Poettker Construction

PARKWAY SCHOOL DISTRICT

WEST MIDDLE SCHOOL

BUILDING RENOVATION AND ABATEMENT

VOLUME FOUR: TECHNICAL

ISSUE FOR PERMIT/BID
PROJECT MANUAL
05 NOVEMBER 2026

PARKWAY SCHOOLS

BID NUMBER: 27-60

Owner's Project Number: PN432502B
Architect's Project Number: 26021

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SECTION 024100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of building elements for alteration purposes excluding removal of hazardous materials and toxic substances.

1.02 RELATED REQUIREMENTS

A. Section 003100 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.

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

C. Section 011000 - Summary: Sequencing and staging requirements.

D. Section 011000 - Summary: Description of items to be removed by Owner.

E. Section 011000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

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

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

H. 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.

I. Section 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

J. Section 311000 - Site Clearing: Vegetation and existing debris removal; earth stripping and stockpiling.

1.03 REFERENCE STANDARDS

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

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

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with requirements in Section 017000.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Use of explosives is not permitted.
   3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   4. Provide, erect, and maintain temporary barriers and security devices.
   5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.

7. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
8. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

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

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

E. Do not begin removal until vegetation to be relocated has been removed and vegetation to remain has been protected from damage.

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

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

H. Provide and maintain daily the effectiveness of dust control walls and required asset protection.

I. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Comply with requirements of Section 017419 - Construction Waste Management and Disposal.
2. Dismantle existing construction and separate materials.
3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

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

3.02 EXISTING UTILITIES

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

B. Protect existing utilities to remain from damage.

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

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

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

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

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

3.03 SELECTIVE DEMOLITION FOR ALTERATIONS

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

B. Separate areas in which demolition is being conducted from areas that remain occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.

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

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

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

F. Protect items to be salvaged by the Owner or reused in the Work by the Contractor.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site daily as it accumulates. Do not use the Owner's dumpsters.

B. Remove materials not to be reused on site; comply with requirements of Section 017419 - Waste Management.

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

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

END OF SECTION

SECTION 028410
HAZARDOUS WASTE MANAGEMENT

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Section 014113 - Asbestos Abatement Codes, Regulations, and Standards - Asbestos Abatement describes federal, state and local regulations applicable to asbestos.

B. Section 028233 - Disposal of Asbestos Containing Waste Materials describes the handling and disposal of asbestos-containing waste.

1.02 DESCRIPTION OF THE WORK:

A. This section describes the segregation, packaging, labeling, transport, and disposal of non-asbestos containing hazardous waste materials generated by demolition activities and the subsequent shipment of properly packaged and labeled waste materials to an approved disposal site.

1.03 CODES AND REGULATIONS

A. General Applicability of Codes and Regulations: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable codes and regulations have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the Contract Documents, or as if published copies are bound herewith.

B. Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all applicable Federal, State, and local regulations pertaining to hazardous waste management and disposal. Hold the Owner and Designer harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of the Contractor, the Contractor's employees, or Subcontractors.

C. Federal Requirements: which govern the management, hauling and disposal of hazardous waste include but are not limited to the following:
   1. DOT: U. S. Department of Transportation, including but not limited to:
      a. Hazardous Substances
         1) Title 49, Part 171 and 172 of the Code of Federal Regulations
      b. Hazardous Material Regulations
         1) General Awareness and Training Requirements for Handlers, Loaders and Drivers
         2) Title 49, Parts 171-180 of the Code of Federal Regulations
      c. Hazardous Material Regulations
         1) Editorial and Technical Revisions
         2) Title 49, Parts 171-180 of the Code of Federal Regulations
   2. EPA: U. S. Environmental Protection Agency (EPA), including but not limited to:
      a. Management of Hazardous Wastes Resource Conservation and Recovery Act (RCRA)
         1) Title 40, Parts 260- 268 of the Code of Federal Regulations

D. State Requirements: Abide by all state requirements which govern the management, hauling and disposal of hazardous waste.

E. Local Requirements: Abide by all local requirements which govern the management, hauling and disposal of hazardous waste.

1.04 DEFINITIONS:

A. Toxicity Characteristic Leaching Procedure (TCLP): A laboratory test method to determine the mobility of both organic and inorganic analytes present in liquid, solid, and multiphasic wastes performed in accordance with test methods required under 40 CFR Part 268.

1.05 SUBMITTALS:

A. Before Start of Work: Submit the following to the Owner for review. Do not start work until these submittals are returned with Owner's action stamp indicating that the submittal is returned for unrestricted use.
   1. Copy of state and local licenses for waste hauler.
   2. U.S. EPA Identification Number of waste hauler.
   3. Name and address of waste disposal facility where hazardous waste materials are to be disposed including:
      a. Contact person and telephone number.
      b. Copy of state license and permit.
      c. Disposal facility permits:
   4. Specimen copy of Uniform Hazardous Waste Manifest form.
   5. Copy of EPA Notice of Hazardous Waste activity form
   6. Copy of forms requires by state and local agencies
   7. Sample of disposal label to be used.

B. During Work: Submit the following as required by the work:
   1. TCLP test results, as required to characterize waste for segregation and packaging purposes.
   2. Submit copies of all executed manifests and disposal site receipts to the Owner and/or Owner's Environmental Consultant.

PART 2 - PRODUCTS:

2.01 MATERIALS

A. Disposal Bags: Provide 6 mil thick leak-tight polyethylene bags.

B. DOT Hazardous Waste Disposal Drums: Provide DOT 17-H Open -Top Drums (55 gallon) in accordance with DOT regulations title 49 CFR Parts 173, 178, and 179.

C. DOT Hazardous Waste Labels: in accordance with DOT regulations Title 49 CFR parts 173, 178, and 179.

D. The Owner will provide boxes, drums, etc. for the proper handling, transport and disposal of these items.

PART 3 - EXECUTION

3.01 GENERAL

A. Do not mix potentially hazardous waste streams. Where feasible, separate each type of hazardous waste from other types of hazardous wastes, from asbestos waste and from construction waste.

B. Segregate, package, label, transport and dispose of Hazardous Waste in accordance with DOT, EPA, State and Local regulations.

3.02 HAZARDOUS WASTE DESIGNATION

A. Where not otherwise designated by the Owner as Hazardous waste, characterize all suspect waste products by conducting representative TCLP testing.

B. Testing of components by use of TCLP will be completed by Owner's Environmental Consultant prior to initiating this project.
   1. A schedule of materials that must be managed as hazardous waste will be coordinated during the pre-construction meeting.

C. Representative sampling of waste products will be in accordance with EPA Document SW 846.

D. TCLP test analysis will be performed in accordance with EPA Method 1311.

3.03 HAZARDOUS WASTE:

A. The following waste products are designated by the Owner as non-salvageable and as Hazardous Waste Types:

1. Waste Type A: PCB waste.
    a. PCB-containing ballasts from fluorescent light fixtures.
2. Waste Type B: Mercury-containing waste.
    a. Individually bagged mercury-containing thermostats.
    b. Fluorescent, and mercury-vapor lamps.

3.04 HAZARDOUS WASTE PACKAGING AND LABELING:

A. Package each segregated hazardous waste Type A and B in specified containers as follows (Important: Do Not mix waste streams):
    1. Waste Type A - Packaging to be provided by Owner
        a. Package in DOT 17-H Open-Top Drums
        b. Fill to capacity only with Waste Type A (Do Not Mix Waste Stream types).
        c. Install gasket on lid, apply lock ring, and seal.
        d. Apply Hazardous Waste Label to drum side.
        e. Enter DOT Shipping Data as follows: RQ Waste Polychlorinated Biphenols, 9, UN-2315, PG-II, (M001).
        f. Adjacent to each label, enter the date indicating when waste was first placed in each drum.
    2. Waste Type B - Packaging to be provided by Owner
        a. Package in DOT 17-H Open-Top Drums with Polyethylene disposal Bag liners
        b. Fill liner bags only with Waste Type B (Do Not Mix Waste Stream types); then neck liner bags down into DOT 17-H Open-Top Drum and seal with duct tape.
        c. Install gasket on lid, apply lock ring, and seal.
        d. Apply Hazardous Waste Label to drum side.
        e. Enter DOT Shipping Data as follows: RQ Hazardous Waste Solid, NOS, 9, NA3077, PG-III, (D009).
        f. Adjacent to each label, enter the date indicating when waste was first placed in each drum.

B. Sealed and Labeled Containers: maintain all containers in a continuously sealed condition after they have been sealed.
    1. Do not reopen sealed containers.
    2. Do not place additional waste in sealed containers.

3.05 TEMPORARY STORAGE:

A. Partially filled containers of hazardous waste may be stored at the work site for intermittent packaging provided that:
    1. Each container is properly labeled when it is first placed in service;
    2. Each container remains closed at all times except when compatible waste types are added; and
    3. When moved from site to site, each container remains within the geographic boundaries of the facility without moving nor crossing public access highways.

3.06 REMOVAL OF HAZARDOUS WASTES:

A. Remove containers of hazardous waste from the work site within seventy-two (72) hours of being filled.
    1. Transporting filled containers from the work site to an approved disposal site or recycling center. Coordinate with Owner prior to transportation to determine the destiny of the wastes.
    2. Continuously maintain custody of all hazardous material generated at the work site including security, short-term storage, transportation and disposition until custody is transferred to an approved disposal site or recycling center. Document continuous chain-of custody.
    3. Do not remove, or cause to be removed, hazardous waste from Owner’s property without a legally executed Uniform Hazardous Waste manifest, which will be provided by the Owner.

4. At completion of hauling and disposal of each load, submit copy of waste manifest, chain of custody form, and landfill receipt to Owner.

3.07 RECYCLING AND RECOVERY:

A. Turn over waste which contains materials for which recovery and/or recycling is possible to an approved recycling center. Materials subject to recycling include:
   1. Fluorescent light tubes.
   2. Thermostats with mercury switches.
   3. Lead acid batteries
   4. Combustible lead-based painted building components and lead-based paint chips.

3.08 BACKCHARGES:

A. Where Contractor fails to fulfill packaging, handling, transport or disposal requirements as outlined herein, Owner may charge back to the Contractor all costs associated with insuring that hazardous wastes are segregated, packaged, transported and disposed of in accordance with all applicable Federal and State regulations.

B. Environmental pollution of Owner's property or other environments resulting from Contractor's hazardous waste management activities may be promptly remediated under Owner's direction, to the Owner's sole satisfaction, and at the Contractor's sole expense.

C. Contractor agrees to either reimburse the Owner or reduce the Contract amount by change order to cover all costs associated with waste re-packaging, waste re-segregation, or pollution remediation efforts.

3.09 REMOVAL OF NON-HAZARDOUS WASTE MATERIALS:

A. Transport and legally dispose of non-hazardous waste products, materials, residues and refuse at a location not on Owner's property.

B. Non-hazardous waste products, materials, residues and refuse include, but are not necessarily limited to:
   1. Materials which are determined to be non-hazardous wastes through objective sampling in accordance with EPA Document SW-846 and laboratory analysis in accordance with EPA Method 1311.
   2. Personnel protective clothing and safety equipment with de minimis or trace contamination, as determined by visual inspection by Owner's Environmental Consultant.

C. Keep premises in a clean and orderly condition during performance of abatement work.

D. Place non-hazardous construction debris wastes on a daily basis in secure containers for local landfill disposal.

END OF SECTION

SECTION 030100
MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cleaning of existing concrete surfaces.

B. Repair of exposed structural, shrinkage, and settlement cracks.

C. Repair of deteriorated concrete.

D. Scope of Work: As indicated on drawings.

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 REFERENCE STANDARDS

A. ASTM C33/C33M - Standard Specification for Concrete Aggregates.

B. ASTM C150/C150M - Standard Specification for Portland Cement.

C. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.

1.04 SUBMITTALS

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

B. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.

C. Project Record Documents: Accurately record actual locations of structural reinforcement repairs and type of repair.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Cleaner Qualifications: Company specializing in, and with minimum of 3 years of experience in, the type of cleaning specified.

C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum of 3 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

A. Degreaser:
   1. Manufacturers:
      a. LATICRETE International, Inc; CITREX: www.laticrete.com/#sle.
      b. SpecChem, LLC; Orange Peel-Citrus Cleaner: www.specchemllc.com/#sle.
      c. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

B. Detergent: Non-ionic detergent.

2.02 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

A. Finish: Repairs, cleanings, etc. materials shall be reviewed for the need for finish. Finish of new or repaired work shall match the color of adjoining concrete.

B. Manufacturers:
   1. Adhesives Technology Corporation: www.atcepoxy.com/#sle.
   2. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
   3. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
   4. Kaufman Products Inc: www.kaufmanproducts.net/#sle.
   5. The QUIKRETE Companies: www.quikrete.com/#sle.
   6. SpecChem, LLC: www.specchemllc.com/#sle.
   7. Stauf USA LLC: www.staufusa.com/#sle.
   8. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
   9. Substitutions: See Section 016000 - Product Requirements.

2.03 EPOXY PATCHING AND REPAIR MATERIALS

A. Manufacturers:
   1. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
   2. Kaufman Products Inc.: www.kaufmanproducts.net/#sle.
   3. SpecChem, LLC: www.specchemllc.com/#sle.
   4. Sto Corp: www.stocorp.com/#sle.
   5. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Epoxy Injection Adhesive:
   1. Manufacturers:
      a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
      b. Kaufman Products Inc; SurePoxy HM, SurePoxy HMLV, SurePoxy HMLV Class B, or SurePoxy HMSLV: www.kaufmanproducts.net/#sle.
      c. SpecChem, LLC; SpecPoxy 1000; www.specchemllc.com/#sle.
      d. W. R. Meadows, Inc; Rezi-Weld LV, Rezi-Weld LV State, Rezi-Weld (IP), or Rezi-Weld Gel Paste: www.wrmeadows.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

A. Anchoring Adhesive: Self-leveling or non-sag as applicable.

B. Portland Cement: ASTM C150/C150M, Type I, grey.

C. Sand: ASTM C33/C33M or ASTM C404; uniformly graded, clean.

D. Water: Clean and potable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means acceptance of substrate.

3.02 CLEANING EXISTING CONCRETE

A. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
   1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
   2. Clean out cracks and voids using same methods.

B. The following are acceptable cleaning methods, in order from gentlest to less gentle:
   1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.
   2. Increasing the water washing pressure to maximum of 400 psi.
   3. Adding detergent to washing water; with final water rinse to remove residual detergent.
   4. Steam-generated low-pressure hot-water washing.

3.03 CRACK REPAIR USING EPOXY ADHESIVE INJECTION

A. Repair exposed cracks.

B. Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than the depth of the crack to be filled or port size diameter no greater than the thickness of the crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.

C. Inject adhesive into ports under pressure using equipment appropriate for particular application.

D. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.

E. Remove temporary seal and excess adhesive.

F. Clean surfaces adjacent to repair and blend finish.

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 042000 - Unit Masonry: Installation of mortar and grout.

1.03 REFERENCE STANDARDS

A. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

B. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

C. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.

D. ASTM C476 - Standard Specification for Grout for Masonry.

E. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

F. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.

G. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry.

H. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength.

I. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

J. ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry.

K. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

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.

C. Samples: Submit two samples of mortar, illustrating mortar color and color range. Matching existing adjoining construction is the goal. Resubmit as directed to achieve this goal.

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

1.05 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
   1. Maintain one copy of each document on project site.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.

B. Grout Aggregate: ASTM C404.

C. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): To match Architect's sample(s) when incorporated into specified mix design(s).
   2. Manufacturers:
      a. Davis Colors: www.daviscolors.com.
      b. Lambert Corporation: www.lambertusa.com.
      c. Substitutions: See Section 016000 - Product Requirements.

D. Water: Clean and potable.

2.02 MORTAR MIXING

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

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

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

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

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

2.03 GROUT MIXING

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

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

C. Do not use anti-freeze compounds to lower the freezing point of grout.

2.04 PRECONSTRUCTION TESTING

A. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

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

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

3.03 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.
   2. Limit height of masonry to 16 inches 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. Brick: Limit pours to maximum 12 feet in height and 25 feet horizontally.
3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
4. Place grout for spanning elements in single, continuous pour.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field tests, in accordance with provisions of Section 014000 - Quality Requirements.

B. Test and evaluate mortar in accordance with ASTM C780 procedures.
   1. Test with same frequency as specified for masonry units.

C. Test and evaluate grout in accordance with ASTM C1019 procedures.
   1. Test with same frequency as specified for masonry units.

D. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314, and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results as specified in individual masonry sections.

END OF SECTION

SECTION 042000
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Concrete building brick.

C. Clay Facing Brick.

D. Mortar and Grout.

1.02 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).

B. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.04 SUBMITTALS

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

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and masonry accessories.

C. Samples: Submit four samples of facing brick, ceramic glazed facing brick, and ceramic glazed structural clay facing tile units to illustrate size, color, texture, and extremes of color range.

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

1.05 QUALITY ASSURANCE

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

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

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

1.06 DELIVERY, STORAGE, AND HANDLING

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 and nominal depths as indicated on drawings for specific locations.

2.02 BRICK UNITS

A. Manufacturers:
   1. Acme Brick; : www.acme.com
   2. General Shale Brick: www.generalshale.com.
   3. Midwest Block and Brick; www.midwestblock.com.
   4. Missouri Brick; www.missouribrickco.com
   5. Richards Brick; www.richardsbrick.com
   6. Substitutions: See section 016000 - Product Requirements.

B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.

