdrivers for Tamper-Resistant Screws: One for each type of screw.
3. Extra Keys for Locking Switches: One of each type.
4. Extra Wall Plates: One of each style, size, and finish.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles for receptacles installed in dwelling units.
- E. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
- F. Provide GFCI protection for receptacles installed in kitchens.
- G. Provide GFCI protection for receptacles serving electric drinking fountains.
- H. Unless noted otherwise, do not use combination switch/receptacle devices.
- I. For flush floor service fittings, use tile rings for installations in tile floors.
- J. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.02 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with stainless steel wall plate.
- C. Isolated Ground Convenience Receptacles: Orange _____, with wall plate engraved "isolated ground".
- D. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

- E. Flush Floor Box Service Fittings: White wiring devices with aluminum cover and ring/flange.
- F. Flush Poke-Through Service Fittings: White wiring devices with aluminum cover and aluminum flange.

2.03 WALL SWITCHES

A. Manufacturers:

- 1. Hubbell Incorporated: www.hubbell.com/#sle.
- 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
- 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- 4. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

- 1. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.

- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- D. Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- E. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.04 WALL DIMMERS

A. Manufacturers:

- 1. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
- 2. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com/#sle.
- 3. Wattstopper.

- B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

- C. Control: Slide control type with separate on/off switch.

- D. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:

- 1. Incandescent: 600 W.
- 2. Electronic Low-Voltage: 400 VA.

3. 0-10V. For control of 0-10V fluorescent ballasts/LED drivers (50 mA max control current); no power pack required to switch line voltage load (8 A, 120-277 V); adjustable high-end and low-end trim; does not have locator light.

E. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

2.05 RECEPTACLES

A. Manufacturers:

1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
4. Eaton Corporation: www.eaton.com/arrowhart.
5. Substitutions: See Section 01 60 00 - Product Requirements.
6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. 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 with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
3. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
4. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
5. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
6. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. 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.
 - a. Provide test and reset buttons of same color as device.
 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.
 4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
 5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
- E. USB Charging Devices:
1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
 - a. Charging Capacity - Two-Port Devices: 3.1A Hybrid Type A & C, minimum.
 - b. Charging Capacity - Four-Port Devices: 5A Hybrid Type A & C, minimum.
 2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.
 3. USB Charging Noncombination Devices: Four-port (Type A); rectangular decorator style.
- F. Surge Protection Receptacles:
1. Surge Protection Receptacles - General Requirements: Listed and labeled as complying with UL 1449, Type 2 or 3.
 - a. Energy Dissipation: Not less than 240 J per mode.
 - b. Protected Modes: L-N, L-G, N-G.
 - c. UL 1449 Voltage Protection Rating (VPR): Not more than 700 V for L-N, L-G modes and 1200 V for N-G mode.
 - d. Diagnostics:
 - 1) Visual Notification: Provide indicator light to report functional status of surge protection.
 2. Standard Surge Protection Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 3. Isolated Ground Surge Protection Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, with ground contacts isolated from mounting strap.
- G. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

2.06 WALL PLATES

A. Manufacturers:

1. Hubbell Incorporated; _____: www.hubbell-wiring.com/#sle.
2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
4. Eaton Corporation - www.eaton.com/arrowhart.
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. 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.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic. Color to match device.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. 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.

2.07 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:

1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
2. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Service fittings compatible with floor boxes provided under Section 26 05 33.16 with components, adapters, and trims required for complete installation.

C. Flush Floor Service Fittings:

1. Single Service Flush Convenience Receptacles:
 - a. Cover: Rectangular.
 - b. Configuration: Two standard convenience duplex receptacle(s) with duplex flap opening(s).
2. Single Service Flush Communications Outlets:
 - a. Cover: Rectangular.
 - b. Configuration: _____.

- c. Voice and Data Jacks: Provided by others.
- 3. Single Service Flush Furniture Feed:
 - a. Cover: Rectangular.
 - b. Configuration: One 2-1/8 inch by 1 inch combination threaded opening(s).
- 4. Dual Service Flush Combination Outlets:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: Two standard convenience duplex receptacle(s) with duplex flap opening(s).
 - 2) Communications: Space for voice and data.
 - 3) Voice and Data Jacks: Provided by others.
- 5. Accessories:
 - a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
 - b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.
- 6. Products:
 - a. Hubbell Incorporated; _____: www.hubbell.com/#sle.
 - b. Legrand Wiremold EF6G-OG.

2.08 POKE-THROUGH ASSEMBLIES

- A. Manufacturers:
 - 1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
 - 2. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
 - 3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.
- C. Flush Floor Service Fittings:
 - 1. Single Service Flush Convenience Receptacles:
 - a. Configuration: Two standard convenience duplex receptacle(s) with duplex flap opening(s).
 - 2. Single Service Flush Communications Outlets:
 - a. Configuration: by others.

- b. Voice and Data Jacks: Provided by others.
- 3. Single Service Flush Furniture Feed:
 - a. Configuration: One 2 inch by 1-1/4 inch combination threaded opening(s).
- 4. Dual Service Flush Combination Outlets:
 - a. Cover: Hinged door(s).
 - b. Configuration:
 - 1) Power: Two standard convenience duplex receptacle(s).
 - 2) Communications: by others.
 - 3) Voice and Data Jacks: Provided by others.
- 5. Dual Service Flush Furniture Feed:
 - a. Configuration:
 - 1) Power: One 3/4 inch threaded opening(s).
 - 2) Communications: Two 1/2 inch threaded opening(s).
- 6. Accessories:
 - a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

PART 3 EXECUTION

3.01 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: 48 inches (1200 mm) above finished floor to center.
 - b. Wall Dimmers: 48 inches (1200 mm) above finished floor to center.
 - c. Receptacles: 18 inches (450 mm) above finished floor to center or 6 inches (150 mm) above counter.
 - 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 (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect 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 (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
- I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices. Provide GFCI protected circuit breaker for receptacles that will not be accessible.
- J. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- K. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- L. Install wall switches with OFF position down.
- M. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- N. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- O. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left, neutral on top.
- P. 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.
- Q. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- R. Identify wiring devices in accordance with Section 26 05 53.
- S. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.02 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. Inspect each surge protection receptacle to verify surge protection is active.
- G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.03 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 Architect.

3.04 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 16.13
ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted enclosed circuit breakers where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 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 circuit breakers, enclosures, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of enclosed circuit breakers 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.
 3. Identify mounting conditions required for equipment seismic qualification.
- D. Field Quality Control Test Reports.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation; _____: www.eaton.com/#sle.
- B. Schneider Electric; Square D Products; _____: www.schneider-electric.us/#sle.
- C. Siemens Industry, Inc; _____: www.usa.siemens.com/#sle.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- D. Short Circuit Current Rating:
 - 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
 - 2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
 - 3. Label equipment utilizing series ratings as required by NFPA 70.
- E. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- F. Conductor Terminations: Suitable for use with the conductors to be installed.
- G. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- H. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
- I. Provide externally operable handle with means for locking in the OFF position.

2.03 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. 14,000 rms symmetrical amperes at 480 VAC.
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - 3. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
- C. Conductor Terminations:
 - 1. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install enclosed circuit breakers plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.

- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- I. Set field-adjustable circuit breaker tripping function settings as indicated.
- J. Identify enclosed circuit breakers in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than _____ amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.
- G. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 28 16.16 ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 25 13 - Low-Voltage Busways: Fusible switch busway plug-in units.
- E. Section 26 29 13 - Enclosed Controllers: Manual motor controllers.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 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.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation; _____: www.eaton.com/#sle.
- B. Schneider Electric; Square D Products; _____: www.schneider-electric.us/#sle.
- C. Siemens Industry, Inc; _____: www.usa.siemens.com/#sle.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

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 (2,000 m).
 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- 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 indicated on the drawings.
 2. Minimum Ratings:
 - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.

- b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
 - c. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
- G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- K. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- M. Heavy Duty Switches:
 - 1. Comply with NEMA BS 31047.
 - 2. Conductor Terminations:
 - a. 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.
- N. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.

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 05 29.
- 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 (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- I. Identify enclosed switches in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

**SECTION 26 51 00
INTERIOR LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Lamps.
- F. LED retrofit luminaire conversion kits.
- G. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.
- E. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- B. IES LM-63 - IESNA Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
- C. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- D. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2019.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.
- G. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- H. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices; 2020.
- 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. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- M. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- N. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- O. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
- P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 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.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.

- b. Include IES LM-79 test report upon request.
- 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
- 3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
- 4. LED Retrofit Luminaire Conversion Kits: Include list of compatible luminaires and/or criteria for compatibility.
- D. Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.
- E. 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.
- F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- G. 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 Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
- H. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.
- 1.06 QUALITY ASSURANCE
 - A. Comply with requirements of NFPA 70.
- 1.07 DELIVERY, STORAGE, AND PROTECTION
 - A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
 - B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- 1.08 FIELD CONDITIONS
 - A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- 1.09 WARRANTY
 - A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
 - B. Provide five year manufacturer warranty for LED luminaires, including drivers.
 - C. Provide five year pro-rata warranty for batteries for emergency lighting units.
 - D. Provide ten year pro-rata warranty for batteries for self-powered exit signs.
 - E. Provide three year manufacturer warranty for LED retrofit luminaire conversion kits.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LUMINAIRES

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. HE Williams
 - 3. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
 - 4. Philips Lighting North America Corporation; _____; www.lightingproducts.philips.com/#sle.
 - 5. LSI.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- 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.

- J. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
 - 1. LED Tape - General Requirements:
 - a. Listed.
 - b. Designed for field cutting in accordance with listing.
 - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
 - 2. White LED Tape:
 - a. Correlated Color Temperature (CCT): 4000 K unless otherwise indicated.
 - b. Color Rendering Index (CRI): Not less than 90.
- K. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.
- L. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

- A. Manufacturers:
 - 1. Acuity Brands, Inc; _____: www.acuitybrands.com/#sle.
 - 2. Hubbell Lighting, Inc; _____: www.hubbellighting.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- C. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Battery:
 - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- F. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- G. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- H. Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.

I. Accessories:

1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
3. Provide compatible accessory wire guards where indicated.
4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.
2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

1. Manufacturers:

- a. Acuity Brands, Inc; _____: www.acuitybrands.com/#sle.
- b. Hubbell Lighting, Inc; _____: www.hubbellighting.com/#sle.
- c. Philips Lighting North America Corporation; _____; www.lightingproducts.philips.com/#sle.
- d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Self-Powered Exit Signs:

- a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
- c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- d. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- e. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

2.05 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.
3. Product(s):
 - a. Lutron Hi-Lume Premier 0.1% Constant Voltage (L3D0-Series): 3-wire and digital control; 0.1 percent dimming with Soft-On and Fade-to-Black low end performance; www.lutron.com/#sle.
 - b. Lutron Hi-Lume 1% (LTE-Series): Forward phase (neutral wire required); one percent dimming; www.lutron.com/#sle.
 - c. Lutron Hi-Lume 1% (L3D-Series): 3-wire and digital control; one percent dimming; www.lutron.com/#sle.
 - d. Lutron 5-Series (LDE5-Series): Digital control; five percent dimming; www.lutron.com/#sle.

