

SECTION 072400

EXTERIOR INSULATION AND FINISH SYSTEM RE-COATING AND REPAIR

PART I – GENERAL

1.01 SCOPE

- A. Provide all labor, materials and equipment necessary to clean, repair and apply waterproofing and restoration re-coating product over existing exterior insulation and finish systems (EIFS).

1.02 RELATED SECTIONS

- A. Joint Sealants 07 90 00

1.03 SYSTEMS DESCRIPTION

- A. Waterproof elastomeric coating and primer for use over existing exterior insulation and finish systems (EIFS).
- B. Class PB/Type A System: (For minor patching areas as indicated on drawings)
 - 1. Expanded polystyrene (EPS) insulation board adhered to substrate.
 - 2. Woven glass fiber fabric embedded in plastic veneer coat over insulation board.
 - 3. Finish coat with integral color and texture over veneer coat.

1.04 REFERENCES

- A. Section Includes
 - 1. ASTM E 96: Test Method for Water Vapor Transmission of Materials
 - 2. ASTM C 661-85: Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer
 - 3. ASTM D 660-93: Test Method for Evaluating Degree of Checking of Exterior Paints
 - 4. ASTM D 661-93: Test Method for Evaluating Degree of Cracking of Exterior Paints
 - 5. ASTM D 662-93: Test Method for Evaluating Degree of Erosion of Exterior Paints
 - 6. ASTM D 714-87: Test Method for Evaluating Degree of Blistering of Paints
 - 7. ASTM D 4214-89: Test Method for Evaluating Degree of Chalking of Exterior Paint Films
 - 8. ASTM D 2370-92: Test Methods for Tensile Properties of Organic Coatings
 - 9. Fed Spec TT-C-555-B Wind Driven Rain

1.05 SUBMITTALS

EXHIBIT 1
SPECIFICATIONS

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- A. Product Data: Catalog sheets, specifications, and installation instructions.
- B. Samples:
 - 1. The applicator shall submit two (2) 2 ft x 4 ft (.61 m x 1.2 m) samples of the proposed finish to the architect and/or owner for approval.
- C. Mock-up:
 - 1. A minimum 6 ft x 6 ft (1.8 m x 1.8 m) area of actual project wall shall be coated with the accepted finish to establish a standard of acceptance by the owner, architect or project manager.
- D. Quality Control Submittals:
 - 1. Installers Qualifications Data:
 - a. Name of each person who will be performing the Work.
 - b. Employer's name, business address and telephone number.
 - c. Names and addresses of the required number of similar projects that each person has worked on which meet the experience criteria.
 - 2. Company Field Advisor Data:
 - a. Name, business address and telephone number of Company Field Advisor secured for the required services.
 - b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
 - c. Services for which authorization is given by the Company, listed specifically for this project.
 - 3. Certificate: Affidavit required under Quality Assurance Article.
- E. Contract Closeout Submittals:
 - 1. Maintenance Data: Deliver 2 copies, covering the installed products, to the Director's Representative.
 - 2. Warranty: Copy of specified warranty.

1.06 QUALITY ASSURANCE

- A. Company's Qualifications:
 - 1. The company shall have been actively marketing the proposed exterior insulation and finish system for a minimum of 5 years.
 - 2. The proposed exterior insulation and finish system shall have been installed on a minimum of 5 projects of comparable scope and complexity to the Work of this section.
- B. Installer's Qualifications: The persons installing the exterior insulation and finish system and their Supervisor shall be personally experienced in exterior insulation and finish system installations and shall have been regularly employed by a Company engaged in the installation of exterior insulation and finish systems for a minimum of 5 years.
 - 1. Furnish to the Director the names and addresses of 5 similar projects which the foregoing people have worked on during the past 3 years.
- C. Certification:

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1. Affidavit signed by the Company Field Advisor, certifying the substrate is suitable for application of the System.
 2. Affidavit signed by the Company Field Advisor, certifying that the completed system meets the performance requirements.
- D. Materials provided for both patching and re-coating shall be from the same company.
- F. Pre-Installation Conference: Before the exterior insulation and finish system work is scheduled to commence, a conference will be called by the Director's Representative at the site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by the Contractor, the exterior insulation and finish system installer, and the Company Field Advisor.
- C. Performance Requirements
1. The specified Smooth coating shall meet or exceed the following tests:
 - a. Water Vapor Transmission (ASTM E 96 Water Method) - 15 perms at 10 mils dry film thickness.
 - b. Accelerated Weathering (ASTM G 26 Test Method 1, BH Apparatus)
 - 1) After 3,000 hours exposure, the coating shall exhibit as a minimum:
 - a) Chalking index of 9 per ASTM D 4214-89 Method B
 - b) Checking index of 10 per ASTM D 660-93
 - c) Cracking index of 10 per ASTM D 661-93
 - d) Blistering index of 10 per ASTM D 714-87
 - e) Erosion index of 9 per ASTM D 662-93
 - f) Rusting index of 10 per ASTM D 610-85
 - c. Salt Spray (Fog) Resistance (ASTM B 117-90)
 - 2) After 500 hours exposure, the coating shall exhibit as a minimum:
 - a) Chalking index of 10 per ASTM D 4214-89 Method B
 - b) Checking index of 10 per ASTM D 660-93
 - c) Cracking index of 10 per ASTM D 661-93
 - d) Blistering index of 10 per ASTM D 714-87
 - e) Erosion index of 10 per ASTM D 662-93
 - f) Rusting index of 10 per ASTM D 610-85
 - d. Hardness (ASTM C 661-85) Type A Shore Durometer; 69.5 @ 20 mils DFT
 - e. Impact Resistance (ASTM D 2794); 98 in-lbs.
 - f. Resistance to Wind Driven Rain (Federal Test Method TT-C-555B) - Passes
 - g. Low-Temperature Flexibility; 1/8 in (3.2 mm) diameter mandrel at -30 °F (-34 °C). No cracking or adhesion loss (Evaluated per ASTM D 522-88).
 - h. Tensile Properties (ASTM D 2370-92):
 - 3) Tensile Strength - 100 psi @ 77 °F (25 °C) 488 psi @ - 0 °F (18 °C)
 - 4) Elongation - 77% @ 77 °F (25 °C) 123% @ -0 °F (18 °C)

1.07 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with company's written recommendations regarding environmental conditions under which system can be applied.
- B. Protection
 - 1. Adjacent areas/materials shall be protected from damage, drops and spills during the application of specified materials.
 - 2. The specified materials shall be protected by permanent or temporary means from weather and other damage, prior to, during, and immediately after application. Care must be taken to prevent condensation and/or heat buildup when using tarp or plastic to prevent damage to the specified materials.

1.08 WARRANTY

- A. Special Warranty: The one-year period required by Paragraph 9.8 of the General Conditions is extended to 2 years for the Work of this section. Refer to Supplementary Conditions.
- B. Manufacturer's Warranty: In addition to the 2-year period specified above, furnish the exterior insulation and finish system company's printed 5-year warranty for the Work of this section.

PART 2 PRODUCTS

2.01 GENERAL

- A. Basis of design shall be Weatherlast products and Outsulation System products (Class PB/Type A System for minor patching areas) as supplied by and obtained from Dryvit or its authorized distributors and referenced herein. Substitutions or addition of other materials shall be strictly in accordance with Division 1 requirements and as approved by the Owner and Architect.

2.02 COMPONENTS

- A. Weatherlastic Elastomeric Coating
 - 1. Weatherlastic Smooth: A smooth, nontextured 100% acrylic based coating utilizing an elastomeric binder.
- B. Weatherprime Acrylic Primer: A pigmented, exterior, acrylic emulsion primer.

2.03 MATERIALS

- A. Water: Shall be clean and potable.
- B. Patching Material
 - 1. The following products have been evaluated and found to be compatible with Weatherlast products:

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- a. #5100 Plastiflex Elastomeric Adhesive Caulk (brush grade) - Available from Scott Paint (www.scottpaint.com) (1-800-282-2016)
 - b. #5200 Plastiflex Elastomeric Patching Compound (knife grade) - Available from Scott Paint (www.scottpaint.com) (1-800-282-2016)
- NOTE: Dryvit does not warrant the performance of the Scott Paint products.

- 2. EIFS systems repairs using Outsulation System products described in Dryvit publication DS498.
- C. Metal Flashings as indicated on the drawings: .050 Aluminum "L" thru wall flashing material matching existing configuration.
- D. Weather Resistant Vapor Barrier: Match existing type and thickness.

2.04 EQUIPMENT

- A. Mixing shall be done with a clean recommended Mixer #15311H7 powered by a 1/2 in (12.7 mm) drill at 400-500 RPM.
- B. Tools associated with the painting trade.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examination of Substrate.
 - 1. Ensure that the substrate is of a type and condition listed in previous sections.
- B. Ensure that minimum application temperatures are met per manufacturer's written instructions.