1. Color and texture to match Architect's sample.
2. Nominal size: As indicated on drawings.
3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.03 MORTAR AND GROUT MATERIALS

PART 3 EXECUTION

3.01 EXAMINATION

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

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

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

3.02 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 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.
   3. Mortar Joints: Concave.

D. Brick Units:
   1. Bond: Running.
   2. Coursing: Three units and three mortar joints to equal 8 inches.
   3. Mortar Joints: Concave.

3.04 PLACING AND BONDING

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

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

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

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

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

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

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

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

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

3.05 GROUTED COMPONENTS

A. Reinforce bond beams with 2, No. 3 bars, 1 inch from bottom web.

B. Lap splices minimum 24 bar diameters.

C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.06 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

3.07 BUILT-IN WORK

A. As work progresses, install built-in metal door frames, glazed frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, and plates and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Do not build into masonry construction organic materials that are subject to deterioration.

3.08 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.09 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.10 FIELD QUALITY CONTROL

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

3.11 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.12 PROTECTION

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

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof-mounted curbs.

B. Roofing nailers.

C. Preservative treated wood materials.

1.02 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. AWPA U1 - Use Category System: User Specification for Treated Wood.

1.03 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.

C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

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

1.05 WARRANTY

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

1.06 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

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

B. Moisture Content: S-dry or MC19.

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

1.07 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.

1.08 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber in contact with roofing, flashing, or waterproofing.

PART 3 EXECUTION

2.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

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

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

2.02 BLOCKING, NAILERS, AND SUPPORTS

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

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.

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

D. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Wall paneling and trim.
   8. Joints of rigid wall coverings that occur between studs.
   9. Fire Extinguishers.
   10. Fire hose cabinets

2.03 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 each roof opening except where specifically indicated otherwise; form corners by alternating lapping side members.

C. Provide separation and no direct contact of aluminum flashings and preservative pressure treated roof blocking to avoid potential corrosion using roofing membrane or roofing felts.

2.04 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

2.05 CLEANING

A. Waste Disposal: See Section 017419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

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

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

END OF SECTION

SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at over roof deck and exterior wall behind wall finish.

1.02 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies.

1.03 SUBMITTALS

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

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

C. Test Reports: For insulation products, provide independent laboratory reports and test results showing negative asbestos containing materials content using Polarized Light Microscopy (PLM) test method.

1.04 QUALITY ASSURANCE

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 on Inside of Concrete and Masonry Exterior Walls: Extruded polystyrene (XPS) board.

2.02 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Comply 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: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.

2.03 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

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.

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 EXTERIOR WALLS

A. Adhere 6 inches wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.

B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
   2. Full bed 1/8 inch thick.

C. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inches wide sealant tape; comply with ASTM E2357.

D. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and protrusions.

E. Extend boards over expansion joints, unbonded to wall on one side of joint.

F. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

G. Place 6 inches wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.

H. Tape insulation board joints.

3.03 BATT INSTALLATION

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

B. Install in exterior wall, roof, and ceiling 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.

END OF SECTION

SECTION 075200
MODIFIED BITUMINOUS MEMBANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Modified bituminous roofing membrane, conventional application.

B. Insulation, flat and tapered.

C. Venting base sheet.

D. Vapor retarders.

E. Cover board.

F. Wood blocking and framing.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood nailers and curbs.

1.03 REFERENCE STANDARDS

A. ANSI/SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low-Slope Roofing Systems;

B. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board.

C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

E. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

F. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement.

H. ASTM D4897/D4897M - Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing.

I. ASTM D6222/D6222M - Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

J. ASTM D6223/D6223M - Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.

K. NRCA (RM) - The NRCA Roofing Manual.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of associated flashings and counterflashings installed by other sections.

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

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's catalog data for membrane and bitumen materials, base flashing materials, insulation, and surfacing.

C. Shop Drawings: Indicate base flashing details, base flashing details, base flashing details, base flashing details, and base flashing details.

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

E. Manufacturer's Field Reports: Indicate procedures followed.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with NRCA ML104 and manufacturer's instructions.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact unless otherwise indicated.

B. Store products in weather protected environment, clear of ground and moisture.

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

D. Stand roll materials on end with selvage edges up.

E. Protect metal flashing and counter-flashings from damage.

F. Do not stockpile materials on roof without first obtaining permission from Owner.

G. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS

A. Do not apply roofing membrane when environmental conditions are outside the ranges recommended by manufacturer.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is below 40 degrees F.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY

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

B. Provide 20-year manufacturer's material and labor warranty to cover failure to prevent penetration of water.

C. Scope of Coverage: Repair any leak in the modified bitumen roofing system caused by the ordinary wear of the elements, manufacturing defect in materials, and the workmanship used to install these materials:
   1. Membranes and Sheets.
   2. Insulation.
   3. Flashings.
   4. Fasteners.
   5. Adhesives.
   6. Metal Edges and Coping.
   7. Accessories.

D. Limit of Liability: No dollar limitation.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Description: APP modified bitumen membrane roofing installed over existing concrete deck.
   1. Cap Sheet.
   2. Base Ply.
   3. Cover Board.
   4. Insulation.

B. Description: APP modified bitumen membrane roofing installed over lightweight concrete deck.
   1. Cap Sheet
   2. Base Ply.
   3. Cover Board.
   4. Insulation.
   5. Venting Base Sheet.

2.02 MANUFACTURERS

A. Modified Bituminous Membrane Roofing:
   1. Elevate Building Products Company: www.holcimelevate.com.
   2. US Ply, Inc.: www.usply.com.
   3. Johns Manville: www.jm.com
   4. Substitutions: Not permitted.

B. Insulation:
   1. Atlas Roofing Corporation: www.atlasroofing.com.
   2. GAF: www.gaf.com/sle.
   3. Elevate Building Products Co.: www.holkimelevate.com.
   4. Johns Manville: www.jm.com
      a. Perimeter Uplift Pressure: 105 pounds/square foot.
      b. Field-of-Roof Uplift Pressure: 60 pounds/square foot.
      c. Dimension of perimeter zone is the lesser of 40 percent of the building height or 10 percent of the least plan dimension in increments of 4 feet.

C. Acceptable Insulation Types - Constant Thickness Application:
   1. Minimum 2 layers of molded polystyrene, polyisocyanurate, or composite board.
   2. Bottom layer of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, composite, or cellular glass board covered with single layer of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, or composite board.

D. Acceptable Insulation Types - Tapered Application:
   1. Uniform thickness cellulose, perlite, composite, polyisocyanurate, extruded polystyrene, molded polystyrene, glass fiber, or cellular glass board covered with tapered extruded polystyrene or perlite board.

2.03 MEMBRANE AND SHEET MATERIALS

A. Membrane Cap Sheet: Polymer modified asphalt, reinforced with non-woven fabric; granule surfaced; with the following characteristics:
   1. Minimum Quality: ASTM D6223/D6223M Type II Grade G; atactic polypropylene (APP) modified, polyester and glass fiber reinforced.
   2. Minimum Thickness: 160 mils.
   3. Minimum Average Weight: 0.9 lb/sq ft.
   4. Sheet Width: 39 inch.
   5. Model:
      a. Elevate (Firestone), APP 180 FR Cool.
      b. US Ply, Safeweld X4FR APP.
      c. Johns Manville, Tricor M FR

6. Substitutions: Not permitted.

B. Membrane Base Ply: Polymer modified asphalt, reinforced with non-woven fabric; smooth surfaced; with the following characteristics:
   1. Minimum Quality: ASTM D6222/D6222M Type I, Grade S; atactic polypropylene (APP) modified, polyester reinforced or ASTM D6223/D6223M Type I, Grade S; atactic polypropylene (APP) modified, polyester and glass fiber reinforced..
   2. Color: Black.
   3. Minimum Thickness: 155 mils.
   4. Minimum Average Weight: 0.9 lb/sq ft.
   5. Sheet Width: 39 inch.
   6. Model:
      a. Elevate (Firestone) APP 160 Cool.
      b. US Ply, Safeweld X4S APP.
      c. Johns Manville, Bicor S
   7. Substitutions: Not permitted.

C. Venting Base Sheet: Asphalt-saturated and -coated, venting glass fiber felt; ASTM D4897/D4897M Type II, heavy-duty.

D. Vapor Retarder Felt: Asphalt-saturated organic, ASTM D226/D226M Type I, No. 15 felt, unperforated.

E. Flexible Flashing Material: Same material as membrane.

2.04 BITUMINOUS MATERIALS

A. Membrane Adhesive: ASTM D3019/D3019M, Type III.
   1. Products:
      a. Elevate (Firestone); Multi-Purpose MB Cold Adhesive.
      b. US Ply; Safeweld Premium APP Modified Adhesive.
      c. Johns Manville; MBR Cold Application Adhesive
   2. Substitutions: Not permitted.

B. Asphalt Primer: ASTM D41/D41M, asphalt type.

C. Asphalt Roof Cement: ASTM D4586/D4586M, Type II, asbestos-free.
   1. Products:
      a. Elevate (Firestone); Multi-Purpose MB Cold Adhesive.
      b. US Ply; USP 954 Premium Modified Flashing Cement.
      c. Johns Manville, MBR Utility Cement
   2. Substitutions: Not permitted.

2.05 COVER BOARD

A. Cover Board: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/4 inch thick.
   1. Products:

2.06 INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 2, and with the following characteristics:
   1. Board Size: 48 inch X 48 inch flat, 48 inch X 96 inch flat, and 48 inch X 48 inch tapered.
   2. Flat Board Thickness: 2.5 inch minimum first layer and 1.5 inch minimum additional layers.
   3. Tapered Board: Slope as indicated; minimum thickness 1.5 inch; fabricate of fewest layers possible.
   4. Thermal Resistance: R-value of 5.7 per inch thickness.
   5. Product:
      a. Atlas Roofing Corporation; ACFoam-II and Tapered ACFoam-II.

b. GAF; EnergyGuard PolyIso and EnergyGuard PolyIso Tapered.
c. Elevate (Firestone); ISO 95+ GL Insulation and Tapered Insulation
d. Johns Manville, ENRGY3

6. Substitutions: Not permitted.

2.07 SURFACING MATERIALS - CONVENTIONAL APPLICATION

2.08 WOOD BLOCKING AND FRAMING

A. Wood blocking and framing used for perimeter nailers, curbs, parapets, and other framed structures as indicated on drawings.

B. Description: Structural Grade No. 2 or better Southern Pine, Douglas Fir, or Exterior Grade plywood.
1. Nailer Width: Minimum 3-½ inch (nominal) wide or as wide as the nailing flange of each roof accessory unless otherwise indicated on the drawings.
2. Nailer Thickness: Thickness of roof insulation.
3. Solid blocking only; use of spacers is prohibited.
4. All wood shall be pressure treated for rot resistance.

C. Reference Standards:
1. Southern Pines: PS 20; SPIB Grading Rules.
2. Western Woods: PS20; WWPA Grading Rules.
3. Plywood: PS 1; APA Grades Stamps.
4. Pressure Preservative Treatment: AWPB LP2

2.09 ACCESSORIES

A. Metal Edges and Coping: Anodized aluminum, minimum.050 inch thickness, complying with ANSI/SPRI ES-1.
1. Color as selected by Architect from manufacturer's full range of colors.

B. Crickets: Fabricated from same material as insulation.

C. Roof Drain Sumps: Factory tapered, asphalt-impregnated wood fiberboard complying with ASTM C208, Type II, Grade 2.

D. Cant and Edge Strips: Asphalt-impregnated wood fiberboard, compatible with roofing materials ; cants formed to 45 degree angle, tapered edge strips, and other configurations as detailed.

E. Insulation Adhesive: Single or two-component low-rise polyurethane adhesive designed for anchoring acceptable roof insulation to acceptable substrates, and to adhere multiple layers of insulation.
1. Products:
a. Elevate (Firestone); I.S.O. series of products.
b. 3M; CR-20.
c. Johns Manville, Two-Part Urethane Insulation Adhesive
2. Substitutions: Not permitted.

F. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

G. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
1. Fasteners, frequency and patterns are to be selected by the Contractor based upon manufacturer's requirements to resist all anticipated loads, based on pull-out testing of the deck material and uplift loads defined in SYSTEM DESIGN CRITERIA in this section.
2. Heavy Duty Fasteners:
a. Heavy duty threaded fastener with polymer coating and drill point tip capable of penetrating 20 gauge steel, of sufficient length to penetrate deck a minimum dimension as listed below.
b. Substrate and minimum penetration:
1) Concrete Deck, 1 inch.

c. Provide galvanized metal or polymer washer at each fastener; approximate diameter between 2 and 3 inches.
d. Cut off fasteners in interior spaces where deck is left exposed leaving manufacturer's required penetration length.
e. Paint fasteners in interior spaces where deck is left exposed to match color of exposed deck.

3. Product:
   a. Elevate (Firestone); Fasteners.
   b. US Ply; PlyFast Fasteners.
   c. Johns Manville, JM Fasteners
4. Substitutions: Not permitted.
5. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

H. Sealants: As recommended by membrane manufacturer.

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.
   1. Examine roof deck to determine that it is sufficiently rigid to support roofers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.

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, other accessories, nailing strips, other accessories, reglets, other accessories, and other accessories are in place.

F. Commencement of work on site shall indicate acceptance of existing conditions.
   1. Report any unsatisfactory conditions in writing to the Owner.

3.02 EXISTING CONCRETE DECK PREPARATION

A. Fill surface honeycomb and variations with latex filler.

3.03 LIGHTWEIGHT CONCRETE DECK PREPARATION

A. Fill surface honeycomb and variations with latex filler.

B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

C. Install venting base sheet on lightweight concrete deck in accordance with manufacturer's instructions.

3.04 WOOD NAILER LOCATION AND INSTALLATION

A. Total wood nailer height shall match the total thickness of insulation being used and shall be installed with a 1/8 inch gap between each length and at each change of direction.

B. Wood nailers shall be firmly fastened to the deck.

C. Mechanically fasten wood nailers to resist a force of 200 pounds per linear foot.

D. Wood nailers are required around the perimeter of all roof penetrations that exceed 12 inches in any direction.

3.05 INSTALLATION - INSULATION

A. Ensure venting base sheet is clean and dry, continuous, and ready for application of roofing system.

B. Attachment of Insulation: Mechanically fasten first layer of flat insulation to deck in accordance with roofing manufacturer's instructionsand attach all subsequent layers of flat and tapered insulation with insulation adhesive in accordance with manufacturer's instructions.

C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

D. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

E. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches and as indicated on drawings.

F. Do not apply more insulation than can be covered with membrane in same day.

3.06 INSTALLATION - MEMBRANE

1. Install modified bituminous membrane roofing system in accordance with manufacturer's recommendations and NRCA (RM) applicable requirements.
2. Install membrane; lap and seal edges and ends permanently waterproof.
3. Install smooth, free from air pockets, wrinkles, fish-mouths, or tears. Ensure full bond of membrane to substrate.
4. At end of day's operation, install waterproof cut-off. Remove cut-off before resuming roofing.
5. At intersections with vertical surfaces:
    a. Extend membrane over cant strips and up a minimum of 8 inches onto vertical surfaces or as indicated on drawings.
    b. Apply flexible flashing over membrane.
6. Coordinate installation of roof drains and sumps and related flashings.
7. Attach with cold adhesive with heat welded seams using torch down method.
8. End Lap Seams: End lap seams shall be a minimum of 6 inches width, offset a minimum of 18 inches.
9. Starting at the low point of the roof, embed one layer of base ply in a uniform application of cold adhesive.
10. Embed the full width of base ply in cold adhesive at a rate of 1.5 gallons to 2 gallons per 100 square feet as recommended by the manufacturer, with no adhesive applied in the side or end lap areas.
11. Apply the cold adhesive using a 1/4 inch notched neoprene squeegee or by spraying.
12. Heat fuse all seams using torch down method in accordance with manufacturer's recommendations; cold adhesive in seams is not acceptable.

3.07 TORCHED HEAT FUSED SEAM APPLICATIONS

A. When heat fusing to cap sheet in areas such as end laps, base flashings, and patches that have granules on receiving surface, heat until granules in the underlying sheet are embedded.

B. Where flashing laps onto field cap sheet, the lap area shall be completed by heat fusing in accordance with manufacturer's instructions.

C. Embed granules with a hot trowel by heating surface and troweling-in all granules until a uniform black surface coated with compound is achieved in lap area.

D. Any area of the sheet not protected with a granule surface shall be dressed with additional loose granules or patched with an additional piece of cap sheet membrane.

3.08 FLASHINGS

A. Base flashings shall be set in flashing cement to surfaces that have been primed.

B. Where flashing laps onto field cap sheet, the lap area shall be completed by heat fusing in accordance with manufacturer's instructions.

C. At outside corner transitions of base flashings, install notched patches to insure water tight corners per manufacturer's instructions.

D. When flashing into masonry, cut reglets into existing masonry, install and seal with sealant per Section 079200; termination bars are not accepatable as a substitute for reglets.

E. The use of surface mounted bar type terminations is prohibited.

3.09 METAL EDGES AND COPING

A. Install in locations indicated on drawings and recommended by manufacturer.

B. Mechanically fasten and flash as indicated on drawings and in accordance with manufacturer's instructions.

3.10 FIELD QUALITY CONTROL

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

3.11 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.12 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

3.13 WARRANTY INSPECTIONS

A. Only if required by the manufacturer as a requirement of the warranty, provide follow up inspections as frequently as manufacturer requires, but no more frequently than annually.