2.06 LAMPS

A. Manufacturers:

1. General Electric Company/GE Lighting; _____: www.gelighting.com/#sle.
2. Osram Sylvania; _____: www.sylvania.com/#sle.
3. Philips Lighting North America Corporation; _____; www.usa.lighting.philips.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.
5. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B. Lamps - General Requirements:

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

2.07 LED RETROFIT LUMINAIRE CONVERSION KITS

- A. Description: Light-emitting diode (LED) retrofit luminaire conversion kits, including but not limited to LED lamps and arrays, control modules, drivers, power supplies, wiring, lampholders, brackets, wire connectors, reflectors, and diffusers, intended for replacement of existing light sources in existing luminaires; listed as complying with UL 1598C; suitable for installation in luminaire to be converted.

2.08 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.
- D. Fire-Rated Luminaire Enclosures:
 - 1. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 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 securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- 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. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.

4. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
5. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

G. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Suspended Luminaires:

1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.

I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

J. Install accessories furnished with each luminaire.

K. Bond products and metal accessories to branch circuit equipment grounding conductor.

L. Emergency Lighting Units:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

M. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

N. Remote Ballasts: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

O. 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. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires Engineer, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

**SECTION 26 56 00
EXTERIOR LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts.
- C. Lamps.
- D. LED retrofit luminaire conversion kits.
- E. Poles and accessories.
- F. Luminaire accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 09 23 - Lighting Control Devices.
 - 1. Includes automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.
- F. Section 26 27 26 - Wiring Devices: Receptacles for installation in poles.
- G. Section 26 51 00 - Interior Lighting.

1.03 UNIT PRICES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. Exterior Lighting Unit:

1.04 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2025).
- B. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- C. IEEE C2 - National Electrical Safety Code; 2017.

- D. IES LM-63 - IESNA Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
- E. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- F. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2019.
- 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 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
- M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.05 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 Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.06 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.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
 - 3. Provide structural calculations for each pole proposed for substitution.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, 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.
 - b. Include IES LM-79 test report upon request.
- 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
- 3. Lamps: Include rated life and initial and mean lumen output.
- 4. LED Retrofit Luminaire Conversion Kits: Include list of compatible luminaires and/or criteria for compatibility.
- 5. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
- E. Field Quality Control Reports.
 - 1. Include test report indicating measured illumination levels.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- H. 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. Touch-Up Paint: 2 gallons (8 liters), to match color of pole finish.
- I. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.
- 1.07 QUALITY ASSURANCE
 - A. Comply with requirements of NFPA 70.
- 1.08 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.
- 1.09 WARRANTY
 - A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
 - B. Provide five year manufacturer warranty for all LED luminaires, including drivers.
 - C. Provide three year manufacturer warranty for LED retrofit luminaire conversion kits.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Manufacturers:

1. Acuity Brands, Inc; _____: www.acuitybrands.com/#sle.
2. HE Williams
3. Hubbell Lighting, Inc; _____: www.hubbelllighting.com/#sle.
4. Philips Lighting North America Corporation; _____; www.lightingproducts.philips.com/#sle.
5. LSI.
6. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Provide products that comply with requirements of NFPA 70.

- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.

- D. Provide products listed, classified, and labeled as suitable for the purpose intended.

- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

- H. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

I. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.

J. 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.

- K. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.

1. LED Tape - General Requirements:

- a. Listed.
 - b. Designed for field cutting in accordance with listing.
 - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
2. White LED Tape:
- a. Correlated Color Temperature (CCT): 4000 K unless otherwise indicated.
 - b. Color Rendering Index (CRI): Not less than 90.

2.03 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:

- 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
- 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:

- 1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
- 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.04 LAMPS

A. Lamps - General Requirements:

- 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
- 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
- 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
- 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

2.05 LED RETROFIT LUMINAIRE CONVERSION KITS

- A. Description: Light-emitting diode (LED) retrofit luminaire conversion kits, including but not limited to LED lamps and arrays, control modules, drivers, power supplies, wiring, lampholders, brackets, wire connectors, reflectors, and diffusers, intended for replacement of existing light sources in existing luminaires; listed as complying with UL 1598C; suitable for installation in luminaire to be converted.

2.06 POLES

A. Manufacturers:

- 1. Acuity Brands, Inc; _____: www.acuitybrands.com/#sle.
- 2. Hubbell Lighting, Inc; _____: www.hubbelllighting.com/#sle.

3. Philips Lighting North America Corporation; _____; www.lightingproducts.philips.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Structural Design Criteria:
 - a. Comply with AASHTO LTS.
 - b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
 - c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.
 - d. Include structural calculations demonstrating compliance with submittals.
3. Material: Aluminum, unless otherwise indicated.
4. Shape: Square straight, unless otherwise indicated.
5. Finish: Match luminaire finish, unless otherwise indicated.
6. Mounting Height: 25ft, unless otherwise indicated.
7. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
8. Unless otherwise indicated, provide with the following features/accessories:
 - a. Top cap.
 - b. Handhole.
 - c. Anchor bolts with leveling nuts or leveling shims.
 - d. Anchor base cover.
 - e. Provision for pole-mounted weatherproof GFI receptacle where indicated.
 - f. Brackets: _____.

C. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.07 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

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 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.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- 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. Foundation-Mounted Poles:
 - a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 30 00.
 - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
 - 2) Position conduits to enter pole shaft.
 - b. Install foundations plumb.

- c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
 - d. Tighten anchor bolt nuts to manufacturer's recommended torque.
 - e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
 - f. Install anchor base covers or anchor bolt covers as indicated.
- 3. Embedded Poles: Install poles plumb as indicated.
- 4. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - b. Provide supplementary ground rod electrode as specified in Section 26 05 26 at each pole bonded to grounding system as indicated.
- 5. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
- 6. 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.
- 3.03 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 Architect.
 - E. Measure illumination levels at night with calibrated meters to verify compliance with performance requirements. Record test results in written report to be included with submittals.
- 3.04 ADJUSTING
 - A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
 - B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.
- 3.05 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.

3.06 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: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, all luminaires that have failed.

3.07 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

**SECTION 28 46 00
FIRE DETECTION AND ALARM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Circuits from protected premises to supervising station, including conduit.
- D. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.
- E. Maintenance of fire alarm system under contract for specified warranty period.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping: Materials and methods for work to be performed by this installer.
- B. Designed using manufacturer's product-specific design software or based on manufacturer's pre-engineered design suitable for the application.
- C. Section 08 33 23 - Overhead Coiling Doors: Coiling fire doors to be released by fire alarm system.
- D. Section 08 71 00 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.
- E. Section 14 21 00 - Electric Traction Elevators: Elevator systems monitored and controlled by fire alarm system.
- F. Section 14 24 00 - Hydraulic Elevators: Elevator systems monitored and controlled by fire alarm system.
- G. Section 14 91 00 - Facility Chutes: Sensors and interlocks monitored by fire alarm system.
- H. Section ____: Communications receivers and other supervising station components.
- I. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- J. Section 21 22 00 - Clean-Agent Fire-Extinguishing System: Supervisory, alarm, and releasing devices installed in extinguishing system.
- K. Section 21 30 00 - Fire Pumps: Supervisory devices.
- L. Section 23 33 00 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.
- M. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems: Requirements for the seismic qualification of equipment specified in this section.
- N. Section 27 51 29.13 - Rescue Assistance Signal Systems: Two-way emergency communication systems for areas of refuge/rescue assistance.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- F. NFPA 76 - Standard for the Fire Protection of Telecommunications Facilities; 2016.
- G. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Proposal Documents: Submit the following with cost/time proposal:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
 - 3. Certification by Contractor that the system design will comply with Contract Documents.
 - 4. Proposed maintenance contract.
- C. Evidence of designer qualifications.
- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. Copy (if any) of list of data required by authority having jurisdiction.
 - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 - 4. System zone boundaries and interfaces to fire safety systems.
 - 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
 - 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.

7. List of all devices on each signaling line circuit, with spare capacity indicated.
 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 9. Air-Sampling Smoke Detection Systems: Include air-sampling pipe network layout with sampling ports identified; include calculations demonstrating compliance with specified requirements.
 10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 11. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
 12. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
 13. Certification by Contractor that the system design complies with Contract Documents.
 14. Do not show existing components to be removed.
- E. Evidence of installer qualifications.
- F. Evidence of instructor qualifications; training lesson plan outline.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- I. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 4. List of recommended spare parts, tools, and instruments for testing.
 5. Replacement parts list with current prices, and source of supply.
 6. Detailed troubleshooting guide and large scale input/output matrix.
 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

- J. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:
 - 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 - 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 - 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- K. Closeout Documents:
 - 1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 - 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
 - 3. Certificate of Occupancy.
 - 4. Maintenance contract.
 - 5. Report on training results.
- L. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
 - 1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
 - 1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 - 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 - 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
 - 4. Certified in the State in which the Project is located as fire alarm installer.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Alarm Control Units and Accessories - Basis of Design: Potter Electric Signal Company, as indicated under product descriptions below; www.pottersignal.com/#sle.
- B. Fire Alarm Control Units and Accessories - Other Acceptable Manufacturers:
 - 1. Honeywell Security & Fire Solutions/Gamewell-FCI; _____: www.gamewell-fci.com/#sle.
 - 2. Honeywell Security & Fire Solutions/Fire-Lite; _____: www.firelite.com/#sle.
 - 3. Honeywell Security & Fire Solutions/Notifier; _____: www.notifier.com/#sle.
 - 4. Honeywell Security & Fire Solutions/Silent Knight; _____: www.silentknight.com/#sle.
 - 5. Honeywell Security & Fire Solutions/Vista; _____: www.security.honeywell.com/#sle.
 - 6. Siemens Building Technologies, Inc; _____: www.usa.siemens.com/#sle.
 - 7. Simplex, a brand of Johnson Controls; _____: www.simplex-fire.com/#sle.
 - 8. Provide control units made by the same manufacturer.
- C. Initiating Devices and Notification Appliances:
 - 1. Same manufacturer as control units.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
 - 1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with Contract Documents.
 - 2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.02 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
 - 1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
 - 2. Protected Premises: Entire building shown on drawings.
 - 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.

- b. The requirements of the State Fire Marshal.
 - c. The requirements of the local authority having jurisdiction , which is _____.
 - d. Applicable local codes.
 - e. Contract Documents (drawings and specifications).
 - f. NFPA 101.
 - g. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
- 4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
 - 5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
 - 6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
 - 7. Program notification zones and voice messages as directed by Owner.
 - 8. Fire Command Center: Location indicated on drawings.
 - 9. Fire Alarm Control Unit: New, located at fire command center.
- B. Supervising Stations and Fire Department Connections:
- 1. Public Fire Department Notification: By on-premises supervising station.
 - 2. On-Premises Supervising Station: Existing proprietary station operated by Owner, located at _____.
 - 3. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.
- C. Circuits:
- 1. Initiating Device Circuits (IDC): Class B, Style A.
 - 2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
 - 3. Notification Appliance Circuits (NAC): Class B, Style W.
- D. Power Sources:
- 1. Primary: Dedicated branch circuits of the facility power distribution system.
 - 2. Secondary: Storage batteries.
 - 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
 - 4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 EXISTING COMPONENTS

- A. Existing Fire Alarm System: Remove existing system completely after new system is fully operational and tested.