3.02 SUBSTRATE PREPARATION

- A. Coated Substrates
 - 1. Shall be cleaned to remove all chalk dirt, dust, loose coatings and other foreign materials.
 - 2. Loose, delaminated or spalled areas shall be repaired with an appropriate procedures and materials compatible with the substrate material.
- B. Minor cracks, small holes and divots shall be treated as follows:
 - 1. Minor static cracks can be bridged by Weatherlastic finishes without special treatment.
 - 2. Repair using procedures described in Dryvit publication DS498.
 - 3. Full cross-sectional repairs as indicated on the drawings in the EIFS surface shall be repaired using procedures described in Dryvit publication DS498 and Outsulation procedures. Install substrate, vapor barrier, flashings, insulation and coatings to match existing cross-sectional thickness and blend smoothly into existing surfaces in accordance with approved mock-up panels.

3.03 RE-COATING MATERIAL APPLICATIONS

- A. The substrate and substrate preparation shall be inspected by the contractor to ensure it is in compliance with this specification.
- B. Mixing

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1. Weatherlastic Smooth coating and Weatherprime shall be mixed thoroughly to a uniform homogeneous consistency using a manufacturers' recommended (or as required) powered by a 1/2 in (12.7 mm) drill 400-500 RPM or equivalent.
- C. General
1. The Weatherlastic Smooth coating can be brush, roller, or spray applied in accordance with specific product instructions.
 2. No additives shall be added under any circumstances.
 3. Weatherlastic Smooth shall be applied to an entire wall surface in a continuous application.
 4. The coating shall be protected from airborne contamination such as dust, soot, etc. and from weather and other damage until fully dried.
 5. The wall surfaces to be coated shall not be hot to the touch and the coating must be applied in the shade.
- D. Compatible Patching Material
1. Brush grade patching material shall be applied using a nylon brush to the required thickness.
 2. Knife grade patching material shall be applied using a putty knife or spatula to the required thickness.
- E. Weatherprime
1. Shall be applied to recommended coating thickness by brush, roller or airless spray equipment.
 2. A maximum 3/4 in (19 mm) nap polyester or polyester blend with nylon or lamb's wool, beveled ends and phenolic core is recommended.
 3. An 18 in (457 mm) wide roller frame with 2 1/4 in (57 mm) inside diameter roller is recommended.
 4. Apply in a continuous application, maintaining a wet edge, to a natural break.
- F. Weatherlastic Smooth Coating Application
1. Brush application recommended only for cutting in and trim, not for entire wall elevation.
 - a. Nylon bristle brush is recommended.
 - b. For waterproofing performance, a minimum 11 mils dry film thickness (22 mils wet film thickness), shall be applied.
 2. Roller Application
 - a. Minimum 10 in (254 mm) wide roller cover with 1 1/4 in - 1 1/2 in (32 mm – 38 mm) nap is recommended.
 - b. Completely saturate the roller cover and keep the roller loaded with coating to avoid foaming. Do not dry-roll or over-roll as this will cause excessive entrapment of air within the coating.
 - c. For waterproofing performance, a minimum 11 mils dry film thickness (22 mils wet film thickness), shall be applied.
 3. Spray Application
 - a. Application by airless spray equipment or mastic pump and gun allows application of coating at total required application rate with a minimum of stipple or thickness variations.
 - b. Equipment should have the capacity to pump minimum of 2 gal (7.6 L) of coating per minute.

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- c. Material hose should be minimum 1/2 in (12.7 mm) I.D. for spraying coating more than a 50 ft (15.2 m) length. Minimum bursting of 800 lbs (360 kg) is recommended.
- d. Tip orifice sizes of .021- .032 will be required depending on equipment used.
- e. Cross apply coating holding spray gun perpendicular to, and approximately three feet from the surface. Avoid excessive material build-up by holding spray gun away from the wall when pulling the trigger, then bringing gun across area to be coated. Maintain a wet edge, and avoid starting and stopping in the middle of the wall. Do not attempt to overreach spray pattern as this may result in appearance of irregular spray pattern. Place scaffolding and equipment to facilitate quick application without numerous interruptions.
- f. A 10% loss from overspray should be anticipated.
- g. Backrolling over sprayed areas is recommended to control pinholing on spray applications over porous surfaces.
- h. All sprayed applications must be free of pinholes to insure waterproofing performance.
- i. For waterproofing performance, a minimum 11 mils dry film thickness (22 mils wet film thickness), shall be applied.