B. Follow up inspections shall be performed jointly with a representative of the manufacturer and Owner present.

C. Manufacturer or their distributor shall be responsible to coordinate and schedule this meeting with the Owner.

1. Manufacturer shall contact the Owner no less than 2 weeks in advance of planned inspection date to coordinate date and time of inspection.
2. Manufacturer's and Owner's representative shall make themselves reasonably available for the inspection.

D. Failure of the manufacturer's representative to arrange any follow up inspections shall not be grounds to cancel the warranty.

END OF SECTION

SECTION 075600
FLUID-APPLIED ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fluid-applied roofing materials.

B. Accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.

B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness.

C. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

D. CRRC-1 - CRRC-1 Roof Product Rating Program Manual.

1.04 SUBMITTALS

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

B. Product Data: Provide manufacturer's data for membrane and accessory materials.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

D. Manufacturer's Installation Instructions: Include standard installation instructions, acceptable installation temperature range, and procedures for unusual perimeter conditions.

E. Field Quality Control Test Report.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of fluid-applied roofing or waterproofing systems.
   1. Three years' documented experience manufacturing type of product specified.

B. Installer Qualifications: Company specializing in installation of fluid-applied roofing or waterproofing systems.
   1. Approved by roofing manufacturer.
   2. Five years of documented experience.

C. Contractor to provide daily logs includiing:
   1. Weather conditions.
   2. Wet mil. thickness.
   3. Appropriate repair information.
   4. Addressing any repairs made.

1.06 MOCK-UPS

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

B. Construct mock-up consisting of at least 100 sq ft of specified roofing materials, including internal and external corners, base flashings, expansion joints, and counterflashings similar to those included as part of this work.
   1. Locate where directed.
   2. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

C. Store materials in weather protected environment, clear of ground and moisture.

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

1.08 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

B. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY

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

B. Provide 20 year leak proof manufacturer warranty that roofing membrane will not crack, split, or flake under normal weather conditions and will not fail to resist penetration of water during that time period.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fluid-Applied Roofing:
   1. Garland Company, Inc: LiquiTec Liquid Roof Membrane; www.garlandco.com
   2. Poly-Armor Roofing; PolyArmor Reactive Plastic Membrane; www.polyarmorroof.com.
   3. Substitutions: Not permitted.

2.02 MATERIALS

A. Fluid-Applied Roofing: White, cold-applied; two-component; polyurea, approved by manufacturer for permanent exposure to weather and sunlight.
   1. Solar Reflectance Index (SRI) - Initial: 105, minimum, determined in accordance with CRRC-1.
   2. Dry Film Thickness (DFT): 80 mils, minimum; can be applied in two coats, base layer average of 40 mils minimun.
      a. Areas with asbestos containing materials apply average of 200 mils Dry Film Thickness (DFT) minimum, applied in three coats.
   3. Suitable for installation over metal, concrete, built-up bituminous, and single-ply sheet roofing substrates.
   4. VOC Content: None.
   5. Tensile Strength: 900 psi, minimum, measured in accordance with ASTM D412.
   6. Ultimate Elongation: 100 - 300% percent, measured in accordance with ASTM D412.
   7. Durometer Hardness, TypeD: 50 +/-10, minimum, in accordance with ASTM D2240.
   8. Adhesion Strength: Minimum 100 psi measured in accordance with ASTM D4541

B. Application: Provide elastomeric roof coating with elastomeric base coat.

2.03 ACCESSORIES

A. General: Auxiliary materials recommended by roofing system manufacturer for intenede use as compatible with the existing roofing system.

B. Flexible Flashing Sheet: Neoprene or other elastic type sheets approved by roofing membrane manufacturer.

C. Cant Strips: Premolded composition material, compatible with roofing membrane.

D. Counterflashings and fasteners: As recommended by roofing manufacturer.

E. Surface Primer Over Roof Substrate for Adhesion of Membrane: Low VOC primer as recommended by the roofing manufacturer for application over roofing substrates.
   1. Color: White.
   2. Roof Membrane Substrate: Includes galvanized metal, concrete, aluminum with Kynar finish, or rigid insulation.

F. Aggregate for Walkways: Silica sand, sieve size between 20 and 60; or other aggregate approved by roofing manufacturer.

G. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

H. Provide replacement expansion joint cover with Johns Manville Expand-O-Flash Expansion Joint Cover or equal. See product data following this section.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to starting this work.

B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of roofing system.

C. Verify that substrate surfaces are smooth, free of honeycombs or pitting, and not detrimental to full contact bond of roofing materials.

D. Verify that roof openings, curbs, and items that penetrate surfaces to receive roofing materials are securely and properly installed.

3.02 PREPARATION

A. Clean and prepare surfaces to receive roofing in accordance with manufacturer's instructions and recommendations:
   1. Field verify roof condition and correct any roof damage prior to installation of the roofing system. Notify Owner/Architect.

B. Ballasted roof areas:
   1. Remove loose gravel from roof prior to installation of the roofing system.
   2. Field verify roof condition and correct any roof damage prior to installation of the roofing system. Notify Owner/Architect.
   3. Clean with the appropriagte cleaner and four thousand psi pressure system minimum.
   4. Allow roof to dry prior to roofing system application.
   5. Apply asphalt moisture care primer.
   6. Install two hundred mil polyuria system (200mil).

C. Seal cracks and non-moving open joints less than 1/2 inch wide with sealant using methods recommended by roofing and sealant manufacturers; do not seal expansion joints or moving joints of any width.

D. Repair existing holes, failed seams, cut, remove and patch areas damaged from prior moisture conditions and prior to roof system application.

E. Install cant strips at inside corners, where indicated and where required by roofing manufacturer.

F. Protect adjacent surfaces not designated to receive roofing.

3.03 INSTALLATION

A. Install fluid-applied roofing in accordance with manufacturer's instructions and recommendations, to specified minimum thickness.

B. Apply roofing materials to surfaces that are acceptable to manufacturer.

C. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect surface conditioner from rain or frost until dry.

D. Installations Over Sealant-Filled Joints: Install an extra coating of roofing material over joints at least 6 inches on each side of joint.

E. Joint Cover Assembly: Install at expansion joints, moving joints 1/2 inch wide or wider, and joints between horizontal and vertical surfaces.
   1. Use flexible flashing sheet wide enough to extend 6 inches on both sides of joint with a loop of sheet extended down into the joint to a depth at least the width of the joint.
   2. Embed sheet in one coat of fluid-applied roofing material.
   3. Before installing the remainder of the roofing material, install a compressible joint sealer backer rod into joint above loop to prevent roofing material from filling loop.

F. Penetrations: Unless otherwise indicated on drawings, or recommended by roofing manufacturer, seal flexible flashing sheet around penetrations and to roofing substrate prior to installation of roofing material, embedding flashing sheet in one coat of roofing material.

G. Applying to Vertical Surfaces: Extend fluid-applied roofing material at least 12 inches above horizontal roofing surfaces.

H. Embedded Flexible Flashing Sheet: Apply full thickness of roofing material over exposed flashing sheet.

I. Roof Drains: Unless otherwise recommended by roofing manufacturer, set drain flange in one coating of roofing material and extend a full thickness of roofing material onto drain clamp flange, with adequate coating of roofing material to ensure waterproof seal of clamp ring.

J. Apply extra thickness of roofing material at corners, intersections, and angles, when recommended by roofing manufacturer.

K. Walkways: Install an extra coating layer of roofing material in walkway areas with aggregate embedded in surface; locate walkways where indicated on drawings or as directed by Architect.

3.04 FIELD QUALITY CONTROL

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

B. Owner will provide inspection services in accordance with Section 014000 - Quality Requirements, and Contractor shall provide temporary construction and materials for testing.

C. Upon completion of horizontal fluid-applied roofing material installation, install dam at perimeter of installation area in preparation for flood testing.

D. Flood area to a minimum depth of 1 inch with clean water, and after 72 hours, inspect for leaks.

E. If leaking is found, remove water, repair leaking areas with new roofing materials as directed by Owner, and repeat flood test. Repair damages to building related to roof test leakage.

F. When area is confirmed to be watertight, drain water and remove dam materials.

G. Materials applied must be wet mil tested and a non destructive dry mill tested performed daily, and recorded on a daily log.

H. After installation, materials applied must be tested for using a calibrated pull tester in accordance with ASTM D4541. Results must be logged and submitted showing a minimum test result of 100 PSI.

3.05 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must proceed over installed roofing materials, protect surfaces using durable materials acceptable to roofing material manufacturer.

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, and exterior penetrations.

B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

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.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement.

D. CDA A4050 - Copper in Architecture - Handbook.

E. SMACNA (ASMM) - Architectural Sheet Metal Manual.

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 QUALITY ASSURANCE

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

B. Maintain one copy of each document on site.

C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

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

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

PART 2 PRODUCTS

2.01 SHEET MATERIALS

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

2.02 FABRICATION

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

B. Fabricate cleats of same material as sheet, minimum ____ inches wide, interlocking with sheet.

C. Form pieces in longest possible lengths.

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

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

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

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

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

2.03 ACCESSORIES

A. Primer Type: Zinc chromate.

B. Protective Backing Paint: Zinc molybdate alkyd.

C. Concealed Sealants: Non-curing butyl sealant.

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

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

PART 3 EXECUTION

3.01 EXAMINATION

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

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

3.02 PREPARATION

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

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

3.03 INSTALLATION

A. Insert flashings into reglets to form tight fit; secure in place with plastic wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.

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

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

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

E. Seal metal joints watertight.

F. Counterflash with reglets at masonry. Surface mounted termination bars are not acceptable.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 077100
ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including copings and copings.

B. Roof control and expansion joint covers.

1.02 RELATED REQUIREMENTS

A. Section 075200 - Modified Bituminous Membrane Roofing

B. 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.

B. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement.

C. NRCA (RM) - The NRCA Roofing Manual.

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

A. Counterflashings:

2.02 COMPONENTS

A. 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: As selected by Architect from manufacturer's standard range.

B. Counterflashings: Factory fabricated and finished sheet metal that overlaps top edges of base flashing by at least 4 inches, and designed to snap into through-wall flashing or reglets with lapped joints.

C. Pipe Penetration Wall Seal and Insulated Piping Protection System: Seal for HVAC piping wall penetrations with wall mounted rigid plastic outlet cover and elastomeric wall seal gasket and having mechanical line insulation with PVC protective cover.
   1. Outlet Cover Color: Gray.
   2. PVC Insulation Cover Color: Black with full-length velcro fastener.

D. Sealant for Joints in Linear Components: As recommended by component manufacturer.

E. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

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

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 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 sealants and roofing cement with work of this section to ensure water tightness.

F. Coordinate installation of flashing flanges into reglets.

END OF SECTION

SECTION 077200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Curbs.

B. Equipment rails.

C. Roof penetrations mounting curbs.

D. Roof walkways and platforms.

E. Non-penetrating pedestals.

F. Snow guards.

G. Piping and conduit supports are specified in their respective sections, not in this section.

1.02 REFERENCE STANDARDS

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

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

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

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. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
   1. Submit shop drawings sealed and signed by a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

D. 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.

B. Provide two year manufacturer warranty for modular guard rail system.

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 flat roof deck sheathing with insulation.
2. Sheet Metal Material:
3. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gauge, 0.048 inch thick.
4. Provide layouts and configurations indicated on drawings.

B. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
1. Provide preservative treated wood nailers along top of curb.
2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
3. Height Above Roof Deck: 14 inches, minimum.

C. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
1. Height Above Finished Roof Surface: 10 inches, minimum.

D. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.
1. Height Above Finished Roof Surface: 8 inches, minimum.

2.02 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Modular Guard Rail System:
1. Non-penetrating railing system for roof edge fall protection.
a. Standards: System shall have top and mid rail in accordance with OSHA Standards - 29 CFR 1910.23 (a)(2).
b. Structural Load: 200 lb (90.7 kg), minimum, in any direction to all components in accordance with OSHA Regulation 29 CFR 1926.502.
c. Height: 42 inches (1067 mm), minimum.
d. Railings: 1-5/8 inch (41 mm) O.D. hot rolled pickled electric weld tubing, free of sharp edges and snag points.
1) Railings must end with a 90 degree railing at each end of a railing run as recommended by the manufacturer to meet structural load requirements.
e. Mounting Bases: Class 30 gray iron material cast with four receiver posts. Provide rubber pads on bottom of bases.
f. Receiver Posts: Shall have a positive locking system into slots that allow rails to be mounted in any direction. Friction locking systems are not allowed. Receiver posts shall have drain holes.
g. Hardware: Securing pins shall be 1010 carbon steel, zinc plated and yellow chromate dipped. Pins shall consist of collared pin and lanyard that connects to lynch pin.
2. Finish:
a. Railing factory finished powder coat paint, color black.
b. Mounting base factory finished powder coat paint, color safety yellow.
3. Products:
a. BlueWater Mfg., Inc.; SafetyRail 2000: www.bluewater-mfg.com.
b. Substitutions: See Section 016000 - Product Requirements.

B. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.
2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
6. Products:
    a. PHP Systems/Design; General Platforms and Stairs: www.phpsd.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

C. General Platforms and Stairs: Structural steel frame, walking surfaces, and railings.
1. Dimensions: As indicated on drawings.
2. Grating Length: Manufacturer's standard length.
3. Provide support plate assemblies and attachment hardware in compliance with manufacturer's written instructions in accordance with installation requirements.
4. Products:
    a. Substitutions: See Section 016000 - Product Requirements.
5. Products:
    a. PHP Systems Design: General Platforms; www.phpsd.com
    b. Substitutions: See Section 016000 - Product Requirements.

D. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
1. Bases: High density polypropylene.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
4. Products:
    a. PHP Systems Design: www.phpsd.com.
    b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

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

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

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

B. Remove burrs, and smooth out any sharp edges

C. Provide caps on all piping railings and ends and holes in pipe to eliminate bee hives.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 078400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of all joints and penetrations in fire-resistance rated and smoke-resistant corridor or other rated assemblies, whether indicated on drawings or not.

1.02 REFERENCE STANDARDS

A. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems.

B. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

C. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

D. FM (AG) - FM Approval Guide.

E. ITS (DIR) - Directory of Listed Products.

F. UL (FRD) - Fire Resistance Directory.

1.03 SUBMITTALS

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

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

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

1.04 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

1.05 MOCK-UPS

A. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall or floor constructions, install one assembly for each different combination.
   2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot of firestopping.

B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.

C. If accepted, mock-up will represent minimum standard for this work.

D. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
   2. A/D Fire Protection Systems Inc: www.adfire.com/#sle.
   3. Hilti, Inc: www.us.hilti.com/#sle.
   4. Nelson FireStop Products: www.nelsonfirestop.com/#sle.
   5. Specified Technologies Inc: www.stifirestop.com/#sle.
   6. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.

2.02 MATERIALS

A. Prohibited Materials: Do not use asbestos.

B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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 016116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

C. ASTM C834 - Standard Specification for Latex Sealants.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

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

F. ASTM C1193 - Standard Guide for Use of Joint Sealants.

G. ASTM C1311 - Standard Specification for Solvent Release Sealants.

1.04 SUBMITTALS

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

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

C. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

D. Test Reports: For joint sealants and backing, provide independent laboratory reports and test results showing negative asbestos containing materials content using Polarized Light Microscopy (PLM) test method.

E. Executed warranty.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

E. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.

5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

F. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.

1.06 WARRANTY

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

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

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants:
   1. Bostik Inc: www.bostik-us.com.
   2. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   3. Hilti, Inc: www.us.hilti.com/#sle.
   4. Pecora Corporation: www.pecora.com.
   5. Sherwin-Williams Company: www.sherwin-williams.com.
   6. Sika Corporation: www.usa-sika.com.
   7. W.R. Meadows, Inc: www.wrmeadows.com/sle.
   8. Substitutions: See Section 016000 - Product Requirements.

B. Self-Leveling Sealants:
   1. Bostik Inc: www.bostik-us.com.
   2. Dow Chemical Company; _____: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   3. Pecora Corporation: www.pecora.com.
   4. Sherwin-Williams Company: www.sherwin-williams.com.
   5. Sika Corporation: www.usa-sika.com.
   6. W.R. Meadows, Inc: www.wrmeadows.com/sle.
   7. 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:
      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 weep holes 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 where installation of sealant is specified in another section.
e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, noncuring.
2. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.

D. Interior Wet Areas: Bathrooms, restrooms, kitchens, and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with acceptable levels of volatile organic compound (VOC) content; see Section 016116.

2.04 NONSAG JOINT SEALANTS

A. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.

B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus ____ percent, minimum.
2. Color: Match adjacent finished surfaces.

C. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's full range.
2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).

D. Type ___ - Noncuring Butyl Sealant: Solvent-based, single component, nonsag, nonskinning, nonhardening, nonbleeding; non-vapor permeable; intended for fully concealed applications.

2.05 SELF-LEVELING JOINT SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F.

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. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.

2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
3. Record each test on Preinstallation Adhesion Test Log as indicated.
4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

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

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

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

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

3.03 INSTALLATION

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

B. Provide joint sealant installations complying with ASTM C1193.

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

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

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

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

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

3.04 FIELD QUALITY CONTROL

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

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

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

3.05 POST-OCCUPANCY

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

END OF SECTION

SECTION 092116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Gypsum wallboard

D. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing.

C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.

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

E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

F. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

G. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels.

H. GA-216 - Application and Finishing of Gypsum Panel Products.

1.04 SUBMITTALS

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

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

C. Test Reports: For plaster, gypsum board panels and drywall compound, provide independent laboratory reports and test results showing negative asbestos containing materials content using Polarized Light Microscopy (PLM) test method.