- B. On-Premises Supervising Station: Include as part of this work all modifications necessary to existing supervising station to accommodate new fire alarm work.
- C. Clearly label components that are "Not In Service."
- D. Remove unused existing components and materials from site and dispose of properly.

2.04 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 - 1. Sprinkler water control valves.
 - 2. Dry-pipe sprinkler system pressure.
 - 3. Dry-pipe sprinkler valve room low temperature.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
 - 1. Sprinkler water flow.
- C. Elevators:
 - 1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
 - 2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
 - 3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.
- D. HVAC:
 - 1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- E. Doors:
 - 1. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 08 71 00.

2.05 COMPONENTS

- A. General:
 - 1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 - 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.
- C. Addressable Fire Alarm Control Unit - Basis of Design: Potter Electric Signal Company; AFC Series; Model AFC-1000; www.pottersignal.com/#sle.
 - 1. System Capacity: 1,270 addresses; six (expandable to 192) notification appliance circuits (NACs); four input/output (I/O) circuits; 1,500 software zones.

2. Features: Strobe synchronization; dedicated alarm, supervisory and trouble relays; 4,000 event history buffer; built-in IP communicator; Ethernet port for programming and network connectivity; e-mail system status, reports and event information.
- D. Master Control Unit: As specified for Basis of Design above, or equivalent.
- E. Initiating Devices:
1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
 - b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
 2. Manual Pull Stations: _____.
 3. Key Operated Pull Stations: _____.
 4. Smoke Detectors: _____.
 5. Duct Smoke Detectors: _____.
 6. Heat Detectors: _____.
 7. Air-Sampling Smoke Detection Systems:
 - a. Design and provide smoke detection system suitable for application and coverage area indicated, consisting of smoke detector unit with aspirator/fan that continuously draws air into sensing chamber through connected sampling pipe network and associated sampling ports.
 - b. Comply with NFPA 72 and list and label as complying with UL 268.
 - c. Comply with applicable requirements of NFPA 76 for Very Early Warning Fire Detection (VEWFD).
 - d. Detector Unit:
 - 1) Sensitivity: Programmable; capable of meeting NFPA 76 requirements for Very Early Warning Fire Detection (VEWFD).
 - 2) Smoke Detection Method: Provide detector units employing laser-based light scattering mass detection.
 - 3) Alarm Levels: Programmable; as indicated or as required to perform alert, pre-alarm action, and alarm functions; minimum of three.
 - 4) Minimum Number of Output Relays Supported: Equivalent to basis of design.
 - 5) Display: Provides local annunciation of detector trouble and alarm status.
 - e. Sampling Pipe Network:
 - 1) Use manufacturer's recommended sampling pipe and fittings; plenum rated; identified in accordance with NFPA 72.
 - 2) Designed using manufacturer's product-specific design software or based on manufacturer's pre-engineered design suitable for the application.

F. Notification Appliances:

- G. Circuit Conductors: Copper or optical fiber; provide 200 feet (60 m) extra; color code and label.
- H. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
- I. Locks and Keys: Deliver keys to Owner.
- J. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
 - 1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 - 2. Provide one for each control unit where operations are to be performed.
 - 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
 - 4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
- B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- C. Obtain Owner's approval of locations of devices, before installation.
- D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.03 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.

3. Factory Instruction: At control unit manufacturer's training facility.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
 1. Initial Training: 1 session pre-closeout.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 1. Initial Training: 1 session pre-closeout.
- D. Detailed Operation: Two-hour sessions for engineering staff; assume NICET level I qualifications or equivalent; combination of classroom and hands-on:
 1. Initial Training: 1 session pre-closeout.
- E. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
 1. Initial Training: One 3-day session, pre-closeout.
- F. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.
- G. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.

3.04 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
 1. Be prepared to conduct any of the required tests.
 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 5. Repeat demonstration until successful.
- B. Occupancy of the project will not occur prior to Substantial Completion.
- C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
 1. Approved operating and maintenance data has been delivered.
 2. Spare parts, extra materials, and tools have been delivered.
 3. All aspects of operation have been demonstrated to Owner.
 4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 5. Occupancy permit has been granted.
 6. Specified pre-closeout instruction is complete.

3.05 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.
- C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
 - 1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 - 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 - 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Provide on-site response within 2 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- G. Comply with Owner's requirements for access to facility and security.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removing surface debris.
 - 2. Removing designated paving, curbs, and other obstructions.
 - 3. Removing designated trees, shrubs, and other plant life.
 - 4. Removing abandoned utilities.
 - 5. Excavating topsoil.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.

1.2 QUALITY ASSURANCE

- A. Perform Work in accordance with the most recent edition of the New Mexico Standard Specifications for Public Works Construction, with latest revisions.
- B. Conform to applicable State of New Mexico code for environmental requirements, disposal of debris, burning debris on site, use of herbicides.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified.
- C. Identify waste area and/or salvage area for placing removed materials.

3.2 PREPARATION

- A. Call New Mexico "One Call" at 811 and local utility companies at least three (3) days before performing Work.

1. Request that underground utilities be located and marked within and surrounding construction areas.

3.3 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping.
- C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs within indicated areas. Remove stumps and surface rock.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

3.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Partially remove paving, curbs, and other obstructions as indicated on Drawings. Neatly saw cut edges at right angle to surface.
- C. Remove abandoned utilities as directed by Owner and/or Engineer. Indicate removal termination point for underground utilities on Record Documents.
- D. Continuously clean up and remove waste materials from site. Do not allow materials to accumulate on site.
- E. The Engineer will indicate to the Contractor which obstructions are to be removed, disposed of, or salvaged, and will require special documentation.
- F. All existing fences crossed by the Work, or are within the construction area, are to be removed and rebuilt to original condition or better. Fence materials resulting from such removal are to be stored or disposed of as directed by the Engineer. Fence materials suitable for reuse or salvage that are damaged, lost or destroyed due to the Contractor's negligence or carelessness are to be replaced at the Contractor's expense.
- G. Do not burn or bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.
- D. Remove excess topsoil not intended for reuse, from site.
- E. All equipment shall be properly maintained and with proper safety devices.
- F. Contractor must maintain control of dust and minimize blowing debris.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating subsoil.
 - 2. Cutting, grading, filling, rough contouring, and compacting site for site structures and building pads.
- B. Related Sections:
 - 1. Section 31 10 00 - Site Clearing: Excavating topsoil.
 - 2. Section 31 23 23 - Backfill: General building area backfilling.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.
- B. American Society for Testing and Materials International (ASTM):
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D422 - Particle -Size Analysis of Soils.
 - 3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
 - 4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort 12,400 ft-lbf/ft³.
 - 5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
 - 6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft³.
 - 8. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
 - 9. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 10. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
 - 11. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - 12. ASTM D2434 - Standard Test Method for Permeability of Granular Soils Constant Head.
 - 13. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).

14. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
15. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
16. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
17. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
18. ASTM D4254 - Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
19. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
20. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
21. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
22. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
23. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
24. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
25. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
26. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
27. ASTM D5080 - Rapid Determination of Percent Compaction.
28. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Section 01 00 00 - Submittal Procedures.
- B. Samples: Submit, in airtight containers, 10 lb sample of each type of fill to testing laboratory.
- C. Materials Source: Submit name of imported materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.
- B. Perform Work in accordance with applicable New Mexico State Standards.

PART 2 PRODUCTS

2.1 MATERIALS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.
- B. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call New Mexico "One Call" at 811 and local utility companies at least three (3) days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove and relocate utilities.
- D. Protect remaining utilities from damage.
- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect benchmarks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- D. Remove excess subsoil not intended for reuse, from site.
- E. Benching Slopes: Horizontally bench existing slopes greater than 1: 4 to key placed fill material to slope to provide firm bearing.

- F. Stability: Replace damaged or displaced subsoil as specified for fill.
- G. Notify Owner of any utility damage at once so emergency measures can be taken. The Contractor will pay for any required repairs.
- H. Intercept and divert surface drainage and precipitation away from excavation through use of dikes, curb walls, ditches, pipes, or other means.
- I. Remove and exclude water, including storm water, groundwater, irrigation water, and/or other waters, from all excavations. Dewatering wells, well-points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level below the bottom of excavations. Water shall be removed and excluded until backfilling is complete and all field soils testing have been completed.
- J. Comply with New Mexico state standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.
- K. Excavation below Fills and Embankments: The subgrade areas beneath embankments shall be excavated to remove not less than the top 1 foot of native material and, where such subgrade is sloped, the native material shall be benched. After the required excavation or over-excavation has been completed, the top 12 inches of material shall be scarified and moisture added or material dried to optimum moisture and the exposed surface shall be proof rolled.
- L. Excavation under areas to be paved shall extend to the bottom of the sub-base. After the required excavation has been completed, the area shall be scarified a minimum of 12 inches below the subgrade surface and recompact prior to the placement of the sub-base aggregate and/or base course aggregate. The finished sub-grade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be reggraded to provide a self-draining subgrade.
- M. Material beyond prescribed lines which is loosened by the Contractor's operations shall be removed, replaced and/or compacted, as directed by the Engineer, at no additional cost to the Owner.

3.4 FILLING

- A. See Section 31 23 23 - Backfill.

3.5 DISPOSAL OF EXCAVATED MATERIALS

- A. Contractor to coordinate with Owner for a location to dispose of excess excavated material or excavated material not suitable for backfill.

3.6 TOLERANCES

- A. Section 01 00 00 - Quality Requirements: Tolerances.
- B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

- A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.
- B. Perform laboratory material tests in accordance with ASTM D1557, ASTM D698, AASHTO T180.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D6938.
 - 2. Moisture Tests: ASTM D6938.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- E. Compaction testing shall be done to the extent such that the Owner and Engineer can be reasonably assured that the backfill has been placed in accordance with the requirements of the Contract Documents or in accordance with the NMDOT Standard Specifications for Road and Bridge Construction, whichever is the more stringent. When a testing allowance is established on the Bid Form, the Owner and Engineer will determine the testing frequency to be used throughout the project. If no allowance is included, the frequency of testing shall be at least once every 400 linear feet of trenching, or at least once every 200 square feet below structural slabs.

END OF SECTION

SECTION 312316.13 TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building , coordinate with site utilities..

1.02 RELATED REQUIREMENTS

- A. Document Report No. 4226031: Geotechnical report; bore hole locations and findings of subsurface materials.