1.05 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.

2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.

B. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
   2. Custom Stud Inc: www.customstud.com
   3. Marino: www.marinoware.com/#sle.
   4. Telling Industries, www.buildstrong.com.
   5. Substitutions: See Section 016000 - Product Requirements.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.

D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

E. Nail Guard:
   1. Provide nail guard as required by local authority having jurisdiction.
   2. Provide nail guard on face of studs where piping and conduit are routed through the partition within 1-1/4" of the face of the studs.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company: www.americangypsum.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
   4. National Gypsum Company: www.nationalgypsum.com/#sle.
   5. PABCO Gypsum: www.pabcogypsum.com/#sle.
   6. USG Corporation: www.usg.com/#sle.
   7. 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. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch.
   4. Paper-Faced Products:
   5. Paper-Faced Products:
      a. American Gypsum Company; LightRoc Gypsum Wallboard: www.americangypsum.com/#sle.
      b. Georgia-Pacific Gypsum; ToughRock: www.gpgypsum.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.
   6. Glass Mat Faced Products Regular and Type X:
      a. Georgia-Pacific Gypsum; DensArmor Plus: www.gpgypsum.com/#sle.
      b. Georgia-Pacific Gypsum; DensArmor Plus Fireguard C: www.gpgypsum.com/#sle.
      c. National Gypsum Company; Gold Bond eXP Fire-Shield Interior Extreme Gypsum Panel: www.nationalgypsum.com/#sle.
      d. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough.
      e. Substitutions: See Section 016000 - Product Requirements.

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 AISI S220 and manufacturer's instructions.

B. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

D. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
   1. Orientation: Horizontal.
   2. Spacing: At 16 inches on center.

E. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall-mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall-mounted door hardware.

3.03 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

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

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated. Walls receiving marker board paint system including new and existing walls.
   2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   3. Level 3: Walls to receive textured wall finish.
   4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.

5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
6. Level 0: Temporary partitions.

C. 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.

D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

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 016116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

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

B. Product Data: Provide data on suspension system components and acoustical units.

C. Manufacturer's qualification statement.

1.06 QUALITY ASSURANCE

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

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels: Match Existing
   1. Armstrong World Industries, Inc; Fine Fisssured: www.armstrong.com.
   2. Acoustic Ceiling Products, Inc; Genesis Standard Series Printed Pro: www.acpideas.com.
   3. CertainTeed Corporation; Fine Fissured High NRC Mineral Fiber Ceiling Panel: www.certainteed.com.

B. Acoustic Tiles/Panels: New Construction
   1. Rockfon; Rockfon Education Standard: www.rockfon.com.

C. Substitutions: See Section 016000 - Product Requirements.

D. Suspension Systems:
   1. Same as for acoustical units.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:

B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:

2.03 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. VOC Content: As specified in Section 016116.

B. Acoustical Panels, Type 24X48: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
   2. Size: 24 by 48 inches.
   3. Panel Edge: Square.
   4. Color: White.
   5. Suspension System: Exposed grid.
   6. Products:
      a. Armstrong World Industries, Inc; Fine Fissured 1728 HumiGuard Plus: www.armstrongceilings.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

C. Acoustical Panels, Type 24x48: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
      a. Form: 2, water felted.
      b. Pattern: "B" - perforated, randomly spaced large holes.
   2. Panel Edge: Square.
   3. Color: White.
   4. Suspension System: Exposed grid.
   5. Products:
      a. Armstrong World Industries, Inc: Fine Fissured 1729 HumiGuard Plus; www.armstrongceilings.com/#sle.

D. Acoustical Panels New Construction: Stone wool (Mineral Wool) ceiling tiles with factory applied latex paint on glass scrim surface Type XX - Stone wool base with membrane faced overlay, with the following characteristics:
   1. Classification: ASTM E1264 Type XX.
      a. Form: 2, water felted.
      b. Pattern: "G" - smooth.
   2. Size: 24 by 48 inch.
   3. Thickness: 5/8 inches.
   4. Light Reflectance: 0.84 percent, determined in accordance with ASTM E1264.
   5. NRC: 0.70 deter,omed om accprdamce wotj ASTM E1264 .
   6. Panel Edge: Square.
   7. Color: White.
   8. Suspension System: Exposed grid.
   9. Products:
      a. Rockfon; Rockfon Education Standard: www.rockfon.com

E. Acoustical PanelsFood Service Areas Washable: Mineral fiber with membrane-faced overlay, with the following characteristics:
   1. Classification: ASTM E1264 Type IV.

2. Panel Edge: Square.
3. Color: White.
4. Suspension System: Exposed grid.
5. Products:
    a. Armstrong World Industries, Inc; 1720 Clean Room FL: www.armstrongceilings.com/#sle.
    b. Armstrong World Industries, Inc; 1721 Clean Room FL: www.armstrongceilings.com/#sle.
    c. USG Corporation; Mars Acoustical Panels: www.usg.com/ceilings/#sle.
    d. Substitutions: See Section 016000 - Product Requirements.

2.04 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.

2.05 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 galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.
1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
2. At Concealed Grid: Provide exposed L-shaped molding.

D. Touch-up Paint: Type, color, and sheen to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, and ASTM E580/E580M and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Use longest practical lengths.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.

G. 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.

H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

J. Do not eccentrically load system or induce rotation of runners.

K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use 2" seismic perimeter molding
   2. Do not use rivets where exposed to public.

L. Replace missing, broken bent or stained grid and tile within the work area.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges, stains 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. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

G. Install hold-down clips on panels within 20 ft of an exterior door, and as directed by contract documents.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 099113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other types of tiles.
   9. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
   10. Exterior insulation and finish system (EIFS).
   11. Glass.
   12. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.

B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

D. SSPC-SP 1 - Solvent Cleaning.

E. SSPC-SP 2 - Hand Tool Cleaning.

1.05 SUBMITTALS

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

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit two paper chip samples, 4 x 4 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
   2. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:
   1. Behr Process Corporation: www.behr.com/#sle.
   2. Glidden Paint: www.glidden.com
   3. PPG Paints: www.ppgpaints.com/#sle.
   4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: Not permitted.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: To be selected from manufacturer's full range of available colors.
   1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
   2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
   1. One coat of alkyd primer.
   2. Gloss: Two coats of alkyd enamel; use this sheen for all locations unless otherwise indicated.

B. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
   1. One coat galvanize primer.
   2. Gloss: Two coats of alkyd enamel; use this sheen for all locations unless otherwise indicated.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Alkyd Primer for Galvanized Metal.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

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

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

I. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.06 SCHEDULE - PAINT SYSTEMS

A. Wood: Finish surfaces exposed to view.

B. Steel Fabrications: Finish surfaces exposed to view.
   1. Exterior: ME-OP-3A, gloss; finish all surfaces, including concealed surfaces, before installation.

C. Galvanized Steel: Finish surfaces exposed to view.
   1. Exterior: Paint MgE-OP-3A, gloss.

END OF SECTION

SECTION 099123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. All miscellaneous steel and unfinished metal elements.
   2. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, electrical equipment, and eletrical raceways, unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Marble, granite, slate, and other natural stones.
   6. Floors, unless specifically indicated.
   7. Ceramic and other tiles.
   8. Glass.
   9. Acoustical materials, unless specifically indicated.
   10. Concealed pipes, ducts, and conduits.
   11. Bathroom and Accessories
   12. FRP Doors

1.02 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 033000 - Cast-in-Place Concrete: Concrete finishing.

C. Section 092116 - Gypsum Board Assemblies: New and existing wall preparation for final finish.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.

B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

D. SSPC-SP 1 - Solvent Cleaning.

E. SSPC-SP 2 - Hand Tool Cleaning.

1.05 SUBMITTALS

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

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for submittals.
   2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
   3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:
   1. Behr Process Corporation: www.behr.com/#sle.
   2. Glidden Paint: www.glidden.com
   3. PPG Paints: www.ppgpaints.com/#sle.
   4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: Not permitted.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.

3. Supply each paint material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Comply with Section 016116.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: As indicated on drawings.
1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
3. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-TR-C - Transparent Finish on Concrete Floors.
1. 1 coat stain.
2. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
3. Sealer Sheen:
   a. Gloss: MPI gloss level 6; use this sheen at all locations.

B. Paint I-OP-AC - Acoustical Restoration Coating over Interior Ceilings:
1. One top coat.

C. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat:
1. One coat of block filler.
2. Semi-gloss: Two coats of latex enamel; use this sheen for all locations unless otherwise indicated.

D. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
1. One coat of latex primer.
2. Semi-gloss: Two coats of latex enamel.

E. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with latex primer.
2. Semi-gloss: Two coats of latex enamel; use this sheen for all locations unless otherwise indicated.

F. Paint MgI-OP-3L - Galvanized Metals, Latex, 3 Coat:
1. One coat galvanize primer.
2. Semi-gloss: Two coats of latex enamel.

G. Paint CI-OP-3E - Concrete/Masonry, Epoxy Enamel, 3 Coat:
1. One coat of catalyzed epoxy primer.
2. Gloss: Two coats of catalyzed epoxy enamel; use this sheen for all locations unless otherwise indicated.

H. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat:
1. One coat of latex primer sealer.
2. Eggshell: Two coats of latex-acrylic enamel; use this sheen for all locations unless otherwise indicated.

I. Paint GI-P-1A - Gypsum Board/Plaster, Primer, 1 Coat:
1. One coat of latex primer sealer.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.
   2. Interior/Exterior Latex Block Filler; MPI #4.
   3. Concrete Floor Primer, Waterborne; MPI #99.
   4. Interior Rust-Inhibitive Water Based Primer; MPI #107.
   5. Interior Water Based Primer for Galvanized Metal; MPI #134 or #134 X-Green.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

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

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Acoustical Panel Ceilings:

H. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Clean concrete according to ASTM D4258. Allow to dry.
   3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

4. Trowel apply grout mixture to eliminate small concrete surface blemishes, rough areas, pits, bug holes and form marks on poured walls, tiltup and precast. Sand to provide a smooth finish prior to application of the finish system.

I. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.
   3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi at 6 to 12 inches. Allow to dry.

J. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

K. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

L. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

M. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

N. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

O. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.06 SCHEDULE - PAINT SYSTEMS

A. Concrete Floors: Transparent finish for concrete floors
   1. Interior: I-TR-C, gloss

B. Concrete, Concrete Masonry Units (CMU), Concrete Block, Brick Masonry: Finish surfaces exposed to view.
   1. Interior: CI-OP-3L, semi-gloss.

C. Gypsum Board: Finish surfaces exposed to view.

D. Plaster: Finish surfaces exposed to view.
   1. Interior Walls and Ceilings: GI-OP-3LA.

E. Steel Fabrications: Finish surfaces exposed to view.
   1. Interior: MI-OP-3L, gloss.

F. Galvanized Steel: Finish surfaces exposed to view.
   1. Interior: MgI-OP-3L.

G. Shop-Primed Metal Items: Finish surfaces exposed to view.
   1. Finish the following items:
      a. Exposed surfaces of steel stairs and railings.
      b. Mechanical equipment.
   2. Interior: MI-OP-2L.

END OF SECTION

SECTION 210500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Above ground piping.

B. Escutcheons.

C. Mechanical couplings.

D. Pipe hangers and supports.

E. Pipe sleeves.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 099113 - Exterior Painting: Preparation and painting of exterior fire protection piping systems.

C. Section 210553 - Identification for Fire Suppression Piping and Equipment: Piping identification.

D. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.03 REFERENCE STANDARDS

A. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard.

B. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

C. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

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

E. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

F. ASTM A536 - Standard Specification for Ductile Iron Castings.

G. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

H. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).

I. AWWA C606 - Grooved and Shouldered Joints.

J. NFPA 13 - Standard for the Installation of Sprinkler Systems.

K. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

L. UL (DIR) - Online Certifications Directory.

1.04 SUBMITTALS

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

B. Shop Drawings in PDF format: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.05 QUALITY ASSURANCE

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

B. Conform to UL, FM, and Warnock Hersey requirements.

C. Valves: Bear FM, ITS (DIR), and UL (DIR) product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.

D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Sprinkler-based System:
   1. Comply with NFPA 13.
   2. See Section 211300.

B. Standpipe and Hose System:
   1. Comply with NFPA 14.
   2. See Section 211200.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX.

D. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 , black.
   1. Minimum Steel Pipe Schedules:
      a. Welded or Roll-Grooved Fittings:
         1) Piping Size From 2-1/2" Up to 4": Schedule 40, up to 300 psi.
         2) Piping Size Larger Than 5": Schedule 10, up to 300 psi.
      b. Threaded or Cut-Grooves Fittings:
         1) Piping Size Less Than 2": Schedule 40, up to 300 psi.
   2. Steel Fittings: ASME B16.9, wrought steel, buttwelded, ASME B16.25, buttweld ends, ASTM A234/A234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded.
   3. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
      a. Piping size 2" or smaller: Standard weight pattern, up to 300 psi.
   4. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
      a. Piping size 6" or smaller: Standard weight pattern, up to 300 psi.
      b. Piping size larger than 6": Extra-heavy pattern where pressures exceed 175 psi
   5. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
   6. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.03 PIPE SLEEVES

A. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor.
   2. Provide sealant for watertight joint.
   3. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

B. Plastic, Sheet Metal, or Moisture-Resistant Fiber: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

C. Not required for wall hydrants for fire department connections or in drywall construction.

D. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.

E. Clearances:
   1. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
   2. Rated Openings: Caulked tight with firestopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.04 ESCUTCHEONS

A. Manufacturers:

B. Material:
   1. Chrome-plated.
   2. Metals and Finish: Comply with ASME A112.18.1.

C. Construction:
   1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
   2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.05 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
   1. Manufacturers:
      a. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
      b. FNW: www.fnw.com/#sle.

B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
   1. Manufacturers:
      a. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
      b. FNW: www.fnw.com/#sle.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

F. Vertical Support: Steel riser clamp.
   1. Manufacturers:
      a. Anvil International: www.anvilintl.com/#sle.

G. Floor Support: Cast iron adjustable floor flange,or steel support.
   1. Manufacturers:
      a. Anvil International: www.anvilintl.com/#sle.
   2. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
   3. Accommodate the Following:
      a. Axial Deflection in Compression and Expansion: _____ inch.
      b. Lateral Movement: _____ inch.
      c. Angular Rotation: 15 degrees.
      d. Force developed by 1.5 times specified maximum allowable operating pressure.
   4. End Connections: Threaded; complying with ASME B16.11.
   5. Provide necessary accessories including, but not limited to, swivel joints.

2.06 MECHANICAL COUPLINGS

A. Manufacturers:
   1. Anvil International: www.anvilintl.com/#sle.

2. Shurjoint Piping Products, Inc: www.shurjoint.com/#sle.
3. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
4. Victaulic Company; FireLock Style 009H: www.victaulic.com/#sle.

B. Rigid Mechanical Couplings for Grooved Joints:
1. Dimensions and Testing: Comply with AWWA C606.
2. Minimum Working Pressure: 300 psig.
3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
4. Housing Coating: Factory applied orange enamel.
5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.
7. Provide stops for direct stab installation without field assembly.

2.07 VALVE MANUFACTURERS

A. NIBCO Inc.: www.nibco.com

B. Milwaukee Valve Co.: www.milwaukeevalve.com

C. OCV Control Valves: www.controlvalves.com

D. Tyco Fire & Building Products: www.tyco-fire.com

E. Victaulic Company: www.victaulic.com

F. Substitutions: See Section 016000 - Product Requirements.

2.08 PRESSURE GAUGES

A. 4-1/2" diameter with aluminum or stainless steel case with phosphor bronzebourdon tube, brass socket for water or oil application, 1/4" bottom connection.
1. 1% full scale accurate with bronze bushed brass movement and adjustable pointer.
2. Standard ranges to be either pressure or pressure and vacuum as required of application.

B. Select gauge range for normal reading near center of gauge.

C. Manufacturers:
1. U. S. Gauge Figure 5801
2. Marshalltown
3. Marsh
4. Weiss
5. Weksler
6. Ashcroft, Wika.
7. Substitutions: See Section 016000 - Product Requirements.

2.09 PRESSURE GAUGE ACCESSORIES

A. All pressure gauges shall have valves and pressure snubbers.
1. Shut-off Valve: 1/4" ball valve as specified for each piping system.
2. Pressure snubber, brass with 1/4" connections, porous metal type.

2.10 TEST PLUGS

A. 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe.

B. Rated for zero leakage from vacuum to 500 psi.

C. Provide extended units for all plugs installed in insulated piping.

D. Manufacturers:
1. Sisco
2. Flow Design
3. Peterson Equipment
4. Substitutions: See Section 016000 - 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 foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Install standpipe piping, hangers, and supports in accordance with NFPA 14.

C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

D. Install piping to conserve building space, to not interfere with use of space and other work.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Pipe Hangers and Supports:
   1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   2. Place hangers within 12 inches of each horizontal elbow.
   3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   6. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

J. Do not penetrate building structural members unless indicated.

K. Locate flexible expansion loops at or near the building seismic joint.

L. Provide sleeves when penetrating floors and walls and seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Aboveground Piping:
      a. Pack solid using mineral fiber complying with ASTM C592.
      b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
   2. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

M. Escutcheons:
   1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
   2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
   3. Attach plates at the underside only of suspended ceilings.
   4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

N. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

O. Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 210523
GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Iron butterfly valves with indicators.

B. Check valves.

C. Iron OS&Y gate valves.

D. Trim and drain valves.

1.02 REFERENCE STANDARDS

A. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS.

B. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

C. FM (AG) - FM Approval Guide.

D. NFPA 13 - Standard for the Installation of Sprinkler Systems.

E. UL 262 - Gate Valves for Fire-Protection Service.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Comply with NFPA 13 for valves.

B. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

2.02 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers:
   1. FNW: www.fnw.com/#sle.
   2. Kennedy Valve: www.kennedyvalve.com/#sle.

B. Minimum Pressure Rating: 175 psig.

C. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.

D. Seat: EPDM.

E. Stem: Stainless steel.

F. Disc: Ductile iron, nickel plated.

G. Actuator: Worm gear or traveling nut.

H. Supervisory Switch: Internal or external.

I. Body Design: Grooved-end connections.

2.03 CHECK VALVES

A. Manufacturers:
   1. FNW: www.fnw.com/#sle.
   2. Kennedy Valve; AWWA Compliant: www.kennedyvalve.com/#sle.

B. AWWA C508 compliant check valves.

C. Minimum Pressure Rating: 175 psig.

D. Type: Center guided check valve.

E. Body Material: Cast iron, ductile iron.

F. Center guided check with elastomeric seal.

G. Hinge Spring: Stainless steel.

H. End Connections: Flanged, grooved, or threaded.

2.04 IRON OS&Y GATE VALVES

A. Manufacturers:
   1. FNW; 751 Series: www.fnw.com/#sle.
   2. Kennedy Valve; Ken-Seal Series, AWWA Compliant: www.kennedyvalve.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Listed and Body Marked: AWWA C509, FM (AG), and UL 262.

C. Size: As indicated on drawings.

D. End Connections: Flanged.

E. Maximum Working Pressure: 175 psi.

F. Body and Bonnet Material: Cast or ductile iron.

G. Wedge: Cast or ductile iron, or bronze with elastomeric coating.

H. Stem: Brass, bronze, or stainless steel.

I. Packing: Non-asbestos PTFE.

J. Supervisory Switch: External.

2.05 TRIM AND DRAIN VALVES

A. Ball Valves:
   1. Description:
      a. Pressure Rating: 175 psig.
      b. Body Design: Two piece.
      c. Body Material: Forged brass or bronze.
      d. Port Size: Full or standard.
      e. Seat: PTFE.
      f. Stem: Bronze or stainless steel.
      g. Ball: Chrome-plated brass.
      h. Actuator: Hand-lever.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with specific valve installation requirements and application in the following Sections:

B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.

C. Valves in horizontal piping installed with stem at or above the pipe center.

D. Position valves to allow full stem movement.

E. Install valve tags. Comply with Section 210553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION

SECTION 210548
VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration-isolated equipment support bases.

B. Vibration isolators.

C. External seismic snubber assemblies.

D. Seismic restraint systems

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings.

C. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage.

D. FM 1950 - Examination Standard for Seismic Sway Braces for Pipe, Tubing and Conduit.

E. MFMA-4 - Metal Framing Standards Publication.

F. NFPA 13 - Standard for the Installation of Sprinkler Systems.

G. UL 203A - Standard for Sway Brace Devices for Sprinkler System Piping.

1.04 SUBMITTALS

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

B. Product Data:
   1. Provide manufacturer's product literature documenting compliance with specified requirements.
   2. Include seismic rating documentation for each restraint component accounting for horizontal, vertical, and combined loads.

C. Shop Drawings:
   1. Provide schedule of vibration isolator type with location and load on each.
   2. Fully dimensioned fabrication drawings and installation details for housekeeping pads, bases, member sizes, attachments, and supported equipment.
   3. Include auxiliary motor slide bases and rails, base weights, concrete weights, equipment static loads, and support points.
   4. Include selections from prescriptive design tables that indicate compliance with the applicable building code.
   5. Clearly indicate the load and capacity assumptions selected. Include copies of any calculations.
   6. Include the calculations that indicate compliance with the applicable building code for seismic controls and the manufacturer's requirements.
   7. Include the seal of the Professional Structural Engineer registered in the the State in which the Project is located, on drawings and calculations which at a minimum include the following:
      a. Seismic Restraint Details: Detailed drawings of seismic restraints and snubbers including anchorage details that indicate quantity, diameter, and depth of penetration, edge distance, and spacing of anchors.
      b. Equipment Seismic Qualification Certification: Certification by the manufacturer or responsible party that each piece of equipment provided will withstand seismic force levels as specified in the applicable building code for seismic controls.
         1) Basis for Certification: Indicate whether certification is based on actual testing of assembled components, on calculations, or on historic data.

2) Indicate equipment is sufficiently durable to resist design forces and or remain functional after the seismic event.

c. Dimensioned outline drawings of equipment identifying center of gravity, locations, and provisions for mounting and anchorage.

d. Detailed description of the equipment anchorage devices on which the certifications are based.

D. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

1.05 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Perform design and installation in accordance with applicable codes.

C. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and registered and licensed in the State in which the Project is located.

D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section. See Section 014533 - Code-Required Special Inspections and Procedures for additional requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mason Industries: www.mason-ind.com.

B. Vibration Eliminator Company, Inc: www.veco-ny.com.

C. The VMC Group: http://thevmcgroup.com

D. Cooper B-line, Inc

E. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. General:

1. Steel springs to function without undue stress or overloading.
2. Steel springs to operate in the linear portion of the load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
3. Lateral to vertical stiffness ratio to not exceed 0.08 with spring deflection at minimum 75 percent of specified deflection.

2.03 SEISMIC RESTRAINT SYSTEMS

A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

B. Where required by NFPA 13, provide products listed as complying with UL 203A or FM 1950.

C. Cable Restraints:

1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

E. Products to be listed in accordance with the requirements of NFPA 13.

F. Cable Restraints:
   1. Wire Rope: Steel wire strand cables sized to resist seismic loads in lateral directions.
   2. Protective Thimbles: Eliminates potential for dynamic cable wear and strand breakage.
   3. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
   4. Connections:
      a. Use overlapping wire rope U clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.
      b. Internally brace clevis hanger bracket cross bolt to prevent deformation.
   5. Vertical Suspension Rods: Attach required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

G. Rigid Restraints:
   1. Structural Element: Sized to resist seismic loads in lateral directions and carry both compressive and tensile loading.
   2. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
   3. Connections: Internally brace clevis hanger bracket cross bolt to prevent deformation.
   4. Static Support System: Anchorage capable of carrying additional tension loads generated by the vertical component of the rigid brace compression which is additive to any static load requirements on the system.
   5. Vertical Suspension Rods: Attached required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

B. Comply with the requirements of NFPA 13.

C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

E. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
   1. Up to 4 Inches Pipe Size: First three points of support.
   2. 5 to 8 Inches Pipe Size: First four points of support.
   3. 10 inches Pipe Size and Over: First six points of support.
   4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.03 INSTALLATION - SEISMIC

A. Comply with the following:
   1. Install in accordance with manufacturer's instructions.

2. Comply with the requirements of ASCE 7, FEMA E-74, and NFPA 13.

B. Provide end of line restraint.

C. Piping:
   1. Provide seismic bracing.
   2. Provide supports, braces, and anchors to resist gravity and seismic design forces.
   3. Provide flexible connections between floor mounted equipment and suspended piping; between unbraced piping and restrained suspended items; as required for thermal movement; at building separations and seismic joints; and wherever relative differential movements could damage pipe in an earthquake.
   4. Brace every run 5.0 feet or more in length with two transverse and one longitudinal bracing locations.
   5. Pipes and Connections Constructed of Ductile Materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections):
      a. Provide transverse bracing at spacing not more than 40.0 feet on center.
      b. Provide longitudinal bracing at spacing not more than 80.0 feet on center.
   6. Pipes and Connections Constructed of Non Ductile Materials (listed plastic pipe):
      a. Provide transverse bracing at spacing not more than 20.0 feet on center.
      b. Provide longitudinal bracing at spacing not more than 40.0 feet on center.
   7. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.
   8. Piping Explicitly Exempt from Seismic Bracing Requirements:
      a. Install piping such that swinging of the pipes will not cause damaging impact with adjacent components, finishes, or structural framing while maintaining clear horizontal distance of 67 percent of the hanger length between subject components.
      b. Provide swing restraints as required to control potential impact due to limited space between subject components.

D. Wall mounted Mechanical Equipment:
   1. Provide support and bracing to resist seismic design force in any direction.
   2. Install backing plates or blocking as required to deliver load to primary wall framing members.
   3. Anchoring to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads is not permitted.

3.04 FIELD QUALITY CONTROL

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

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

D. Inspect isolated equipment after installation and submit report. Include static deflections.

E. Perform testing and inspections of the installation in accordance with Section 014533 - Code-Required Special Inspections and Procedures.

END OF SECTION

SECTION 210553
IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Section 211200 - Fire Extinguishing Systems.

B. Section 211300 - Fire Suppression Sprinklers.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials.

1.04 SUBMITTALS

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

B. List: Submit list of wording, symbols, letter size, and color coding for 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.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Major Control Components: Nameplates.

B. Piping: Tags.

C. Equipment: Nameplates.

D. Relays: Tags.

E. Small-sized Equipment: Tags.

F. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

2.02 IDENTIFICATION MANUFACTURERS

A. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.

B. Seton Identification Products: www.seton.com.

C. Brady Corp. .

D. Craftmark Identification Systems.

E. Labelmaster

F. VisionMark, Inc.

G. Almetek Industries, Inc.

H. Advanced Graphic Engraving: www.advancedgraphicengraving.com.

I. MIFAB, Inc.: www.mifab.com.

J. Substitutions: See Section 016000 - Product Requirements.

2.03 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Thickness: 1/8 inch.
5. Plastic: Comply with ASTM D709.

2.04 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

B. Metal Tags: Aluminum with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Beaded Chains: stainless steel with locking link.

D. Nylon Ties: Clear, non-conductive, locking type.

E. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.05 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

E. Color code as follows:
   1. Fire Quenching Fluids: Red with white letters.

2.06 FIRE SIGNS

A. Description:
   1. Vinyl: Flexible, pressure sensitive, 0.019 inch thick, self-adhesive.
   2. Plastic: 0.060 inch thick.
   3. Aluminum: 0.040 inch thick, with a vinyl clad finish.
   4. White background with red lettering or red backdround wit white lettering.

2.07 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. Sprinkler Valves: red.

PART 3 EXECUTION

3.01 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. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.

3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

F. Install indentification in clear view and align with axis of piping.

G. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

I. Install fire signs per NFPA 13 requirement.

END OF SECTION

SECTION 211200
FIRE-SUPPRESSION STANDPIPES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Valves.

1.02 RELATED REQUIREMENTS

A. Section 014100 - Regulatory Requirements.

B. Section 210500 - Common Work Results For Fire Suppression: Fire protection piping.

C. Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.

1.03 REFERENCE STANDARDS

A. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

PART 2 PRODUCTS

2.01 VALVES

A. Specialty Valves:
   1. Hose Connection Valve:
      a. Angle type; brass finish; 2-1/2 inch NPS, thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of same material and finish.
   2. Angle Hose Valves:
      a. Manufacturers:
         1) Zurn Industries, LLC; ZW5000: www.zurn.com/#sle.
      b. Cast bronze, 2-1/2 inch, NPS handwheel operated globe valve with grooved or threaded end connections, pressure with outlet discharge field-set to hose inlet pressure.Thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of same material and finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 14.

C. Flush entire system of foreign matter.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing (Field Acceptance Test) in accordance with Section 014000.

B. Test entire system in accordance with NFPA 14.

C. Test shall be witnessed by Authority Having Jurisdiction.

END OF SECTION

SECTION 211300
FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. System design, installation, and certification.

C. Fire department connections.

1.02 REFERENCE STANDARDS

A. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.

B. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry.

C. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

D. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

E. ITS (DIR) - Directory of Listed Products.

F. UL (DIR) - Online Certifications Directory.

1.03 SUBMITTALS

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

B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Shop Drawings:
   1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
   2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
   3. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect.

D. Hydrant Flow Test or Hydraulic Calculation Report:

E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.
   2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
   3. Sprinkler Wrenches: For each sprinkler type.

G. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations. Provide complete AS-BUILT drawings in .PDF and .DGN or .DWG.

1.04 QUALITY ASSURANCE

A. Maintain one copy of referenced design and installation standard on site.

B. Conform to UL (DIR) requirements.

C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

E. Installer Qualifications: Company specializing in performing the work of this section documented experience .

F. Equipment and Components: Provide products that bear UL label or marking for fire sprinkler system.

G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sprinklers, Valves, and Equipment:
   1. Anvil International: www.anvilintl.com/#sle.
   2. Tyco Fire Protection Products, a Tyco Business: www.tyco-fire.com.
   3. Viking Corporation: www.vikinggroupinc.com.
   4. Globe Sprinkler Corporation: http://www.globesprinkler.com
   5. Substitutions: See Section 016000 - Product Requirements.

2.02 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for building areas noted.Commercial grade.

B. Occupancy: As indicated on drawing.

C. Water Supply: Determine volume and pressure from water flow test data.
   1. Design per hydraulic test data.

D. Interface system with building fire and smoke alarm system.

E. Provide fire department connections where indicated.

F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

G. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   6. Other Types: As required.
   7. Manufacturers:
      a. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
      b. Powers Fasteners, Inc www.powers.com.
      c. Viking Corporation: www.vikinggroupinc.com.

2.03 SPRINKLERS

A. Manufacturers:
   1. Tyco Fire Products: www.tyco-fire.com
   2. Viking Corporation: www.vikinggroupinc.com
   3. Substitutions: See Section 016000 - Product Requirements.

B. Suspended Ceiling Type: Concealed pendant type with matching screw on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Extended.
   3. Finish: Brass.

4. Escutcheon Plate Finish: Enamel, color white .
5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

C. Exposed Area Type: Upright type as indicated on plan.
1. Response Type: Quick.
2. Coverage Type: Extended.
3. Finish: Chrome plated.
4. Fusible Link: Glass bulb type temperature rated for specific area hazard.

D. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
1. Response Type: Quick.
2. Coverage Type: Extended.
3. Finish: Chrome plated.
4. Escutcheon Plate Finish: Brushed Chrome
5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

E. Dry Sprinklers: Plain barrel sidewall type with matching push on escutcheon plate.
1. Response Type: Quick.
2. Coverage Type: Extended.
3. Finish: Brass.
4. Cover Plate Finish: Chrome plated.
5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

F. Storage Sprinklers: Specific type as indicated on drawing.
1. Response Type: Standard.
2. Coverage Type: As scheduled for each type of sprinkler on drawing. .
3. Fusible Link: Glass bulb type

G. Guards: Finish to match sprinkler finish.

H. Flexible Drop System: Stainless steel, multiple use, open gate type.
1. Application: Use to properly locate sprinkler heads.
2. Include all supports and bracing.
3. Provide braided type tube as required for the application.
4. Manufacturers:
a. FlexHead Industries, a brand of Anvil International; _____: www.anvilintl.com/#sle.
b. Victaulic Company; Vic-Flex: www.victaulic.com/#sle.
c. Viking Corporation: www.vikinggroupinc.com.
d. Substitutions: See Section 016000 - Product Requirements.

2.04 PIPING SPECIALTIES

A. Backflow Preventer: Reduced pressure principle valve assembly backflow preventer with drain and OS & Y supervised valves on each end.
1. Manufacturers:
a. Wilkins: http://wilkinsbackflow.com.
b. Viking Group Inc.: http://www.vikinggroupinc.com.
c. AMES Fire and Water Works: www.amesfirewater.com.
d. Substitutions: See Section 016000 - Product Requirements.

B. Test Connections:
1. Backflow Preventer Test Connection:
a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch National Standard male hose threads with cap and chain.
b. Furnish one valve for each 500 gpm of system demand or fraction thereof.
c. Provide permanent sign reading "Test Valve" in accordance with NFPA 13

C. Electric Alarm: Electrically operated horn/strobe.

D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
   1. Manufacturers:
      a. Potter Electric.
      b. Simplex.
      c. Substitutions: See Section 016000 - Product Requirements.

E. Fire Department Connections:
   1. Type: Exposed, projected wall mount made of corrosion resistant metal complying with UL 405.
      a. Inlets: Inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
         1) Two way, 2-1/2" threades swivel fittings.
      b. Outlet: Bottom with pipe threads, 6 NPS
      c. Rated Working Pressure: 175 psi.
      d. Finish: Hard-coated forged aluminum construction.
         1) Free standing:
            (a) galvanized steel elbow.
      e. Signage: Raised or engraved lettering 1 inch minimum label "Standpipe and Sprinkler - Fire Department Connection".
      f. Manufacturers:
         1) Elkhart Brass Manufacturing Company, Inc: www.elkhartbrass.com.
         2) Fire End & Croker Corporation: www.croker.com.
         3) Guardian Fire Equipment, Inc.: www.guardianfire.com.
         4) Potter-Roemer
         5) Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Provide approved backflow preventer assembly at sprinkler system water source connection.

D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
   1. Install 3/4 inch automatic drip drain for Fire Department Connection as indicated on drawing.

E. Locate outside alarm horn/strobe on building wall as indicated on plan.

F. Place pipe runs to minimize obstruction to other work.

G. Place piping in concealed spaces above finished ceilings.

H. Center sprinklers in one direction only in ceiling tile with location in other direction variable dependent upon spacing and coordination with ceiling elements.

I. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

J. Flush entire piping system of foreign matter.

K. Install guards on sprinklers where indicated.

L. Hydrostatically test entire system.

M. Require test be witnessed by Fire Marshal and Authority Having Jurisdiction.

N. Provide fully completed and sighed NFPA “Material and Test Certificates” for both underground and aboveground piping, signed by authority having jurisdiction

3.02 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

1.02 RELATED REQUIREMENTS

A. Section 014000 - Quality Requirements: Employment of testing agency and payment for services.

1.03 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

C. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing.

1.04 SUBMITTALS

A. See Section 013000 - 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. 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.

D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit under provisions of Section 014000.
   2. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   3. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
   4. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
   5. Include the following on the title page of each report:
      a. Name of Testing, Adjusting, and Balancing Agency.
      b. Address of Testing, Adjusting, and Balancing Agency.
      c. Telephone number of Testing, Adjusting, and Balancing Agency.
      d. Project name and owner project number.
      e. Project location.
      f. Project Architect.
      g. Project Engineer.
      h. Project Contractor.
      i. Project altitude.
      j. Report date.

E. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
2. SMACNA (TAB).
3. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. 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. NEAABC BB, 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.

D. 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. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

B. 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.

3.06 AIR SYSTEM PROCEDURE (AS APPLICABLE TO THE PROJECT)

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. 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.

O. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.07 SCOPE

A. Test of existing prior to commencement of demolition.
   1. As specified on drawings.

B. Test, adjust, and balance the following:

C. See drawing for additional information and requirement.

3.08 MINIMUM DATA TO BE REPORTED

A. 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.

B. 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.

C. 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.

D. 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.

E. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

F. Duct Leak Tests:
1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
    a. Blower.
    b. Orifice, tube size.
    c. Orifice size.
    d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

G. 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.

H. 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.

I. Sound Level Reports:
1. in general sound test and report are not required when system sound level is accepted by Owner at a visual inspection. If the system/component has a sound problem, upon the request of Owner, the sound and report shall be performed to assist the Engineer and/or contractor to analyze the problem for resolution, at contractor's cost.
2. Location.
3. Octave bands - equipment off.
4. Octave bands - equipment on.

J. Vibration Tests:
1. In general vibration test is not required when system vibration level is accepted by Owner at a visual inspection. If the system/component has a sound problem, upon the request of Owner, the sound and report shall be performed to assist the Engineer and/or contractor to analyze the problem for resolution, at contractor's cost.
2. Location of points:
   a. Fan bearing, drive end.
   b. Fan bearing, opposite end.
   c. Motor bearing, center (if applicable).
   d. Motor bearing, drive end.
   e. Motor bearing, opposite end.
   f. Casing (bottom or top).
   g. Casing (side).
   h. Duct after flexible connection (discharge).
   i. Duct after flexible connection (suction).
3. Test readings:
   a. Horizontal, velocity and displacement.
   b. Vertical, velocity and displacement.
   c. Axial, velocity and displacement.
4. Normally acceptable readings, velocity and acceleration.
5. Unusual conditions at time of test.
6. Vibration source (if non-complying).

END OF SECTION

SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct liner.

C. Jacketing and accessories.

1.02 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.

E. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

F. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2008.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

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

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Test Reports: For duct insulation, provide independent laboratory reports and test results showing negative asbestos containing materials content using Polarized Light Microscopy (PLM) test method.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

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, UL 723, ASTM E84, or UL 723.

2.02 MANIFACTURERS

A. Knauf Insulation: www.knaufusa.com.

B. Johns Manville Corporation: www.jm.com.

C. Owens Corning Corp: www.owenscorning.com.

D. CertainTeed Corporation: www.certainteed.com.

E. Substitutions: See Section 016000 - Product Requirements.

2.03 GLASS FIBER, FLEXIBLE

A. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure-sensitive tape.

B. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

C. Outdoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

2.04 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, noncombustible blanket.
   1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 450 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent.
   4. Maximum Density: 8.0 pcf.

B. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure-sensitive tape.

C. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

D. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
   2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.05 JACKETING AND ACCESSORIES

A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
   1. Lagging Adhesive:
      a. Compatible with insulation.

B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.

C. Aluminum Jacket:
   1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.

D. Alumaguard Jacket: A composite membrane consisting of a multiply embossed UV-resistant aluminum foil/polymer laminate to which is applied a layer of rubberized asphalt.
   1. Thickness: 55-60 mils
   2. Weight: 0.3 lbs/sf

2.06 DUCT LINER

A. 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.
   3. Service Temperature: Up to 250 degrees F.
   4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
   5. Minimum Noise Reduction Coefficients:
      a. 1/2 inch Thickness: 0.30.
      b. 1 inch Thickness: 0.45.
      c. 1-1/2 inches Thickness: 0.60.
      d. 2 inch Thickness: 0.70.

B. Adhesive: Waterproof, fire-retardant type, ASTM C916.

C. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

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 insulation 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.

D. Insulated Ducts Conveying Air Above Ambient Temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

E. Ducts Exposed in Finished Spaces shall double wall insulated duct as specified in Section 233100 HVAC Ducts and Casings.

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. 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.

H. Duct and Plenum Liner Application:
   1. Adhere insulation with adhesive for 100 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 SCHEDULES

A. Ducts Exposed to Outdoors:
1. Double Wall Construction: Flexible Glass Fiber Duct Liner Insulation, 2 inches thick.
2. Rigid Glass Fiber Duct Insulation with Aluminimum Jacket, 2 inches thick.

END OF SECTION

SECTION 230913
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Automatic dampers.

B. Damper operators.

1.02 RELATED REQUIREMENTS

A. Section 233300 - Air Duct Accessories.

B. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

C. Section 262726 - Wiring Devices: Elevation of exposed components.

1.03 REFERENCE STANDARDS

A. NEMA BS 31032 - Residential Controls–Electrical Wall-Mounted Room Thermostats.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

C. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.04 SUBMITTALS

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

B. Submit all submital documents listed in this Section under Section 230923 - Direct-Digital Control System for HVAC.

C. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

D. Manufacturer's Instructions: Provide for all manufactured components.

E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.05 QUALITY ASSURANCE

1.06 WARRANTY

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

B. Provide five year manufacturer's warranty for contro valves.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table below.

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Ducted Air	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Dew Point	±1.5ºC (±3ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15º (±0.25ºF)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (Accuracy applies to 10%–100% of scale)
Airflow (measuring stations)	±5% of full scale

Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (For both absolute and differential pressure)
Electrical	±1% of reading (Not including utility-supplied meters)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm

B. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table below.

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0–1.5 kPa (0–6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1–150 psi) 0–12.5 kPa (0–50 in. w.g.) differential

2.02 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.03 CONTROL DAMPERS

A. See Section 233300 for dampers and this section for actuators and operators.

2.04 DAMPER OPERATORS

A. General:
   1. Provide actuators with torque capacity sized for minimum of 20 percent greater than maximum design stream velocity and hold tight seal against maximum system pressures.
   2. Provide spring return for two position control and for fail safe operation.
   3. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
   4. Provide one operator for maximum 36 sq ft damper section.

2.05 ELECTRIC OPERATORS:

A. Electric Operators:
   1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.
   2. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range.
   3. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
   4. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
   5. Control damper shall fail normally open or closed, as scheduled on plans, or as follows:
      a. Outside air damper in air handlers - normally closed.

b. Returned air damper in air handlers - normally open.
c. Other applications-as scheduled or as required by sequences of operation.

6. Product:Belimo

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Ensure installation of components is complementary to installation of similar components.

G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

C. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

D. Control Damper Installation

1. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼ in. larger than damper dimensions and shall be square, straight, and level.
2. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 0.3 cm (1/8 in.) of each other.
3. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
4. Install extended shaft or jackshaft according to manufacturer’s instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
5. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
6. Provide a visible and accessible indication of damper position on the drive shaft end.
7. Support ductwork in area of damper when required to prevent sagging due to damper weight.
8. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

E. Actuators

1. General. Mount and link control damper actuators according to manufacturer's instructions.
   a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.

b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
c. Provide all mounting hardware and linkages for actuator installation.

2. Electric/Electronic
   a. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer's recommendations.

F. Control Damper Installation
1. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
2. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼ in. larger than damper dimensions and shall be square, straight, and level.
3. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 0.3 cm (1/8 in.) of each other.
4. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
5. Install extended shaft or jackshaft according to manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
6. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
7. Provide a visible and accessible indication of damper position on the drive shaft end.
8. Support ductwork in area of damper when required to prevent sagging due to damper weight.
9. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

END OF SECTION

SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air plenums and casings.

B. Metal ducts.

1.02 RELATED REQUIREMENTS

A. Section 230713 - Duct Insulation: External insulation and duct liner.

B. Section 233300 - Air Duct Accessories.

1.03 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

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

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.

F. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry.

G. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

H. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

1.04 SUBMITTALS

A. See Section 013000 - 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.

1.05 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

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

C. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.07 WARRANTY

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

B. Duct Sealing and Leakage in accordance with Static Pressure Class:
   1. Low Pressure Service: From 2 in-wc to 3 in-wc:
      1) Rectangular: Class 24 or 24 cfm/100 sq ft.
      2) Round: Class 6 or 6 cfm/100 sq ft.
      3) Rectangular: Class 12 or 12 cfm/100 sq ft.

4) Round: Class 12 or 12 cfm/100 sq ft.

2. Low Pressure Service: Up to 2 in-wc:
    1) Round: Class 3 or 3 cfm/100 sq ft.
3. Medium and High Pressure Service: Above 3 in-wc:
    a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
4. 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.
5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. 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.

C. Duct Fabrication Requirements:
    a. Seal: Class C, apply to seal off transverse joints.
    b. Leakage:

D. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.

2.02 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 233319.

C. Duct Shape and Material in accordance with Allowed Static Pressure Range:
    a. Leakage:
    b. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
2. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
3. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
5. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
    a. Leakage:
6. Fittings: Manufacture with solid inner wall of perforated galvanized steel.

D. Material Requirements:

2.03 METAL DUCTS

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
    1) L&L Fabrication; www.landlfab.com/duct-fabrication/.
    2) Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
    3) Carlisle HVAC Products; Nexus Flange Connectors with Sealant Pocket: www.carlislehvac.com/#sle.
    b. Insulation:
        1) Material: Fiberglass.
    c. 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.

d. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
1) Thickness: 2 inch.

2. 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.
3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

B. Rectangular Metal Duct:
a. Manufacturers:
1) Substitutions: See Section 016000 - Product Requirements.

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).

C. Connectors, Fittings, Sealants, and Miscellaneous:

2.04 AIR PLENUMS AND CASINGS

A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.
1. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.

B. Access Doors:
1. Construct panels 3 inches thick, packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16-gauge, 0.059-inch sheet steel.
2. Fabricate acoustic plenum or casing with reinforcing turned inward.

C. Minimum Fabrication Requirements:
1. Provide 16-gauge, 0.059-inch sheet steel back facing and 22-gauge, 0.029-inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers.
2. Mount floor-mounted plenum or casings on 4-inch high concrete curbs. At floor, rivet panels on 8-inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.
3. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
4. Provide clear wire glass observation ports, minimum 6 by 6 inch size.

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. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

D. Flexible Ducts: Connect to metal ducts with adhesive.

E. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

F. 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.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.

END OF SECTION

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.

B. Duct access doors.

C. Duct test holes.

D. Flexible duct connectors.

E. Volume control dampers.

F. Low leakage (Class 1A) control dampers.

1.02 RELATED REQUIREMENTS

A. Section 233100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

B. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

1.04 SUBMITTALS

A. See Section 013000 - 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.

1.05 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with blades aligned in short dimension; steel or aluminum construction matching the ductwork matrial; with individually adjustable blades, mounting straps.

2.02 DUCT ACCESS DOORS

A. Manufacturers:
   1. Acudor Products Inc, a Division of Nelson Industrial Inc: www.acudor.com.
   2. Elgen Manufacturing, Inc: www.elgenmfg.com.
   3. Lloyd Industries, Inc: www.firedamper.com/#sle.
   4. Nailor Industries, Inc: www.nailor.com.
   5. Ruskin Company, a brand of Johnson Controls: www.ruskin.com.
   6. SEMCO LLC; _____: www.semcohvac.com/#sle.
   7. Substitutions: See Section 016000 - Product Requirements.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

2.03 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:
2. Carlisle HVAC Products; Dynair Test Port with Red Cap with O-Ring Seal: www.carlislehvac.com/#sle.

2.04 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
      a. Net Fabric Width: Approximately 2 inches wide.

C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

D. Maximum Installed Length: 14 inch.

2.05 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

A. Manufacturers:
   1. Ruskin Company; CD50: www.ruskin.com/#sle.

B. Maximum Leakage Allowed: 3 cfm/sq ft at 1 in-wc.

C. Frame:
   1. Material: 20-gauge galvanized steel.
   2. Free-area: Single cross section.

D. Blade:
   1. Type: Multi-blade extruded airfoil for high pressure.
   2. Operation: Opposed type.
   3. Maximum Individual Blade Height: 6 inches.
   4. Material: 12-gauge aluminum.

E. Other Requirements:
   1. Paint Finish: Standard.
   2. Sleeve or Flange: Factory-mounted standard.
   3. Custom: Include bird screen and insect screen.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.

B. Provide 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 minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.

C. Provide duct test holes where indicated and required for testing and balancing purposes.

D. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

E. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

F. 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 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Metal-clad cable.

C. Wiring connectors.

D. Electrical tape.

E. Heat shrink tubing.

F. Oxide inhibiting compound.

G. Wire pulling lubricant.

H. Cable ties.

I. 120V power connections to fire alarm components.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 284600 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction.

H. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable.

I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

J. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

K. NFPA 70 - National Electrical Code.

L. UL 44 - Thermoset-Insulated Wires and Cables.

M. UL 83 - Thermoplastic-Insulated Wires and Cables.

N. UL 267 - Outline of Investigation for Wire-Pulling Compounds.

O. UL 486A-486B - Wire Connectors.

P. UL 486C - Splicing Wire Connectors.

Q. UL 486D - Sealed Wire Connector Systems.

R. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables.

S. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

T. UL 1569 - Metal-Clad Cables.

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. No submittals required.

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 conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect 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.

C. Nonmetallic-sheathed cable is not permitted.

D. Service entrance cable is not permitted.

E. Armored cable is not permitted.

F. Metal-clad cable is permitted only as follows:
   1. At indoor, dry locations.
   2. Where not exposed to damage or corrosive atmospheres.
   3. Where not exposed to view.
   4. Where concealed above accessible ceilings for connections to luminaires.
   5. Where concealed in hollow stud walls and above accessible ceilings for branch circuits up to 20 A.
   6. Provide single conductor building wire in raceway for circuit homerun to panelboards.

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. Conductors for Grounding and Bonding: Also comply with Section 260526.

I. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.

J. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

K. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

L. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

M. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
         3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
   2. Control Circuits: 16 AWG.

N. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
      a. Conductors size 6 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
   3. Color Code (Power and Lighting):
      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. Equipment Ground, All Systems: Green.
      d. Travelers for 3-Way and 4-Way Switching: Purple or purple electrical tape wrapped around jacket of conductor utilized.

e. 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.
f. For control circuits, comply with manufacturer's recommended color code.

4. Color Code (Systems): The following colors apply to overall outside jacket when conductors are not in color marked conduit. All system wiring not in conduit must be plenum rated.
   a. Fire Alarm System: Red.
   b. Telephone System: White.
   c. HVAC Control System: Green.
   d. PA System: Grey.
   e. Cat5e Data System: Blue.
   f. Cat6 Data System: Violet.
   g. Security System: White.
   h. CCTV System: Yellow

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.
      d. Houston Wire and Cable Company: www.houwire.com
      e. General Cable Technologies Corporation: www.generalcable.com
      f. Coleman Cable, Inc: www.colemancable.com
      g. Substitutions: See Section 016000 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.
   2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
   1. Copper Building Wire: Type THHN/THWN, THHN/THWN-2, or XHHW-2.
   2. Any Copper Wire Installed Underground: Type XHHW-2.

2.04 METAL-CLAD CABLE

A. Manufacturers:
   1. Cerro Wire LLC[<>]: www.cerrowire.com.
   2. AFC Cable Systems Inc: www.afcweb.com/#sle.
   3. Encore Wire Corporation: www.encorewire.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.
   5. Coleman Cable, Inc: www.colemancable.com
   6. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide dedicated neutral conductor for each single circuit (120/277V) when utilizing multi-conductor MC cable.

G. Grounding: Full-size integral equipment grounding conductor.

H. Armor: Aluminum or steel interlocked tape.

2.05 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 260526.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
   5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   7. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. NSI Industries LLC: www.nsiindustries.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

H. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.

c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. 3M: www.3m.com.
e. Substitutions: See Section 016000 - Product Requirements.

2.06 ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
c. Substitutions: See Section 016000 - 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; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Wire Pulling Lubricant:
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. Substitutions: See Section 016000 - Product Requirements.
2. Listed and labeled as complying with UL 267.
3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
4. Suitable for use at installation temperature.

C. Cable Ties: Material and tensile strength rating suitable for application.

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. Arrange circuiting to minimize splices.
   2. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   3. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   4. Common Neutrals: 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.
   5. Provide oversized neutral/grounded conductors where indicated and as specified below.
      a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
      b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. 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.

H. 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.
      c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

I. Install conductors with a minimum of 12 inches of slack at each outlet.

J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

L. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.

3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

M. 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.

N. Insulate ends of spare conductors using vinyl insulating electrical tape.

O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

P. Identify conductors and cables in accordance with Section 260553.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

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 014000 - Quality Requirements, for additional requirements.