1.03 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2025.
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)); 2012 (Reapproved 2021).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. Provide fill material as indicated on structural drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 TRENCHING

- A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove excavated material that is unsuitable for re-use from site.
- G. Remove excess excavated material from site.
- H. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

- I. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot (305 mm) into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.03 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.04 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 feet (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- F. Correct areas that are over-excavated.
 - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated:
- H. Reshape and re-compact fills subjected to vehicular traffic.

3.05 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.

3.06 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Frequency of Tests: provide one test per lift for structural backfill and one test at each trench for footings and utility trenches..

END OF SECTION

SECTION 312316 EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

- A. Section 015713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 017000 - 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. General requirements for dewatering of excavations and water control.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bedding and Fill to Correct Over-Excavation:
- B. Underground Warning Tapes: refer to civil for site utilities

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- D. Protect plants, lawns, rock outcroppings, and other features to remain.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

3.02 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
 - 1. Excavate to the specified elevations.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.03 FILLING AND BACKFILLING

- A. Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation.

END OF SECTION

SECTION 31 23 23

BACKFILL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backfilling building perimeter to subgrade elevations.
 - 2. Backfilling site structures to subgrade elevations.
 - 3. Fill under slabs-on-grade.
 - 4. Fill under paving.
 - 5. Fill for over-excavation.
 - 6. Pipe bedding material.
- B. Related Sections:
 - 1. Section 03 05 00 - Basic Concrete Materials and Methods: Concrete materials.
 - 2. Section 31 22 13 - Rough Grading: Site filling.

1.2 REFERENCES

- A. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
 - 1. NMSSPWC Sections 701, 801 & 802 "Trenching, Excavation and Backfill".
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO T99 - Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 3050mm (12-in.) Drop.
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- C. American Society for Testing and Materials International (ASTM):
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D422 - Particle -Size Analysis of Soils.
 - 3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
 - 4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
 - 6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³, 2,700 kN-m/m³).
 - 8. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
 - 9. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

10. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
11. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
12. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
13. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
14. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
15. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
16. ASTM D4254 - Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
17. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
18. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
19. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
20. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
21. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
22. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
23. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
24. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
25. ASTM D5080 - Rapid Determination of Percent Compaction.
26. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

- A. Percentage Compaction: Ratio, expressed as percentage, of actual density of material compared with maximum dry density based on Modified Proctor (ASTM D1557).
- B. Optimum Moisture Content: Based on Modified Proctor (ASTM D1557).
- C. Unified Soil Classification System: Based on ASTM D2487.

1.4 SUBMITTALS

- A. Section 01 00 00 - Submittal Procedures.
- B. Submit samples and certified test documentation of all materials to be used.
- C. Materials Source: Submit name of imported fill materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

- E. Submit field soil test on material in place as backfill and pipe bedding material.
- F. Submit construction drawings with compaction test locations marked and labeled with station, date, test number, depth of test below ground surface, and test result.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Suitable materials may be processed on-site, or may be imported. If imported materials are required to meet the quantity requirements of the project, it will be provided at no additional expense to the Owner, unless a unit price item is included for imported materials on the Bid Form. The following types of materials are defined as suitable where scheduled:

- 1. Type A (three-quarter inch minus aggregate backfill): Crushed rock or gravel, and sand with the gradation requirements below.

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4-inch	100
No. 4	30 – 50
No.200	0 – 12

- 2. Type B (Class I crushed stone): Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4-inch	100
No. 4	30 – 50
No. 200	0 - 5

- 3. Type C (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a No. 4 sieve, and a sand equivalent value not less than 30.

a. This material to be used only when approved by Engineer.

- 4. Type D: (pipe bedding material): The following gradation ranges are acceptable for pipe bedding material:

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4inch	100
No.4	70-100
No.10	50-100
No. 200	0-35

All soil bedding materials used should be non-plastic. All soil bedding materials should extend a minimum of 4 inches in all directions, except for gas lines having 6" minimum above and below the pipe.

5. Type E (pea gravel backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.

6. Type F (coarse drain rock): Crushed rock or gravel meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
2-inch	100
1-1/2-inch	90- 100
1-inch	20 – 55
3/4-inch	0 – 15
No. 200	0 – 3

7. Type G (aggregate base, base course) as follows:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1-inch	100
3/4 inch	80-100
No.4	30-60
No.10	20-45
No. 200	3-10

8. Type H (graded drain rock): Drain rock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1-inch	100
3/4-inch	90 - 100
3/8-inch	40 - 100
No. 4	25 – 40
No. 8	18 – 33
No. 30	5 – 15
No. 50	0 – 7
No. 200	0 – 3

9. Type I Not Used

10. Type J (cement-treated backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.

11. Type K (topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

12. Type L (controlled low strength material): Controlled low strength material, also referred to as 'soil cement slurry' or 'flowable fill' shall meet the following requirements:
 - a. Slurry shall have a 7-day compressive strength of not less than 50 psi and not more than 150 psi. The compressive strength shall be determined in accordance with ASTM D4832.
 - b. Typical cement content: 3 to 10 percent by dry weight of soil to obtain specified compressive strength.
 - c. The water-cement ratio of the mix shall not exceed 3.5:1. The water content shall not exceed that required to provide a mix that will flow and can be pumped.
 - d. The consistency of the slurry shall be such that the slurry flows easily into all openings between the pipe and the lower portion of the trench.
13. Type M (aggregate sub-base, structural fill). Well-graded crushed rock or natural gravel meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
4-inch	100
3-inch	95 100
No. 200	3 - 15

- B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, the Engineer shall be immediately notified. In case of conflict between types of pipe embedment backfills, the Contractor is to use the agency-specified backfill material if that material provides a greater degree of structural support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, the Contractor shall use the agency-specified backfill material if that material provides the greater in-place density after compaction.
- C. Fill and backfill types, including use of native soil, shall be used in accordance with the following provisions. Native soil used for fill and backfill must meet the requirements of the type of material specified below and as shown for the corresponding type of material shown in 2.1.A above.
 1. Embankment fills shall be constructed of Type M material, as defined herein, or other material approved by the Project Engineer. Drainage structures embankments shall be backfilled with materials used in original construction.
 2. Pipe zone backfill shall consist of the following materials for each pipe material listed below. All pipe bedding material shall receive prior approval by the Engineer before use.
 - a. Concrete pipe, shall be provided Type A or B pipe bedding and embedment backfill material, or native material that meets the criteria described below, and is acceptable to the Engineer.
 - b. Plastic pipe shall be provided Type D bedding and embedment zone material, or native material that meets the criteria described below, and is acceptable to the Engineer.

- 1) In trenches where dewatering is required, the pipe bedding material and embankment backfill shall be Type A or B as directed by the Engineer.
- c. Excavated native material will be allowed, provided that it is free draining and contains no organic materials, no rocks larger than 1/2-inch, clods or frozen lumps. A proctor of this material shall be submitted to the Engineer for review and approval before use. If native backfill material is approved, on-site screening may be required by Engineer to remove any rock material larger than 1/2-inch at no additional expense to the Owner. The location of such sites must be coordinated with the Owner.
3. Trench zone backfill for pipelines shall be any of Types A through H backfill materials or any mixture thereof.
4. Final backfill material for pipelines under paved areas shall be Type G backfill material.
5. Final backfill under areas not paved shall be the same material as that used for trench backfill, unless otherwise indicated.
6. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
7. Aggregate base materials under pavements, curb and gutter, and sidewalk shall be Type G material constructed to the thickness indicated.
8. Aggregate sub-base shall be Type M material.
9. Backfill around structures shall be Types A through Type H materials, or any mixture thereof.
10. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter fabric shall be placed over the exposed foundation. Filter fabric shall be Mirafi 140 N, Mirafi 700X, or equal.
11. Under all other structures, Type G or H material shall be used.
12. Backfill used to replace pipeline trench over-excavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.
- D. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify subgrade surface to depth of 8 inches.
- D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING FOR STRUCTURES, SITE WORK AND APPURTENANCES

- A. Backfill areas to contours and elevations with unfrozen materials as indicated on the Drawings or as directed by the Engineer.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer.
- D. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 8 inches compacted depth.
 - 2. Structural Fill: Maximum 6 inches compacted depth.
 - 3. Granular Fill: Maximum 6 inches compacted depth.
- E. Employ placement method that does not disturb or damage other work.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Slope grade away from building minimum 6 inches in 10 ft, unless noted otherwise.
- H. Make gradual grade changes. Blend slope into level areas.
- I. Shape and drain embankments and excavations, maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work, and reestablish grade where settlement or erosion occurs.
- J. Bench hillside slopes or fills to key the embankment. Remove and re-compact a minimum of 12 inches normal to the slope of the hillside or fill as the embankment or fill is brought up in layers.
- K. Under surfaced or paved roads, driveways or parking areas, apply base course at uppermost layer of backfill to same thickness as existing driving surface, or 6 inches, whichever is

greater. If paved, apply pavement patch to thickness equal to or greater than existing pavement.

- L. Remove surplus backfill materials from site.
- M. Leave fill material stockpile areas free of excess fill materials.
- N. Repair or replace remaining items damaged by excavation or filling.

3.4 BACKFILLING OF TRENCHES

- A. Place a minimum of 4 inches of bedding material in pipe trenches to lines and grades indicated on Drawings or as directed by Engineer and compact before pipe is laid. Grade bedding material parallel to bottom of pipe.
- B. Do not place material when either the material or the surface upon which it is to be placed is frozen.
- C. Pipe zone backfill materials shall be manually spread around the pipe so that, when compacted, the pipe zone backfill will provide uniform bearing and side support.
 - 1. Exercise care not to damage pipe or appurtenances when placing embedment material.
 - 2. Maintain optimum moisture content of fill materials to attain required compaction density.
 - 3. Ensure material is placed to equal height on both sides of pipe to avoid unequal loading and possible lateral displacement of the pipe. Elevation difference of embedment between each side of pipe shall not exceed 6 inches.
 - 4. Place material in uniform layers.
 - 5. Work material into pipe haunches to prevent voids and achieve specified compaction under the haunches.
 - 6. No backfilling by machine methods permitted until a minimum of one foot of material has been placed by hand over the top of the pipe.
 - 7. Place material to a compacted depth of 12 inches over the top of the pipe, 15 inches of compacted depth over the top of the pipe in paved or traffic areas, and compacted by hand held compacting tools before other backfilling is done.
- D. If pipe laying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.
- E. When the bottom of the trench is unstable, an additional 4 inches shall be over-excavated and filled with bedding material before pipe is laid.
- F. Where rock is present and where there is concern that settling rocks in the surrounding material may rupture the pipeline, the amount of bedding material below and above the pipe shall be increased. In these cases there will be 8 inches of bedding material below the pipe and 15 inches above, as directed by the Engineer.

- G. When using free-draining crushed rock or gravel for embedment on stretches longer than 300 feet, install trench plugs composed of silty, non-plastic material at 300 foot intervals to impede flow of trench water through the embedment.
- H. Under surfaced or paved roads, driveways or parking areas, apply base course at uppermost layer of backfill to same thickness as existing driving surface, or 6 inches, whichever is greater. If paved, apply pavement patch to thickness equal to or greater than existing pavement.

3.5 COMPACTION

- A. Do not place and compact soil under the following conditions:
 - 1. Ambient air temperature below freezing.
 - 2. Rain that creates puddles in clayey or silty materials.
 - 3. Ice or snow pockets visible in material being placed.
- B. Surface Preparation:
 - 1. Prepare surface so that first compacted lift will be placed on firm, stable base. Compact surface to specified percent compaction, if necessary.
 - 2. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing first layer of material to be compacted.
 - 3. Do not place material to be compacted on frozen surface.
- C. Compact material in trenches in layers having approximately the same top elevation on both sides of the pipeline to avoid unequal loading and displacement of the pipe.
- D. Placement:
 - 1. Place soil to be compacted in horizontal layers.
 - 2. Blend materials as needed to ensure compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations and other imperfections.
- E. Compaction Procedures:
 - 1. Silty or Clayey Material:
 - a. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, rubber tire rollers or other suitable compaction equipment.
 - b. Uniformly distribute equipment passes.
 - c. Compact in horizontal layers to compacted thickness of 6 inches or less.
 - 2. Cohesionless Free-Draining Material: Compact in horizontal layers to maximum compacted thickness of:
 - a. Tampers and rollers: 6 inches
 - b. Crawler-type tractors, vibrating drum rollers, surface vibrators or similar equipment: 12 inches
 - c. Saturation and internal vibration: Penetrating depth of vibrator.
 - 3. When compacting pipe embedment material, exercise care not to damage the pipe or appurtenances with compaction equipment. Do not apply compaction equipment directly above the pipe.
 - 4. Demonstration: Lift thicknesses may vary depending on equipment and methods. Field adjustments to the specified lift thicknesses may be allowed or required.

Contractor shall demonstrate that proposed equipment and methods will meet required compaction for the proposed lift thickness.

5. Flooding and jetting is not allowed unless specifically approved by the Engineer.

F. Moisture Content:

1. Optimum moisture content for each soil type, whether native soil or imported material, shall be determined by the Modified Proctor method, ASTM D1557.
2. Moisture content during compaction shall be no more than 2 percentage points wet or dry of optimum moisture content.
3. Moisten or aerate material, as necessary, to provide specified moisture content. Add water to soil in increments that will permit moisture content to be uniform and homogenous through each layer after mixing.
4. Add no more than 2 percent water to fill by sprinkling just prior to compaction when fill is clayey and contains dry clods of clay.
 - a. If clayey soil is more than 2 percent below optimum moisture, pre-conditioning and curing may be required to obtain uniform and homogenous distribution of moisture in clods.
 - b. Use of disks, harrows or rakes may be required to blend moisture prior to placement and compaction.
5. For cohesionless soils, add water as necessary during compaction, as these soils are free-draining.

G. Minimum Percent Compaction:

1. Over-excavation: Backfill of over-excavation to specified or directed lines shall be compacted to same percent compaction as embedment material or undisturbed foundation material, whichever is greater. If the in-place compaction of the undisturbed foundation material is greater than 95%, the over-excavation backfill may be compacted to 95%.
2. Pipe Bedding Material: Place and compact pipe bedding material as indicated on Drawings for given soil classification, pipe wall thickness, and depth of cover. If native material meets grading requirements and is used, compact to 95%.
3. Initial and Final Backfill: For trenches outside of roads, driveways, parking areas or wash crossings, compact to 90%, or to a density equal to that of the adjacent undisturbed soil, as directed by the Engineer. For trenches within the driving surfaces of roads, driveways or parking areas (both paved and unpaved) or within wash crossings, compact to 95%.
4. Embankments: Compact to same requirements as Final Backfill.
5. Under buildings, tanks, slabs and other structures: Compact to 95%.
6. Note that all Percent Compaction values in these Technical Specifications and Drawings are based on Modified Proctor, ASTM D1557, unless otherwise noted.

3.6 TOLERANCES

- A. Section 01 00 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling within Building Areas: Plus or minus 1 inch from required elevations.

- C. Top Surface of Backfilling under Paved Areas: Plus or minus 1 inch from required elevations.
- D. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.
- E. Percent Compaction: Shall meet minimum required compaction as set forth in these specifications
- F. Moisture Content: As set forth in these specifications.

3.7 FIELD QUALITY CONTROL

- A. Section 01 00 00 - Execution Requirements: Testing, Adjusting, and Balancing.
- B. Perform laboratory material tests in accordance with ASTM D1557.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D6938.
 - 2. Moisture Tests: ASTM D6938.
- D. When tests indicate Work does not meet specified requirements, remove material, replace, compact, and retest.
- E. Provide test trenches and excavations including excavation, trench support, and groundwater removal for the soils testing operations, at the locations and depths required. The cost of all work associated with accessing, preparing, or time delays for testing to be included in the unit price of the applicable pay item being tested.
- F. Compaction testing shall be done to the extent such that the Owner and Engineer can be reasonably assured that the backfill has been placed in accordance with the requirements of the Contract Documents, or as required by the utility for which the trenching is being provided, whichever is the more stringent. When a testing allowance is established on the Bid Form, the Owner and Engineer will determine the testing frequency to be used throughout the project. If no allowance is included, the frequency of testing shall be at least once every 400 feet of trenching, or at least once every 200 square feet below structural slabs.
- G. Correction of Substandard Work: All fill and backfill represented by tests that fail to meet compaction, moisture content, soil classification or other specifications shall be uncovered as needed, replaced as needed, re-compacted and re-tested until all specifications are met, at no additional expense to the Owner.
 - 1. Elevations, lines and grades of replaced material, as well as of pipe and other structures resting against such material, shall be re-surveyed at the direction of the Engineer. Contractor shall correct elevations, lines and grades as needed, at no additional expense to the Owner.

3.8 PROTECTION OF FINISHED WORK

- A. Section 01 00 00 - Execution Requirements: Protecting Installed Construction.

- B. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 321623 SIDEWALKS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete sidewalks.
- B. Concrete wheelchair ramps.

1.02 RELATED REQUIREMENTS

- A. Section 321313 - Concrete Paving.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 305R - Guide to Hot Weather Concreting; 2010.
- C. ACI 306R - Guide to Cold Weather Concreting; 2016.
- D. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- F. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Concrete: Provide data on admixtures.
- C. Design Data: Indicate pavement thickness, design strength, reinforcement, and typical details.

1.05 FIELD CONDITIONS

- A. Follow recommendations of ACI 305R and ACI 306R when concreting during hot and cold weather, respectively.

PART 2 PRODUCTS

2.01 CONCRETE SIDEWALKS AND WHEELCHAIR RAMPS

- A. Concrete Forms: Wood.
- B. Concrete Materials: Comply with ASTM C94/C94M.
- C. Aggregate: Pit Run, washed, 3/8 inch (1 cm) stone; free of shale, clay, friable material and debris.
- D. Reinforcement:
 - 1. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, plain type, flat sheets, unfinished.
- E. Joint Filler: Preformed expansion, with a thickness of 1/2 inch (13 mm).

PART 3 EXECUTION

3.01 CONCRETE SIDEWALK AND WHEELCHAIR RAMP INSTALLATION

- A. Mixing:
 - 1. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Forming:
 - 1. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

2. Sidewalk Forms: Place and secure forms to location, dimension, profile, and gradient shown on drawings. Height equal to the full depth of the finished sidewalk.
 3. Wheelchair Ramps: Place and secure forms to location, dimension, profile, and gradient shown on drawings. Comply with ADA Standards.
- C. Reinforcement:
1. Place wire-mesh reinforcement mid-height of forms.
- D. Placement:
1. Place concrete in a single lift.
 2. Consolidate concrete by tamping and spading.
- E. Joints:
1. Spacing: Provide scored joints every 10 feet (3 m).min. unless indicated otherwise on drawings.
 2. Filler height equal to the full depth of the finished concrete.
- F. Finishing:
1. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge, 1/4 inch radius (6 mm radius).
 2. Wheelchair Ramps: Broomed perpendicular to slope.

3.02 TOLERANCES

- A. Surface Flatness: 1/4 inch (6 mm), maximum, measured with 10 foot (3 m) straight edge.

END OF SECTION

**SECTION 328423
UNDERGROUND SPRINKLERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe and fittings, valves, sprinkler heads, emitters, bubblers, and accessories.

PART 2 PRODUCTS

2.01 IRRIGATION SYSTEM

2.02 PIPE MATERIALS

- A. PVC Pipe: ASTM D2241; 200 psi (1.38 MPa) pressure rated upstream from controls, 160 psi (1.10 MPa) downstream; solvent welded sockets.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify location of existing utilities.
- B. Verify that required utilities are available, in proper location, and ready for use.
- C. Coordinate relocation of irrigation lines with new construction.

3.02 TRENCHING

- A. Trench to accommodate grade changes and slope to drains.
- B. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.03 INSTALLATION

- A. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.
- B. Connect to utilities.
- C. Set outlets and box covers at finish grade elevations.
- D. Provide for thermal movement of components in system.
- E. Use threaded nipples for risers to each outlet.
- F. After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.

END OF SECTION

**SECTION 329119
LANDSCAPE GRADING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Topsoil placement.
- B. Finish grading.

1.02 RELATED REQUIREMENTS

- A. Section 311000 - Site Clearing.
- B. Section 329219 - Seeding.
- C. Section 329223 - Sodding.

1.03 REFERENCE STANDARDS

- A. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping and Construction Purposes; 2023.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Topsoil excavated on-site.
 - 1. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds and foreign matter.

PART 3 EXECUTION

3.01 TOPSOIL PLACEMENT

- A. Uniformly distribute and spread topsoil.
- B. Compacted Topsoil Thickness: Place in areas to receive seeding or sod as required by new construction...

3.02 FINISH GRADING

- A. Maintain profiles and contour of subgrade.
- B. Remove roots, weeds, rocks, and foreign material while spreading.
- C. Maintain uniform topsoil thickness.
- D. Lightly compact placed topsoil.

END OF SECTION

SECTION 329219 SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Seeding, mulching and fertilizer.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading.
- B. Section 329119 - Landscape Grading.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

PART 2 PRODUCTS

2.01 SEED MIXTURE

- A. Seed Mixture:
 - 1. Coordinate seed mixture as recommended for project location. Coordinate seeding requirements with NMSU.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION

- A. Prepare subgrade in accordance with Section 312200.

3.03 SEEDING

- A. Apply seed at a rate of 1 lbs per 1000 sq ft (____ Kg per 1000 sq m) evenly in two intersecting directions. Rake in lightly. For over seeding purposes only.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- D. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches (100 mm) of soil.
- E. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches (100 by 100 mm).

END OF SECTION

SECTION 329223 SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Sod installation.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading.
- B. Section 329119 - Landscape Grading.