B. Perform continuity test on all branch circuit conductors.

C. Verify proper phasing of connections and correct, if necessary.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.

B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

C. NFPA 70 - National Electrical Code.

D. UL 467 - Grounding and Bonding Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. No submittals required.

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 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. 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. 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.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
   1. Use insulated copper conductors:
      a. Exceptions:
         1) Use bare tinned copper conductors where installed underground in direct contact with earth.
         2) Use bare tinned 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. Use exothermic welded connections for underground, concealed and other inaccessible connections.
   3. Use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
      a. Exceptions:
         1) Use exothermic welded connections for connections to metal building frame.
   4. Manufacturers - Mechanical and Compression Connectors:
      a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
      b. Burndy LLC: www.burndy.com/#sle.
      c. Erico International Corporation: www.erico.com
      d. ILSCO: www.ilsco.com
      e. Harger Lightning & Grounding: www.harger.com/#sle.
      f. Thomas & Betts Corporation: www.tnb.com/#sle.
      g. Substitutions: See Section 016000 - Product Requirements.
   5. Manufacturers - Exothermic Welded Connections:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Harger Lightning & Grounding: www.harger.com.
      c. ThermOweld: www.thermoweld.com.
      d. Substitutions: See Section 016000 - Product Requirements.

D. Oxide Inhibiting Compound: Comply with Section 260519.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. 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.

D. Identify grounding and bonding system components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

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

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

B. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

C. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

D. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.03 REFERENCE STANDARDS

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

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. MFMA-4 - Metal Framing Standards Publication.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction.

F. NFPA 70 - National Electrical Code.

G. UL 5B - Strut-Type Channel Raceways and Fittings.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
   2. Coordinate work to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
   4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
   5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. No submittals required.

1.06 QUALITY ASSURANCE

A. Products: Listed and classified by a Nationally Recognized Testing Laboratory as suitable for the purpose specified and indicated.

B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with the following. Where requirements differ, comply with most stringent.
      a. NFPA 70.
      b. Requirements of authorities having jurisdiction.
   2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
   3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel or stainless steel.
      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. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
   1. Manufacturers:
      a. Substitutions: See Section 016000 - Product Requirements.

D. Metal Channel/Strut Framing Systems:
   1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
   2. Comply with MFMA-4.
   3. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
   5. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.

E. Anchors and Fasteners:
   1. Concrete: Use preset concrete inserts or expansion anchors.
      a. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
         1) Comply with MFMA-4.
         2) Channel Material: Use galvanized steel.
   2. Solid or Grout-Filled Masonry: Use expansion anchors.
   3. Hollow Masonry: Use toggle bolts.
   4. Hollow Stud Walls: Use toggle bolts.
   5. Steel: Use beam clamps.
   6. Sheet Metal: Use sheet metal screws.
   7. Plastic and lead anchors are not permitted.
   8. Powder-actuated fasteners are not permitted.
   9. Hammer-driven anchors and fasteners are not permitted.
   10. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
      a. Comply with MFMA-4.

b. Channel Material: Use galvanized steel.
c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install hangers and supports in accordance with NECA 1.

C. 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. Field Welding, Where Approved by Architect: See Section 055000.

H. 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.

I. Conduit Support and Attachment: See Section 260533.13 for additional requirements.

J. Box Support and Attachment: See Section 260533.16 for additional requirements.

K. Interior Luminaire Support and Attachment: See Section 265100 for additional requirements.

L. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

M. Secure fasteners in accordance with manufacturer's recommended torque settings.

N. Remove temporary supports.

O. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

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

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 260533.13
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. Stainless steel intermediate metal conduit (IMC).

D. PVC-coated galvanized steel rigid metal conduit (RMC).

E. Flexible metal conduit (FMC).

F. Liquidtight flexible metal conduit (LFMC).

G. Galvanized steel electrical metallic tubing (EMT).

H. Stainless steel electrical metallic tubing (EMT).

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 260526 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260533.23 - Surface Raceways for Electrical Systems.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).

E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

F. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit.

G. NFPA 70 - National Electrical Code.

H. UL 1 - Flexible Metal Conduit.

I. UL 6 - Electrical Rigid Metal Conduit-Steel.

J. UL 360 - Liquid-Tight Flexible Metal Conduit.

K. UL 514A - Metallic Outlet Boxes.

L. UL 514B - Conduit, Tubing, and Cable Fittings.

M. UL 797 - Electrical Metallic Tubing-Steel.

N. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel.

O. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds.

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 013000 - Administrative Requirements for submittals procedures.

1.06 QUALITY ASSURANCE

A. Products: Listed and classified by a Nationally Recognized Testing Laboratory as suitable for the purpose specified and indicated.

B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Use the conduit types indicated for the specified applications. Where conduit type for a particular application is not specified, consult Architect.

B. Underground:
1. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
2. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, stainless steel rigid metal conduit (RMC) elbows, galvanized steel intermediate metal conduit (IMC) elbows, stainless steel intermediate metal conduit (IMC) elbows, PVC-coated galvanized steel rigid metal conduit (RMC) elbows, or concrete-encased PVC elbows for bends.

C. Embedded Within Concrete:
1. Within Slab on Grade: Not permitted.
2. Within Slab Above Ground: Not permitted.

D. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).

E. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).

F. Flexible Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit (FMC).
2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
3. Maximum Length: 6 feet unless otherwise indicated.

G. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.02 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.

C. Structured Cabling for Voice and Data Systems: Conduits Only. See Owners low-voltage matrix of responsibility.

D. Fittings for Grounding and Bonding: See Section 260526 for additional requirements.

E. Provide conduit, fittings, supports, and accessories required for complete raceway system.

F. Provide products listed, classified, and labeled by testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.

G. Minimum Conduit Size:

H. Where conduit size is not indicated, size to comply with NFPA 70.

2.03 GALVANIZED STEEL 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.
   5. Substitutions: See Section 016000 - Product Requirements.

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. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.
   2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
   3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
   4. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   5. 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. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.

B. 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 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.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Thomas & Betts Corporation: www.tnb.com.
   2. Robroy Industries: www.robroy.com.
   3. Substitutions: Not permitted.

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.

D. Interior Coating: Urethane, minimum thickness of 2 mil, 0.002 inch.

E. PVC-Coated Boxes and Fittings:
   1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
   2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
   3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
   4. Material: Use steel or malleable iron.
   5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
   6. Interior Coating: Urethane, minimum thickness of 2 mil, 0.002 inch.

F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.
   4. Substitutions: See Section 016000 - Product Requirements.

B. 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.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:

1. Manufacturers:
    a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    c. Substitutions: See Section 016000 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
    a. Do not use die cast zinc fittings.

2.09 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com.
2. Nucor Tubular Products: www.nucortubular/#sle.
3. Wheatland Tube Company: www.wheatland.com.
4. Substitutions: See Section 016000 - 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. Manufacturers:
    a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    c. Substitutions: See Section 016000 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
    a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use compression/gland or set-screw type.
    a. Do not use indenter type connectors and couplings.

2.10 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.

B. 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.

2.11 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

D. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.

E. Sealing Systems for Concrete Penetrations:
1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

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.

D. Verify routing and termination locations of conduit prior to rough-in.

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 PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.

E. 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 top of parapet walls.
      c. Across building exterior surfaces.
   6. Arrange conduit to maintain adequate headroom, clearances, and access.
   7. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
   8. Arrange conduit to provide no more than 150 feet between pull points.
   9. Route conduits above water and drain piping where possible.
   10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
   12. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.
   13. Group parallel conduits in same area on common rack.

F. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   4. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.

5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.
11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

G. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
8. Secure joints and connections to provide mechanical strength and electrical continuity.

H. 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.
3. Provide sleeves for penetrations as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
6. Where conduits penetrate waterproof membrane, seal to maintain integrity of membrane.
7. Provide decorative metal escutcheon plates for conduit penetrations exposed to public view.
8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.

I. Underground Installation:
1. Provide trenching and backfilling; see Section 312316.13.
2. Backfill with red flowable-fill to a minimum of 4 inches above underground conduits.
   a. Anchor underground conduits at 10 foot intervals to trench bottom to avoid floating after flowable fill is poured.
3. Minimum Conduit Depth:
   a. Underground, Exterior: 18 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.

J. 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 conduits are subject to earth movement by settlement or frost.

K. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
   a. Where conduits enter building from outside.
   b. Where service conduits enter building from underground distribution system.
   c. Where conduits enter building from underground.
   d. Where conduits may transport moisture to contact live parts.
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
   a. Where conduits pass from outdoors into conditioned interior spaces.
   b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

L. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

M. Provide grounding and bonding; see Section 260526.

N. Identify conduits; see Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - 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 260533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260533.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

E. Section 260533.23 - Surface Raceways for Electrical Systems:
   1. Accessory boxes designed specifically for surface raceway systems.
   2. Lay-in wireways and wiring troughs with removable covers.

F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 262726 - Wiring Devices:
   1. Wall plates.
   2. Additional requirements for locating boxes for wiring devices.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

F. NFPA 70 - National Electrical Code.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

I. UL 508A - Industrial Control Panels.

J. UL 514A - Metallic Outlet Boxes.

K. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

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 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for boxes for hazardous (classified) locations, floor boxes, underground boxes/enclosures, and boxes/cabinets/enclosures over 100 cubic inches.
   1. Outlet and device box submittals are not required.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - 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.

B. Comply with NEMA 250 for electrical cabinets and enclosures larger than 100 cubic inches (1,650 cu cm).

C. Products: Listed and classified by a Nationally Recognized Testing Laboratory as suitable for the purpose specified and indicated.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes for damp or wet locations; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes where exposed galvanized steel rigid metal conduit is used.
   4. Use suitable masonry type boxes where flush-mounted in masonry walls.

5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Use shallow boxes where required by the type of wall construction.
7. Do not use "through-wall" boxes designed for access from both sides of wall.
8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
12. Wall Plates: Comply with Section 262726.
13. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
    c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
    d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    e. Thomas & Betts Corporation: www.tnb.com/#sle.
    f. Substitutions: See Section 016000 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
    c. Wet, Damp, or Corrosive Locations: Type 4X, stainless steel or fiberglass.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. 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. Substitutions: See Section 016000 - Product Requirements.

D. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
1. Manufacturers:
    a. Appleton, a brand of Emerson Electric Co: www.emerson.com/#sle.
    b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.
    d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130.

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. Provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas.

G. Boxes may be surface-mounted where exposed conduits are permitted.

H. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100.
   2. Unless dimensioned, box locations indicated are approximate.
      a. Owner must approve any adjustment to box locations for wall devices.
   3. Locate boxes for devices installed under other sections:
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
      b. Communications Systems Outlets: Comply with Section 271000.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
   9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
      b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
   10. Locate junction and pull boxes to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260534.
   11. Locate junction and pull boxes in the following areas:
      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 260529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

L. Floor-Mounted Cabinets: Mount on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.

M. Install boxes as required to preserve insulation integrity.

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 078400.

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 260526.

S. Identify boxes in accordance with Section 260553.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 260533.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface raceway systems.

B. Wireways.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260533.13 - Conduit for Electrical Systems.

D. Section 260533.16 - Boxes for Electrical Systems.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 262723 - Indoor Service Poles.

G. Section 262726 - Wiring Devices: Receptacles.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA BI 50061 - Installation Guidelines for Surface and Nonmetallic Raceway.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NFPA 70 - National Electrical Code.

E. UL 5 - Surface Metal Raceways and Fittings.

F. UL 5A - Nonmetallic Surface Raceways and Fittings.

G. UL 111 - Outline of Investigation for Multioutlet Assemblies.

H. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate rough-in locations of outlet boxes provided under Section 260533.16 and conduit provided under Section 260533.13 as required for installation of raceways provided under this section.
   3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
   4. Floor raceway systems: Coordinate the work with other trades to provide floors suitable for installation of floot raceway systems where indicated.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install raceways until final surface finishes and painting are complete.
   2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.

1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.

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 products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 RACEWAY REQUIREMENTS

A. Provide all components, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

A. Manufacturers:
   1. Wiremold, a brand of Legrand North America, Inc; Wiremold : www.legrand.us/#sle.
   2. Panduit Corporation: www.panduit.com
   3. Substitutions: Not permitted.

B. Surface Metal Raceways: Listed and labeled as complying with UL 5.

C. Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.

D. Multioutlet Assemblies: Listed and labeled as complying with UL 111.

E. Surface Raceway Systems (Metal and Nonmetallic):
   1. Type, Size, and Length: As indicated on the drawings.
   2. Color: Match adjacent finish, contractor to paint if necessary to match adjacent finish.
   3. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.
   4. Integrated Device Provisions:
      a. Receptacles:
         1) Comply with Section 262726.
         2) Configuration: As indicated on the drawings.
         3) Color: As specified in Section 262726.
         4) Spacing: As indicated on the drawings.
      b. Communications Outlets:
         1) Configuration: As indicated on the drawings.
         2) Spacing: As indicated on the drawings.

2.03 WIREWAYS

A. Manufacturers:
   1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
   2. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
   3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.

C. Wireway Type, Unless Otherwise Indicated:
   1. Indoor Clean, Dry Locations: NEMA EN 10250, Type 1, painted steel with hinged cover secured with latches.

2. Outdoor Locations: NEMA EN 10250, Type 3R, painted steel with screw-cover; include provision for padlocking.

D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.

E. Minimum Wireway Size: 2.5 by 2.5 inches unless otherwise indicated.

F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.

C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Surface Nonmetallic Raceways: Install in accordance with NEMA BI 50061.

D. Install raceways plumb and level.

E. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.

F. Secure and support raceways in accordance with Section 260529 at intervals complying with NFPA 70 and manufacturer's requirements.

G. Close unused raceway openings.

H. Provide grounding and bonding in accordance with Section 260526.

I. Identify raceways in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

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

B. Inspect raceways for damage and defects.

C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.

D. Correct wiring deficiencies and replace damaged or defective raceways.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

A. Protect installed raceways from subsequent construction operations.

END OF SECTION

SECTION 260548
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Seismic control requirements.
   1. Includes requirements for seismic qualification of equipment not specified in this section.

B. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

A. Section 014533 - Code-Required Special Inspections and Procedures.

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

C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

D. Section 260529 - Hangers and Supports for Electrical Systems.

1.03 DEFINITIONS

A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., conduit, cable tray).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment.

F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage.

G. ICC (IBC) - International Building Code.

H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components.

I. MFMA-4 - Metal Framing Standards Publication.

J. NECA 1 - Standard for Good Workmanship in Electrical Construction.

K. NFPA 70 - National Electrical Code.

L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Seismic Controls:
      a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.

5. Notify Architect 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 033000.

1.06 SUBMITTALS

A. See Section 013000 - 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.
2. Seismic Controls: Include seismic load capacities.

D. Shop Drawings - Seismic Controls:
1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify mounting conditions required for equipment seismic qualification.
3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
4. Indicate proposed arrangement of distributed system trapeze support groupings.
5. Indicate proposed locations for distributed system flexible fittings and/or connections.
6. Indicate locations of seismic separations where applicable.

E. Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

F. Evidence of qualifications for seismic controls designer.

G. Evidence of qualifications for manufacturer.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
1. Designer may be employed by the manufacturer of the seismic restraint products.

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

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SEISMIC CONTROL REQUIREMENTS

A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.

B. Seismic Design Criteria: ICC (IBC).

C. Component Importance Factor (Ip): Electrical components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.

D. Seismic Qualification of Equipment:
   1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
   2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
   3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
   4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

E. Seismic Restraints:
   1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
   2. Seismic Restraint Exemptions:
      a. Exemptions for Seismic Design Category D, E, and F:
         1) Electrical components with component importance factor (Ip) of 1.0 where all of the following apply:
            (a) The component is positively attached to the structure.
            (b) Flexible connections are provided between the component and associated ductwork, piping, and conduit.
            (c) Either:
               (1) The component weighs 400 pounds or less and has a center of mass located 4 feet or less above the adjacent floor level.
               (2) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
      b. Raceway Exemptions, All Seismic Design Categories:
         1) Conduits less than 2-1/2 inch trade size.
         2) Trapeze supported raceways weighing less than 10 pounds per foot.
         3) Hanger supported raceways where each hanger in the raceway run is 12 inches or less in length from the raceway support to the supporting structure; rod hangers, where used, to be equipped with swivels.
      c. Lighting Exemptions, All Seismic Design Categories:
         1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
         2) Lay-in luminaires weighing less than 56 pounds secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.
   3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
      a. ASHRAE (HVACA).

b. FEMA 413.
c. FEMA E-74.
d. SMACNA (SRM).

4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Restraint Systems:
   a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
   c. Use only one restraint system type for a given electrical component or distributed system (e.g., conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
   e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
   f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
   g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
   h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
   i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
   j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.

F. Seismic Attachments:
1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
   a. Increase size of pad as required to comply with anchor requirements.
   b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

G. Seismic Interactions:
1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.

2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.

H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
a. Relative displacements at connections between components, including distributed systems (e.g., conduit, cable tray); do not exceed load limits for equipment utility connections.
b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
c. Design displacements at seismic separations.
d. Anticipated drifts between floors.

2.02 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:
1. Seismic Restraint Systems:
a. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
b. Eaton Corporation: www.eaton.com/#sle.
c. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
d. Mason Industries: www.mason-ind.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.
3. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:
1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Seismic special inspections include, but are not limited to:
   1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.

D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

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

B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Secure fasteners according to manufacturer's recommended torque settings.

E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

F. Seismic Controls:
   1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
   2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
   3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
   4. Equipment with Sheet Metal Housings:
      a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
      b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
      c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
   5. Concrete Housekeeping Pads:
      a. Size in accordance with seismic design to meet anchor requirements.
      b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
   6. Seismic Restraint Systems:
      a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
      b. Install restraints within permissible angles in accordance with seismic design.
      c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
      d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
      e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

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

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Seismic Controls:
   1. Verify snubbing element air gaps.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

C. NFPA 70 - National Electrical Code.

D. NFPA 70E - Standard for Electrical Safety in the Workplace.

E. UL 969 - Marking and Labeling Systems.

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. No submittals required.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use lamicoid/phenolic identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Panelboards:
         1) Identify unique Parkway School District asset code with equipment number.
         2) Identify ampere rating.
         3) Identify voltage and phase.
         4) Identify power source and circuit number.

5) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
6) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
7) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

2. Use identification labels to identify each piece of electrical distribution and control equipment.
   a. Enclosed remote located switches, circuit breakers, and motor controllers:
      1) Identify voltage and phase.
      2) Identify power source and circuit number.
      3) Identify load(s) served.
3. Use identification label to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
4. Use identification label to identify disconnect location for equipment with remote disconnecting means.
5. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
6. Use identification label on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
7. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
8. 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: 5 by 7 inches.
   b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
9. Use warning signs to identify electrical hazardsat electrical room or area entrances with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
   2. Use identification label to identify color code for ungrounded and grounded power conductors at each piece of feeder or branch-circuit distribution equipment.
   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.
   4. Use underground warning tape to identify direct buried cables.

C. Identification for Raceways:
   1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
   2. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.

a. Maximum Intervals: 20 feet.
b. Color-Coded Bands: Use vinyl color coding electrical tape to mark bands 3 inches wide.
1) Color Code:
(a) Fire Alarm System: Red.
(b) Telephone System: White.
(c) HVAC Control System: Green.
(d) PA System: Grey.
(e) Cat5e Data System: Blue.
(f) Cat6 Data System: Violet.
(g) Security System: White.
(h) CCTV System: Yellow
2) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
c. Color Code:
1) Emergency Power System: Red.
2) Fire Alarm System: Red.
3. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.

D. Identification for Boxes and Enclosures larger than 100 cubic inches:
1. Use voltage markers to identify highest voltage present in power and lighting systems.
2. Use color coded vinyl labels with printed system name to identify specified systems.
a. Vinyl Tape Color Code:
1) Fire Alarm System: Red.
2) Telephone System: White.
3) HVAC Control System: Green.
4) PA System: Grey.
5) Data System: Blue.
6) Security System: White.
7) CCTV System: Yellow
3. Use warning labels to identify electrical hazards with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

E. Identification for Devices:
1. Use identification label to identify fire alarm system device number.
a. For fire alarm devices concealed above suspended ceilings, provide identification labeling on a white, standard size, single-gang, LED indicator cover plate flush mounted to ceiling tile below device location. Install a standard, signle-gang switch box in the ceiling to attach blank cover plate.
2. Use identification label to identify serving branch circuit for all receptacles.
a. For receptacles in public areas, provide identification on inside surface of wallplate.

F. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.
b. Outdoor Locations: Use plastic nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated electrically non-conductive phenolic with beveled edges; minimum thickness of 1/8 inch; engraved text.
a. Minimum Text Size: 1/2 inch
3. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
   1. Manufacturers:
      a. Brady Corporation: www.bradyid.com.
      b. Brother International Corporation: www.brother-usa.com/#sle.
      c. Panduit Corp: www.panduit.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.
   2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
      a. Use only for indoor locations.
   3. Text: Use machine-printed text. Do not use handwritten text.

C. Format for Receptacle Identification:
   1. Legend: Power source and circuit number or other designation indicated.
   2. Text: All capitalized.
   3. Minimum Text Height: 3/16 inch.
   4. Color: Black text on clear background.

D. Format for Fire Alarm Device Identification:
   1. Legend: Fire Alarm Device ID indicated on drawings.
   2. Text: All capitalized unless otherwise indicated.
   3. Minimum Text Height: 3/16 inch.
   4. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com.
   2. HellermannTyton: www.hellermanntyton.com/#sle.
   3. Panduit Corp: www.panduit.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl self-laminating type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use machine-printed text, all capitalized unless otherwise indicated.
   1. Do not use handwritten text.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl type markers.

D. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
   2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
   3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:

1. Markers for Voltage Identification: Highest voltage present.

F. Color: Black text on orange background.

2.05 UNDERGROUND WARNING TAPE

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial.

C. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
1. Materials:
a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
b. Outdoor Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
a. Do not use labels designed to be completed using handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches.

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. Locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Enclosure front.
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. Interior Components: Legible from the point of access.
6. Conduits: Legible from the floor.
7. Conductors and Cables: Legible from the point of access.
8. 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, rivets, self-adhesive backing, or epoxy cement 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. Secure rigid signs using stainless steel screws.

3.03 FIELD QUALITY CONTROL

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

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage digital lighting control systems.

B. Line-voltage switches and occupancy sensors.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems

C. Section 260533.16 - Boxes for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

F. Section 265100 - Interior Lighting.

G. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NFPA 70 - National Electrical Code.

F. UL 916 - Energy Management Equipment.

G. UL 1472 - Solid-State Dimming Controls.

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. 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 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include manufacturer's standad data sheets to 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. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

2. Provide One WattStopper LMCT-100 Digital Wireless Configuration Tool.

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 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.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 LOW-VOLTAGE LIGHTING CONTROL SYSTEMS

A. Manufacturer:
   1. WattStopper: www.wattstopper.com
      a. System:
         1) Digital Lighting Management (DLM)
   2. Substitutions: Not Permitted.

2.03 LINE-VOLTAGE SWITCHES AND OCCUPANCY SENSORS

A. Manufacturers:
   1. Hubbell Wiring Devices - Kellems (H-Moss): www.hubbell-wiring.com
   2. Substitutions: Not permitted.
   3. Source Limitations: Furnish products produced by a single manufacturer.

B. Combination Wall Switch-Occupancy Sensor:
   1. Hubbell Wiring Devices:
      a. Catalog Number: AD1277.
      b. Color: Ivory.
      c. Single or Dual Circuit, as noted on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: As indicated on the drawings.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 4 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions and the following guidance:
   1. Utilize Wattstopper DLM Device Model LMDC-100 where ceilings are 8 foot to 12 foot above finished floor.
   2. Utilize Wattstopper DLM Device Model LMDX-100 where ceilings are greater than 12 foot above finished floor. Mount on walls 8 foot to 12 foot above finsihed floor.

D. Connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.

G. Provide required supports in accordance with Section 260529.

H. 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.

I. Identify lighting control devices in accordance with Section 260553.

J. Occupancy Sensor Locations:
   1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
   2. Locate dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

K. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

L. Where indicated or required, provide cabinet or enclosure in accordance with Section 260533.16 for mounting of lighting control device system components.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - 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. 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, as necessary, to minimize undesired activations and to achieve desired function.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Location: At project site.

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lighting and appliance panelboards.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262813 - Fuses: Fuses for fusible switches and spare fuse cabinets.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA 407 - Standard for Installing and Maintaining Panelboards.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA PB 1 - Panelboards.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less.

G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

H. NFPA 70 - National Electrical Code.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

K. UL 67 - Panelboards.

L. UL 98 - Enclosed and Dead-Front Switches.

M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

N. UL 869A - Reference Standard for Service Equipment.

O. UL 943 - Ground-Fault Circuit-Interrupters.

P. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

Q. UL 1699 - Arc-Fault Circuit-Interrupters.

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 013000 - 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.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device.

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. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Substitutions: Not Permitted.

F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Seismic Qualification: Provide panelboards and associated components suitable for application under the seismic design criteria specified in Section 260548 where required. Include certification of compliance with submittals.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

D. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating as indicated on the drawings.

E. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

F. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

G. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

H. 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 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
   3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. 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 4X stainless steel.
   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 feed-through lugs or oversized lugs are provided.
      c. Provide painted steel boxes for surface-mounted panelboardswhere exposed to public view, finish to match fronts.
   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.

K. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

L. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list and label panelboards as a complete assembly including surge protective device.

M. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

N. Provide the following features and accessories where indicated or where required to complete installation:
   1. Feed-through lugs.
   2. Oversized lugs.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Copper.
   3. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic bolt-on type.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489; 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 as indicated on drawings.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.
      b. Provide compression lugs where indicated.
      c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
   6. Do not use handle ties in lieu of multi-pole circuit breakers.
   7. Do not utilize multi-pole circuit breakers for multi-wire branch circuits. Utilize single-pole breakers and single neutrals for every branch circuit instead.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 260529.

F. Provide required seismic controls in accordance with Section 260548.

G. Install panelboards plumb.

H. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

I. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

J. Mount floor-mounted power distribution panelboards on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.

K. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling.

L. Provide grounding and bonding in accordance with Section 260526.

M. Install all field-installed branch devices, components, and accessories.

N. Provide fuses complying with Section 262813 for fusible switches as indicated.

O. Where accessories are not self-powered, provide control power source as indicated on drawings.

P. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

Q. Set field-adjustable circuit breaker tripping function settings as indicated.

R. Provide filler plates to cover unused spaces in panelboards.

S. Identify panelboards in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

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

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1for all main circuit breakers. 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 AFCI circuit breakers to verify proper operation.

G. Test shunt trips to verify proper operation.

H. 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 262726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Wall plates.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260533.16 - Boxes for Electrical Systems.

C. Section 260533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 260583 - Wiring Connections: Cords and plugs for equipment.

F. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA WD 1 - General Color Requirements for Wiring Devices.

D. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

E. NFPA 70 - National Electrical Code.

F. UL 20 - General-Use Snap Switches.

G. UL 498 - Attachment Plugs and Receptacles.

H. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.

I. UL 943 - Ground-Fault Circuit-Interrupters.

J. UL 1449 - Standard for Surge Protective Devices.

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. 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. No submittals required.

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 FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Wiring Devices Installed in Finished Spaces: Ivory withivory nylon wall plate.

C. Wiring Devices Installed in Unfinished Spaces: Ivory withivory nylon wall plate.

D. Wiring Devices Installed in Wet or Damp Locations: Ivory with specified weatherproof cover.

E. Wiring Devices Installed in Rough Service Locations (Laboratories Workshops Gymnasiums Kitchens): Ivory with stainless steel wall plate.

F. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

G. Wiring Devices Connected to TVSS Power Panels: Grey with grey nylon wall plate.

2.02 WALL SWITCHES

A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.03 RECEPTACLES

A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.

B. Convenience Receptacles:
   1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
   2. 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.

C. GFCI Receptacles:
   1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
      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.

2.04 WALL PLATES

A. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard.
   3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

D. Weatherproof Covers for Wetor Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

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. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: As indicated on the drawings.
   2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   4. Locate wall switches on strike side of door with edge of wall plate 4 inches from edge of door frame. Where 4 inches is not possible due, 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. Connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.

J. Install wiring devices plumb and level with mounting yoke held rigidly in place.

K. Install wall switches with OFF position down.

L. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.

M. 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.

N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

O. Identify wiring devices in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

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

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch 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.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 265100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

E. Lamps.

F. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems.

B. Section 260533.16 - Boxes for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.

1.03 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code).

B. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.

C. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.

D. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction.

F. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems.

G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.

H. NFPA 70 - National Electrical Code.

I. NFPA 101 - Life Safety Code.

J. UL 924 - Emergency Lighting and Power Equipment.

K. UL 1598 - Luminaires.

L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

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 013000 - Administrative Requirements, for submittal procedures.

B. 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.

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: Instructions for each product including information on replacement parts.

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 PROTECTION

A. Receive, handle, and store products according to manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
   3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
   4. Air-Handling Recessed Fluorescent Luminaires: Suitable for air supply/return, heat removal, or combination as indicated.

H. 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.

I. LED Luminaire Components: UL 8750 recognized or listed as applicable.

2.03 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. 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.

C. Battery:
1. Sealed maintenance-free nickel cadmium unless otherwise indicated.
2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. 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 and similar signs for special purpose applications such as area of refuge/rescue assistance.

B. All Exit Signs: Internally illuminated with LEDs; complying withall applicable local and state codes, and listed and labeled as complying with UL 924.

C. Self-Powered Exit Signs:
1. 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.
2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
4. Provide low-voltage disconnect to prevent battery damage from deep discharge.

D. Accessories:
1. Provide compatible accessory wire guards where indicated.

2.05 DRIVERS

A. Manufacturers:
1. Alloy LED; www.alloyled.com/#sle.
2. General Electric Company/GE Lighting: www.gelighting.com/#sle.
3. Lutron Electronics Company, Inc; www.lutron.com/#sle.
4. OSRAM Sylvania, Inc: www.osram.us/ds/#sle.
5. Philips Lighting North America Corporation; www.usa.lighting.philips.com/#sle.
6. Substitutions: See Section 016000 - Product Requirements.

7. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.

B. 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.

2.06 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. Cree, Inc: www.cree.com.
5. Technical Consumer Products, Inc: www.tcpi.com.
6. Green Creative, LLC: www.gc-lighting.com.
7. Substitutions: See Section 016000 - Product Requirements.
8. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.

B. Lamps - General Requirements:
1. Provide new, compatible, operable LED 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: 4000K for each type of LED 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 ACCESSORIES

A. Threaded Rods for Suspended Luminaires: Zinc-plated steel, field-painted as directed.

B. Provide accessory plaster frameswhere indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

E. Provide required support and attachment in accordance with Section 260529.

F. Provide required seismic controls in accordance with Section 260548.

G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

H. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
   4. Secure pendant-mounted luminaires to building structure.
   5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
   6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
   7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

I. 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.

J. Suspended Luminaires:
   1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
   2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
   3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
   4. Install canopies tight to mounting surface.
   5. Support pendants from swivel hangers.

K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

L. Install accessories furnished with each luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Air Handling Luminaires: Interface with air handling accessories furnished and installed under Section 233600.

O. Emergency Lighting Units:
   1. Connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.

P. Exit Signs:
   1. Connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.

Q. Identify luminaires connected to emergency power system in accordance with Section 260553.

R. Install lamps in each luminaire.

S. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.04 FIELD QUALITY CONTROL

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

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs and emergency lighting 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. Air-Handling Luminaires with Air Control Blades or Heat Removal Dampers: Adjust as indicated or as required for proper airflow as directed by Architect.

D. 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 manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

B. 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 284600
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

B. Transmitters for communication with supervising station.

C. Does not include 120V power connections to fire alarm components.

D. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

E. Section 083323 - Overhead Coiling Doors: Coiling fire doors to be released by fire alarm system.

F. Section 087100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.

G. Section 211300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.

H. Section 233300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

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.

B. ADA Standards - 2010 ADA Standards for Accessible Design.

C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.

D. NFPA 70 - National Electrical Code.

E. NFPA 72 - National Fire Alarm and Signaling Code.

1.03 SUBMITTALS

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

B. Copies of design documents Submitted to Authorities Having Jurisdiction: 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.

C. 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.

D. Project Record Documents: See Section 017800 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.

E. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Contractor shall use ABF, Inc. as the installer. All work associated with the fire alarm shall be through the listed installer, including all conduit and wiring work.
1. Contact Information: Mike Wagner, O: 636-600-4705, E-mail: mikew@abfsecurity.com

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Edwards (A United Technologies Corporation Company): www.edwardsfiresafety.com

B. Substitutions: Not permitted.

2.02 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide modifications and extensions to the existing automatic fire detection and alarm system:
1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
2. Protected Premises: As shown on drawings.
3. Evacuation Alarm: General evacuation of entire premises.
4. Hearing Impaired Occupants: Provide visible notification devices in all public areas and in dwelling units.
5. Master Control Unit (Panel): Existing, See drawings for location.

B. Circuits:
1. Signaling Line Circuits (SLC): Match existing system.
2. Notification Appliance Circuits (NAC): Match existing system.

C. Spare Capacity:
1. When adding or relocating devices, add booster power supplies and control modules as necessary to maintain a fully operational fire alarm system.

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 components indicated and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system.

B. Clearly label components that are "Not In Service."

C. 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.

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
1. Sprinkler water flow.
2. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.
3. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
4. All heat detectors.
5. All smoke detectors.

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. Door Magnetic Holders: Release upon activation of smoke detectors on either side of door, upon alarm from all manual pull stations, and upon sprinkler activation.
2. 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 087100.
3. Overhead Coiling Fire Doors: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 083323.

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. See Section 260553 - Identification for Electrical Systems for labeling requirements.

B. Remote Annunciators: Match existing system.

C. Initiating Devices:
1. Manual Pull Stations: Match existing system.
2. Smoke Detectors: Match existing system.
3. Duct Smoke Detectors: Match existing system.
4. Heat Detectors: Match existing system.
5. Addressable Interface Devices: Match existing system.

D. Notification Appliances:

1. Strobes: Match existing system.
2. Combination Horn-Strobes: Match existing system

E. Circuit Conductors: Copper; color code and label per Section - Identification for Electrical Systems

F. Locks and Keys: Deliver keys to Owner.
1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 5 keys of each type

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.

H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
1. Record all system operations and malfunctions.
2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.03 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
1. Be prepared to conduct any of the required tests.
2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
3. Have authorized technical representative of control unit manufacturer present during demonstration.
4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
5. Repeat demonstration until successful.

B. Occupancy of the project will not occur prior to Substantial Completion.

C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
   1. All aspects of operation have been demonstrated to Owner.
   2. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
   3. Occupancy permit has been granted.

END OF SECTION