1.03 REFERENCE STANDARDS

- A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.04 QUALITY ASSURANCE

- A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of New Mexico.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sod on pallets. Protect exposed roots from dehydration.
- B. Do not deliver more sod than can be laid within 24 hours.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sod: TPI (SPEC), Certified Turfgrass Sod quality; cultivated grass sod; type indicated below; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft (100 sq m). Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
- B. Provide sod mixture/type suitable to Doña Ana County.
 - 1. Bermudagrass Grass Type: _____ percent.
 - 2. Buffalograss Grass Type: _____ percent.
 - 3. Zoysiagrass Grass Type: _____ percent.

PART 3 EXECUTION

3.01 PREPARATION

- A. Prepare subgrade in accordance with Section 312200.

3.02 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod immediately after delivery to site to prevent deterioration.
- C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches (300 mm) minimum. Do not stretch or overlap sod pieces.
- D. Water sodded areas immediately after installation. Saturate sod to 4 inches (100 mm) of soil.
- E. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller not exceeding ____ lbs. (Roll sodded areas with roller not exceeding ____ kg.)

END OF SECTION

GEOTECHNICAL ENGINEERING REPORT

NMSU GENESIS BUILDING A ADDITION

**3655 A RESEARCH DRIVE
LAS CRUCES, NEW MEXICO**

Project No. 4226031

March 26, 2026

Prepared for:

**STUDIO D ARCHITECTS
Fairacres, NM**

Prepared by:

**COZ ENGINEERING, LLC
Las Cruces, New Mexico**

COZ Engineering, LLC

PO Box 13331
Las Cruces, New Mexico 88013
Cell: 575.642.7671
Email: thecoz42@gmail.com

March 26, 2026

Studio D Architects
PO Box 1467
Fairacres, NM 88033

Attn. Abelardo Natividad
E: abel@studio-d.biz
P: 575.521.3757

**Re: Geotechnical Engineering Report
NMSU Genesis Building A Addition
3655 A Research Drive
Las Cruces, New Mexico
COZ Report No. 4226031**

Dear Mr. Natividad:

The following is a geotechnical engineering report for the proposed addition in Las Cruces, New Mexico. Recommendations for earthwork, foundations and other geotechnical considerations are presented in the report.

Thank you for the opportunity to provide this geotechnical engineering report. If you have any questions or concerns, please contact me at (575)-642-7671.

Sincerely,

COZ Engineering, LLC



Dan Cospers, P.E.

<i>Site Investigation:</i>	<i>1</i>
<i>Site Conditions:</i>	<i>1</i>
<i>Planned Construction:</i>	<i>1</i>
<i>Initial Site Grading:</i>	<i>2</i>
<i>Soil Improvements:</i>	<i>2</i>
<i>Fill Material:</i>	<i>2</i>
<i>Compaction Requirements:</i>	<i>3</i>
<i>Foundations:</i>	<i>3</i>
<i>Drainage Recommendations:</i>	<i>5</i>
<i>Seismic Site Classification:</i>	<i>5</i>
<i>Testing and Inspection:</i>	<i>6</i>
<i>Report Limitations:</i>	<i>7</i>

Appendix:

Site Plan
Boring Logs
Laboratory Results

Site Investigation:

A subsurface investigation was performed for the proposed NMSU Genesis Building A Addition to be located at 3655 A Research Drive in Las Cruces, New Mexico. Two (2) test borings were advanced within the proposed building/addition footprints. The borings were terminated at a depth of 20 feet below ground surface (bgs). The test boring logs and location plan are provided in the appendix of this report.

Site Conditions:

The current site surfaces are landscape grass, concrete flatwork, exposed subgrade and large diameter trees adjacent to an existing structure. Soils investigated at this site were generally comprised of poorly graded sand with varying amounts of silt and gravel from the surface to the total explored depths.

The groundwater table was not encountered during the field investigation.

Planned Construction:

Based on the information provided, I understand there will be a single-story addition to the northwest corner of the existing structure (approximately 800 square feet) and a separate greenhouse (approximately 900 square feet). The construction type is anticipated to be steel-frame for the addition and CMU block for the greenhouse, both supported on monolithic slabs with turn-down edges. Structural loading information was not known at the time of this report. However, it is assumed that maximum column loads (if applicable) of 25 kips with maximum wall loads of 3 klf can be expected for the project.

Initial Site Grading:

Areas for planned construction should be clear of debris, concrete, vegetation (including tree root systems) and any oversized or deleterious material prior to grading operations. Fill construction shall not be allowed on surfaces that contain vegetation or rocks larger than four inches in greatest dimension. No fill shall be placed that contains vegetative materials as decomposition of that material can cause voids and possibly result in surface settlement. Voids in the soil matrix created or encountered during grading operations shall be backfilled with approved compacted fill material.

Soil Improvements:

Based on the geotechnical engineering analyses and subsurface exploration, it is my opinion that the proposed structures can be supported by engineered fill underlain by prepared native subgrade soils. Subgrade preparation (beneath engineered fills) should consist of scarifying the exposed subgrade surface a minimum thickness of 10 inches, moisture conditioning (-2% to +2% of optimum moisture content per ASTM D-1557) and compaction to a minimum of 95% of modified Proctor density (per ASTM D-1557).

Fill Material:

Engineered fill material for this project should meet the following gradation criteria:

<u>Sieve</u>	<u>% Passing</u>
4"	100
3/4"	70-100
#4	50-100
#200	50 max.

The plasticity index of the minus #40 sieve portion should not exceed fifteen (15). The near surface on-site soils encountered in the borings meet the above specifications. On-site soils, imported soils, or a resulting mix of imported soils and native soils should be tested for compliance with the above referenced recommendation prior to use as engineered fill for this project.

Compaction Requirements:

The maximum thickness of engineered fill lifts should be 10 inches or less in loose thickness. Engineered fill materials should be compacted to a minimum of 95% of modified Proctor density (ASTM D-1557) at a moisture content within -2% to +2% of optimum moisture (ASTM D-1557).

Foundations:

The addition and greenhouse structures can be supported by monolithic slabs with turn-down edges and isolated spread footing for columns (if applicable) bearing on engineered fill. Design recommendations for foundations are presented in the following table.

Element	Recommendation
Foundation	Monolithic Slabs with Turn-Down Edges and Spread Footings
Bearing Strata	Minimum thickness of 24 inches of engineered fill underlain by prepared native subgrade soils.
Allowable Bearing Pressure	2,000 psf
Minimum Foundation Dimensions	Columns: 30 inches in width Turn-Down Edges: 18 inches in width
Ultimate Coefficient of Sliding Friction	0.35
Minimum Foundation Embedment	Columns and Turn-Down Edges: 18 inches
Estimated Settlement	1 inch or less
Estimated Differential Settlement	1/2 inch or less

The design bearing pressure may be increased by one-third when considering total loads that include wind and seismic conditions.

The new foundation excavations should include removal and replacement of any loose backfill encountered adjacent to the existing foundations. However, when excavating adjacent to the existing foundations, the bottom of the existing foundation should not be undermined. The area of undermining can be defined as a 45-degree line extending down and away from the bottom of the footing. If excavations are required directly adjacent to the existing footings, underpinning of the existing footings (typically achieved with helical piers) or staged excavations may be required to reduce the potential for foundation movement. It is assumed that the existing building is supported by spread and continuous footings.

The minimum engineered fill thickness is recommended below bottom of all footings. The subgrade soils should be removed to the minimum depth and a minimum of 5 feet

horizontally beyond the edge of the slab foundations/footings (where applicable). The soils should be replaced with approved engineered fill.

Additional foundation settlements can occur if water from any source infiltrates the foundation soils. Proper drainage should be provided during construction and in the final design.

Drainage Recommendations:

All grades must provide effective drainage away from the structures during and after construction. In areas where sidewalks or paving (concrete or asphalt surfacing) do not immediately adjoin the structures, it is recommended that finished grade immediately surrounding the perimeter foundations (where applicable) be sloped away a minimum of 5% grade for a distance of ten (10) feet. Runoff water caused by precipitation should be rapidly concentrated and directed away from the structures. Downspouts or roof drains should discharge into splash blocks when the ground surface beneath such features is not protected by concrete flatwork or paving. Water cannot be allowed to pond within ten (10) feet of any structure wall. It is recommended that planters and grass lawns not be placed within 5 feet of perimeter foundation elements. Moisture infiltration may cause unsatisfactory foundation performance.

Seismic Site Classification:

The seismic site classification is based upon the soil profile in the upper 100 feet as defined by the weighted average of standard penetration blow-counts or shear wave velocity in accordance with Section 20.4 of the ASCE 7 and the International Building Code (IBC).

Based upon my field investigation, it is my opinion that the Seismic Site Classification is **D** ("**Stiff Soil**"). The maximum depth of the borings advanced at the site was 20 feet. Therefore, soil properties below the maximum boring depth to 100 feet were estimated based on my experience with the general area. Deeper borings or geophysical testing would be required to confirm the conditions below the current boring depth.

Testing and Inspection:

It is recommended that all site grading and fill operations be inspected by a geotechnical engineer. The inspecting engineer should be responsible for immediately reporting any site or soil conditions that vary significantly from this report.

The testing of materials should be made at the following:

Soils:

- 1) One (1) soil density every 2,500 feet of pad area but a minimum of two (2) per compacted lift of material (ASTM D-1556, ASTM D-2167, or ASTM D-2922, ASTM D-3017).
- 2) One (1) soil density every three (3) isolated spread footings per lift or every 100 lineal feet of prepared continuous footing trench per lift of compacted material (ASTM designations as above).
- 3) One (1) sieve analysis and plasticity index per material used according to ASTM D-422 and ASTM D-4318.
- 4) One (1) proctor per each type of material used according to ASTM D-1557.

Concrete:

- 1) One (1) set of concrete cylinders with field testing per 50 cubic yards or day's placement if less than 50 yards, to include: sampling, temperature, slump test, air entrainment test, preparation of 4 cylinders, retrieving cylinders, lab curing and breaking and reporting the cylinders 1@7 days and 2 @ 28 days and 1@56 days (if needed) (ASTM C-31, 39, 172 and 1064)

Report Limitations:

The conclusions, recommendations and opinions presented herein are:

- 1) Based upon evaluation and interpretation of the findings of the field and laboratory program. It is recommended that I be contacted if the actual structural loading information becomes available and is significantly different from my estimates. A reevaluation of my recommendations may be required for this report.
- 2) Based upon an interpolation of soil conditions between and beyond the explorations.
- 3) Subject to confirmation of the conditions encountered during construction.
- 4) Based upon the assumption that sufficient observation and testing will be provided during construction.

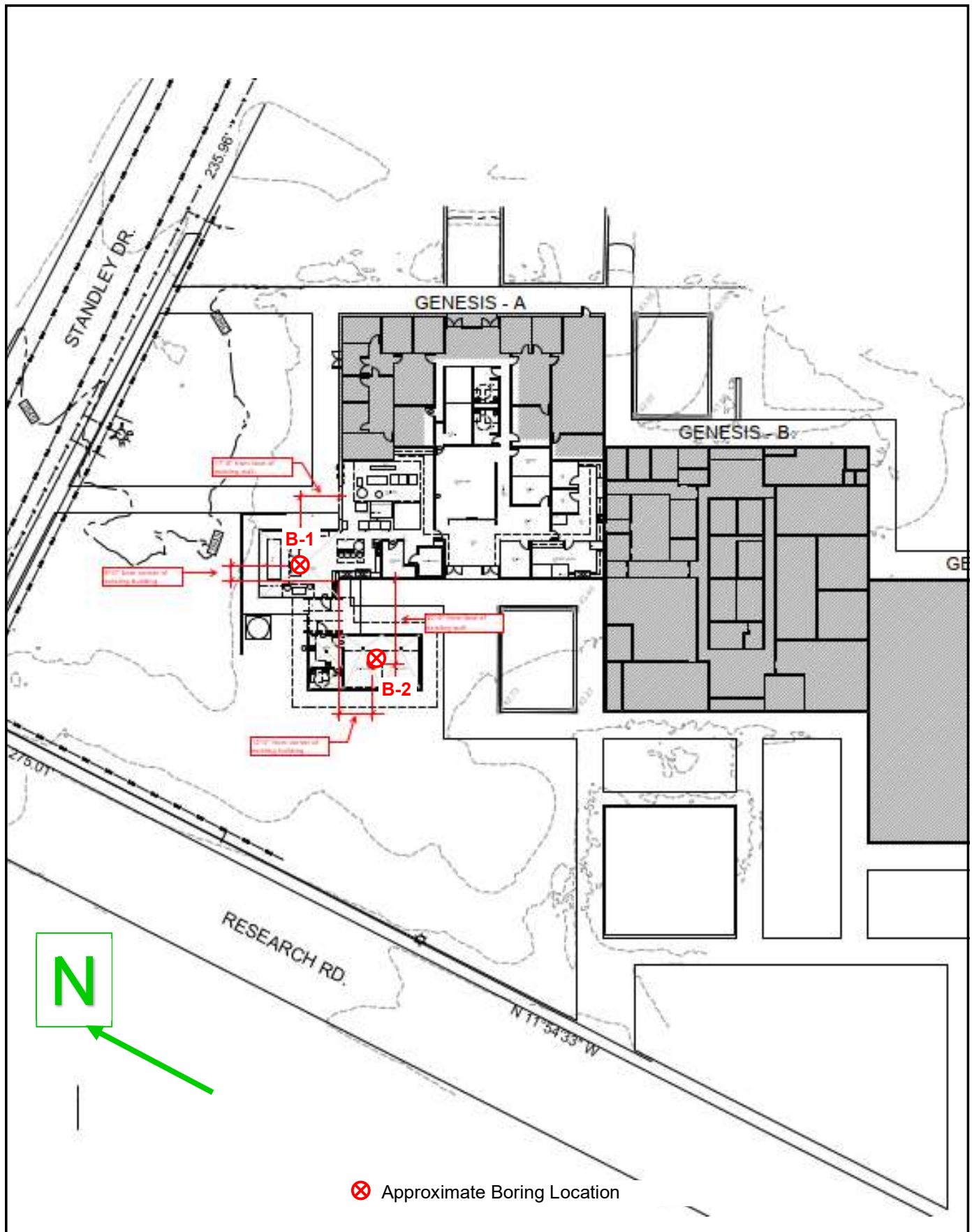
There is no other warranty, either express or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as he

NMSU Genesis Building A Addition

March 26, 2026

COZ Report No. 4226031

deems necessary to satisfy himself as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions are encountered during construction that appear to differ from those indicated in this report, I should be notified immediately.



Project Manager: DC	Project No. 4226031	COZ Engineering, LLC PO Box 13331 Las Cruces, NM 88013	BORING LOCATION PLAN	Exhibit
Drawn by: DC	Scale: AS SHOWN		NMSU Genesis Building A Addition 3655 A Research Drive Las Cruces, NM	1
Checked by: DC	File Name: Figures			
Approved by: DC	Date: 3-23-26			

Project: **NMSU Genesis Building A Addition**
 Project Location: **3655 A Research Drive, Las Cruces, NM**
 Project Number: **4226031**

Log of Boring B-1
Sheet 1 of 1

Date(s) Drilled 3-12-26	Logged By RC	Checked By COZ
Drilling Method hollow-stem auger	Drill Bit Size/Type	Total Depth of Borehole 21.5 feet bgs
Drill Rig Type CME-75	Drilling Contractor Southlands	Approximate Surface Elevation
Groundwater Level and Date Measured not encountered	Sampling Method(s) SPT	Hammer Data
Borehole Backfill cuttings	Location see boring plan	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Percent Fines	LL, %	PI, %
0	0				SP		POORLY GRADED SAND WITH GRAVEL: brown, dry, loose				
1	1										
2	2										
3	3		1	2\3\4				3.1	3.3		NP
4	4										
5	5		2	12\9\16			medium dense				
6	6										
7	7										
8	8										
9	9										
10	10		3	12\14\11				2.8	3.6		NP
11	11										
12	12										
13	13										
14	14										
15	15		4	7\3\3	ML		SANDY SILT: brown, moist, medium stiff				
16	16										
17	17										
18	18										
19	19										
20	20		5	3\9\16	SP		POORLY GRADED SAND WITH GRAVEL: brown, dry, medium dense				
21	21										
22	22						Bottom of Boring				
23	23										
24	24										
25	25										

Project: **NMSU Genesis Building A Addition**
 Project Location: **3655 A Research Drive, Las Cruces, NM**
 Project Number: **4226031**

Log of Boring B-2
Sheet 1 of 1

Date(s) Drilled 3-12-26	Logged By RC	Checked By COZ
Drilling Method hollow-stem auger	Drill Bit Size/Type	Total Depth of Borehole 21.5 feet bgs
Drill Rig Type CME-75	Drilling Contractor Southlands	Approximate Surface Elevation
Groundwater Level and Date Measured not encountered	Sampling Method(s) SPT	Hammer Data
Borehole Backfill cuttings	Location see boring plan	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Percent Fines	LL, %	PI, %
0	0				SP-SM		POORLY GRADED SAND WITH SILT: brown, dry, loose, trace gravel				
1	1										
2	2										
3	3	1	3/3/5					3.8	10.7		NP
4	4										
5	5	2	4/2/2								
6	6										
7	7										
8	8										
9	9										
10	10	3	4/4/4		SP-SM		POORLY GRADED SAND WITH SILT AND GRAVEL: brown, dry, loose				
11	11										
12	12										
13	13										
14	14										
15	15	4	7/9/6				medium dense	1.8	6.2		NP
16	16										
17	17										
18	18										
19	19										
20	20	5	5/5/7								
21	21										
22	22						Bottom of Boring				
23	23										
24	24										
25	25										

Project: **NMSU Genesis Building A Addition**
 Project Location: **3655 A Research Drive, Las Cruces, NM**
 Project Number: **4226031**

Key to Log of Boring Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Percent Fines	LL, %	PI, %
1	2	3	4	5	6	7	8	9	10	11	12

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet). 2 Depth (feet): Depth in feet below the ground surface. 3 Sample Type: Type of soil sample collected at the depth interval shown. 4 Sample Number: Sample identification number. 5 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log. 6 Material Type: Type of material encountered. 7 Graphic Log: Graphic depiction of the subsurface material encountered. 8 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.	9 Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample. 10 Percent Fines: The percent fines (soil passing the No. 200 Sieve) in the sample. WA indicates a Wash Sieve, SA indicates a Sieve Analysis. 11 LL, %: Liquid Limit, expressed as a water content. 12 PI, %: Plasticity Index, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
 COMP: Compaction test
 CONS: One-dimensional consolidation test
 LL: Liquid Limit, percent

PI: Plasticity Index, percent
 SA: Sieve analysis (percent passing No. 200 Sieve)
 UC: Unconfined compressive strength test, Qu, in ksf
 WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

 SILT, SILT w/SAND, SANDY SILT (ML)

 Poorly graded SAND (SP)

 Poorly graded SAND with Silt (SP-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

 Auger sampler	 CME Sampler
 Bulk Sample	 Grab Sample
 3-inch-OD California w/ brass rings	 2.5-inch-OD Modified California w/ brass liners

 Pitcher Sample
 2-inch-OD unlined split spoon (SPT)
 Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

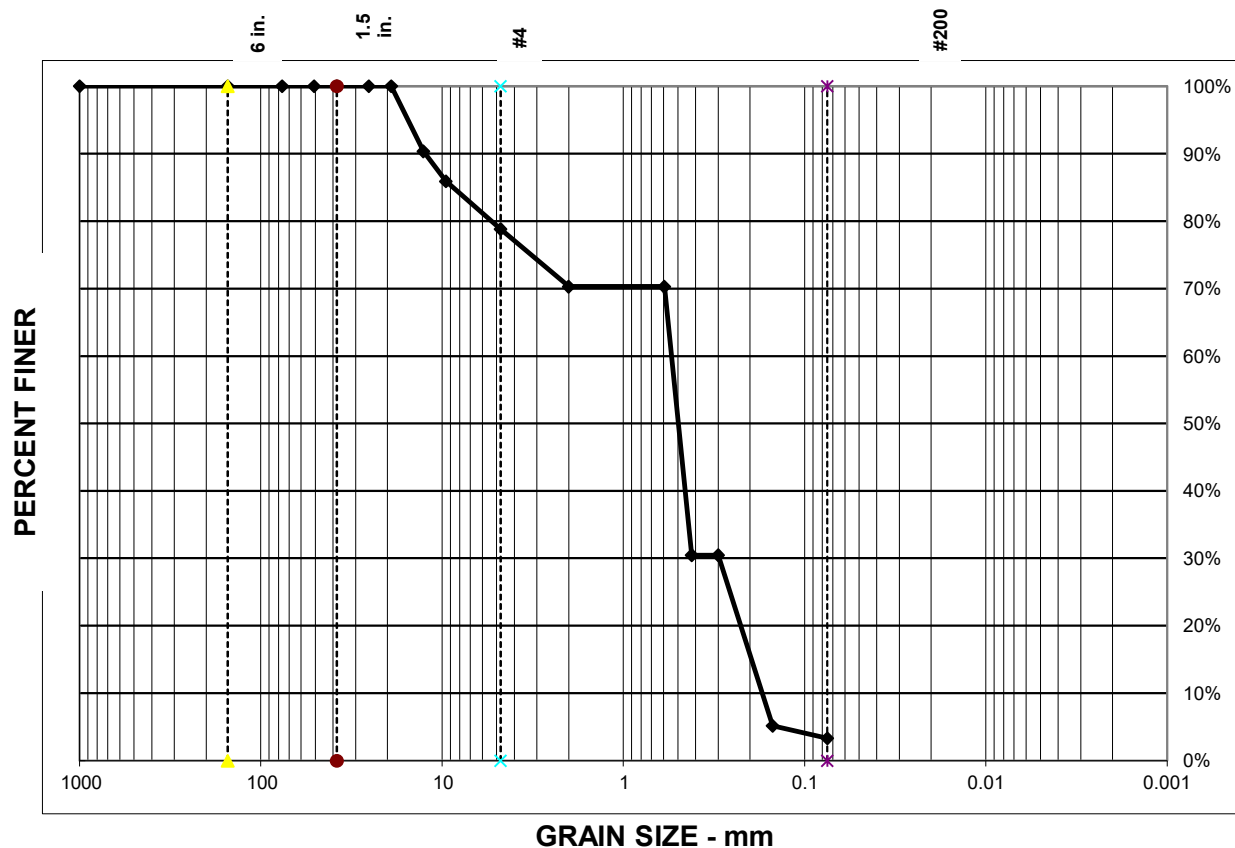
	Water level (at time of drilling, ATD)
	Water level (after waiting)
	Minor change in material properties within a stratum
	Inferred/gradational contact between strata
	Queried contact between strata

GENERAL NOTES

- Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
- Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Figure B-1

GRAIN SIZE DISTRIBUTION GRAPH



TEST SUMMARY (ASTM C136)

Sieve Size	1 1/2"	3/4"	3/8"	#4	#10	#40	#100	#200
% Passing (Cumulative)	100%	100%	86%	79%	70%	30%	5%	3.3%
Specification								

% GRAVEL =	21%	D ₈₅ = 8.7	D ₁₅ = 0.2
% SAND =	75%	D ₆₀ = 0.5	D ₁₀ = 0.2
% SILT & CLAY =	3%	D ₅₀ = 0.5	C _u = 3.2
		D ₃₀ = 0.3	C _c = 0.9

Sample Date: 3/12/26

Project No.: 4226031

Project Name: NMSU Genesis Building A Addition

Report Date: 3/26/26

Sample Location: B-1 at 2.5'

Liquid Limit: Plasticity Index: NP

USCS Classification: SP

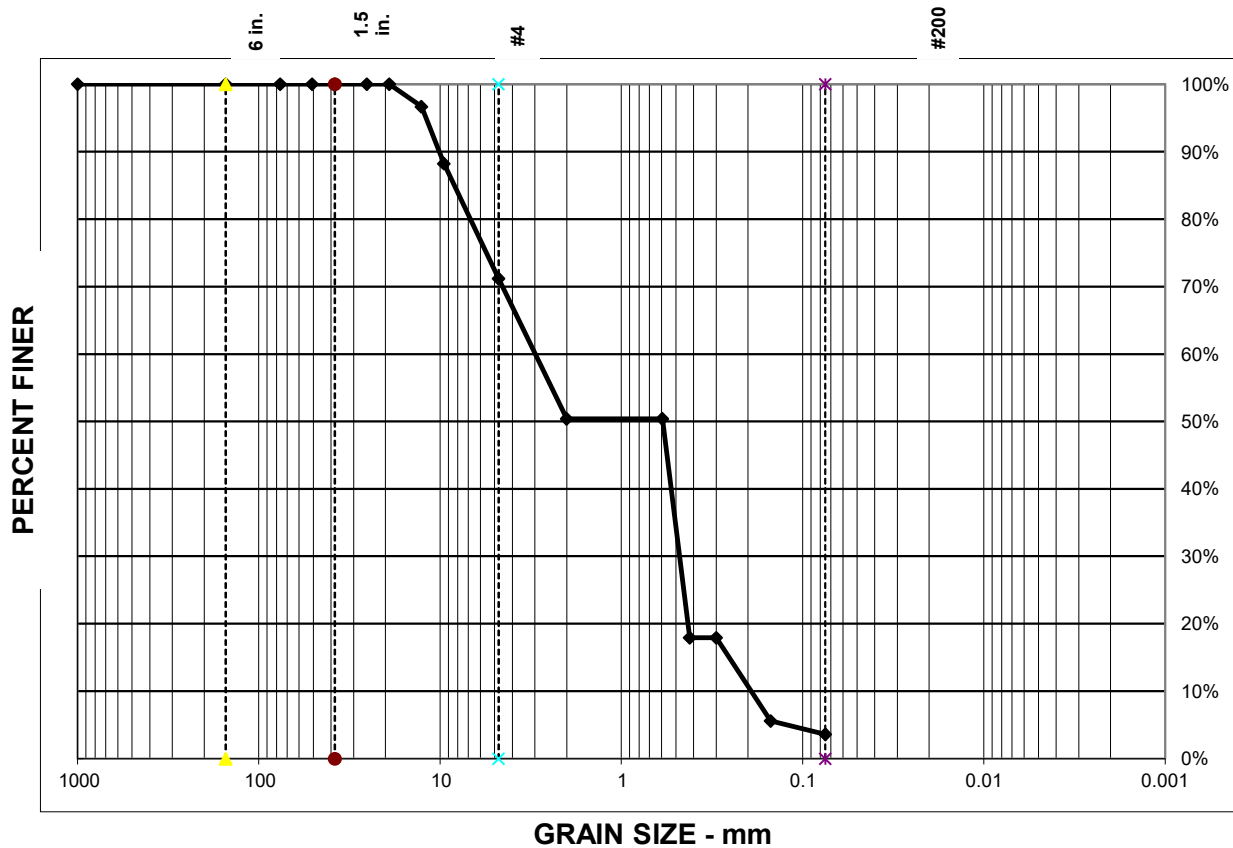
Material Description: Poorly Graded Sand with Gravel

In-Situ Moisture Content: 3.1%

COZ Engineering, LLC

PO Box 13331
Las Cruces, NM 88013
(575) 642-7671

GRAIN SIZE DISTRIBUTION GRAPH



TEST SUMMARY (ASTM C136)

Sieve Size	1 1/2"	3/4"	3/8"	#4	#10	#40	#100	#200
% Passing (Cumulative)	100%	100%	88%	71%	50%	18%	6%	3.6%
Specification								

% GRAVEL =	29%	D ₈₅ = 8.3	D ₁₅ = 0.3
% SAND =	68%	D ₆₀ = 3.0	D ₁₀ = 0.2
% SILT & CLAY =	4%	D ₅₀ = 0.6	C _u = 15.5
		D ₃₀ = 0.5	C _c = 0.4

Sample Date: 3/12/26

Project No.: 4226031

Project Name: NMSU Genesis Building A Addition

Report Date: 3/26/26

Sample Location: B-1 at 10'

Liquid Limit: Plasticity Index: NP

USCS Classification: SP

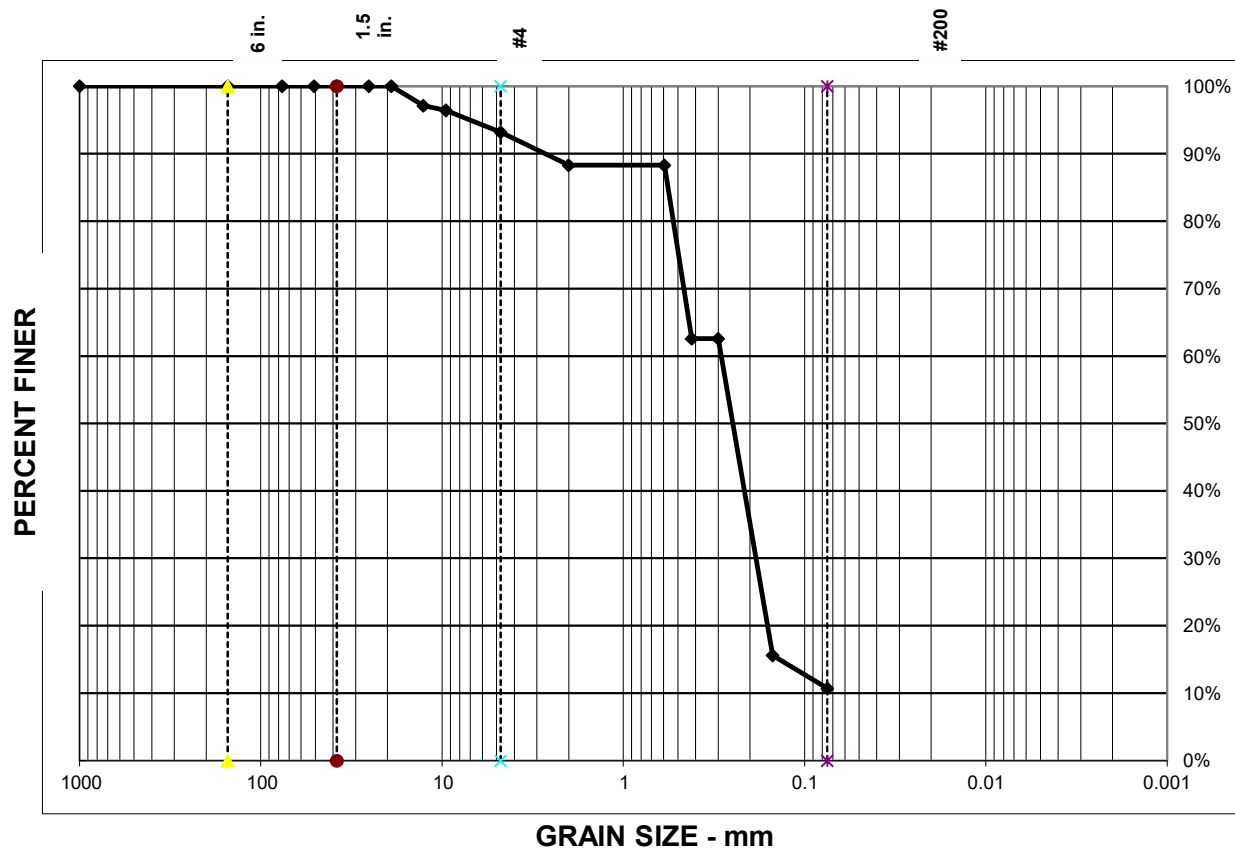
Material Description: Poorly Graded Sand with Gravel

In-Situ Moisture Content: 2.8%

COZ Engineering, LLC

PO Box 13331
Las Cruces, NM 88013
(575) 642-7671

GRAIN SIZE DISTRIBUTION GRAPH



TEST SUMMARY (ASTM C136)

Sieve Size	1 1/2"	3/4"	3/8"	#4	#10	#40	#100	#200
% Passing (Cumulative)	100%	100%	96%	93%	88%	63%	16%	10.7%
Specification								

% GRAVEL =	7%	$D_{85} = 0.6$	$D_{15} = 0.1$
% SAND =	82%	$D_{60} = 0.3$	$D_{10} =$
% SILT & CLAY =	11%	$D_{50} = 0.2$	$C_U =$
		$D_{30} = 0.2$	$C_c =$

Sample Date: 3/12/26

Project No.: 4226031

Project Name: NMSU Genesis Building A Addition

Report Date: 3/26/26

Sample Location: B-2 at 2.5'

Liquid Limit: Plasticity Index: NP

USCS Classification: SP-SM

Material Description: Poorly Graded Sand with Silt

In-Situ Moisture Content: 3.8%

COZ Engineering, LLC

PO Box 13331
Las Cruces, NM 88013
(575) 642-7671

GRAIN SIZE DISTRIBUTION GRAPH