3.05 CLEAN-UP

- A. Materials left over by the applicator at the job site shall be removed by the applicator.
- B. The applicator shall clean adjacent materials and surfaces and the work area of foreign materials resulting from their work.

-End of Section-

SECTION 078400

FIRESTOPPING

PART 1 GENERAL

1.01 REFERENCES

- A. UL 1479 Fire Tests of Through-Penetration Firestops.
- B. ASTM E 814 Method of Fire Tests of Through-Penetration Fire Stops.

1.02 DEFINITIONS

- A. UL Fire Resistance Directory: Product directory published yearly, with supplements, by Underwriters Laboratories Inc., containing listings and classifications in effect as of the published date for product categories covered by UL.
- B. Inchcape Directory of Listed Products: Product directory published yearly by Inchcape Testing Services containing listings which reflect certifications granted for materials, products, systems and equipment which have been tested by Inchcape Testing Services to recognized governing standards.
- C. Omega Point Laboratories Listings Directory: Product Directory published yearly by Omega Point Laboratories, Inc. containing listed building products, materials, and assemblies which have been tested by Omega Point Laboratories to recognized governing standards.
- D. Factory Mutual Approval Guide: Product directory published yearly, with supplements, by Factory Mutual Research Corp., containing listed building products, materials, and assemblies which have been tested by Factory Mutual Research Corp., to recognized governing standards.
- E. F Rating: Prohibits flame passage through the system and requires acceptable hose stream test performance.
- F. T Rating: Prohibits flame passage through the system and requires the maximum temperature rise on the unexposed surface of the wall or floor assembly, on the penetrating item and on the fill material not to exceed 325 degrees F above ambient, and requires acceptable hose stream test performance.
- G. Company Field Advisor: An employee of the Company which lists and markets the primary components of the system under their name who is certified in writing by the Company to be technically qualified in design, installation, and servicing of the required products or an employee of an organization certified by the foregoing Company to be technically qualified in design, installation and servicing of the required products. Personnel involved solely in sales do not qualify.

1.03 DESIGN REQUIREMENTS

- A. Devices and materials shall meet the hourly fire resistance ratings required by the Project as determined by UL 1479, or ASTM E 814 and be listed and detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 1. Exception: Where no listed designs exist that meet the requirements of a specific project condition, submit details and manufacturer's written recommendations for a design meeting the requirements. Include evidence of engineering judgement and extrapolation from listed designs.

1.04 SUBMITTALS

- A. Submittals Package: Submit the following items specified below the same time as a package:
 - 1. Product Data.
 - 2. Samples.
 - 3. Quality Control Submittals.
 - 4. Firestop Schedule.
- B. Product Data: Catalog sheets, specifications and installation instructions for each firestop device and material.
 - 1. Indicate design number for each firestop proposed to be used which is detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 2. State the specific locations where each firestop system is proposed to be installed.
- C. Samples: One of each product if requested.
- D. Quality Control Submittals:
 - 1. Design Data: Show details and include engineering information and manufacturer's written recommendations required under Design Requirements Article for each proposed firestop if other than a design detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - a. State the specific locations where each firestop is proposed to be installed.
 - 2. Installer's Qualifications Data:
 - a. Name of each person who will be performing the Work and their employer's name, business address and telephone number.
 - b. Names and addresses of 3 similar projects that each person has worked on during the past 5 years.
 - 3. Company Field Advisor Data:

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- a. Name, business address and telephone number of Company Field Advisor secured for the required services.
 - b. Certified statement from the Company listing the qualifications of the Company Field Advisor, and listing of services and each product specifically listed for this Project for which Company Field Advisor is given authorization by the Company to render advice.
- E. Firestop Schedule: Submit schedule itemizing the following:
- 1. Manufacturer's product reference numbers and/or drawing numbers.
 - 2. UL, Inchcape Testing Services, Factory Mutual Research Corp., or Omega Point Lab design number.
 - 3. Location of firestop material.
 - 4. Penetrating Item Description/Limits: Material, size, insulated or uninsulated, and combustibility.
 - 5. Maximum allowable annular space or maximum size opening.
 - 6. Wall type construction.
 - 7. Floor type construction.
 - 8. Hourly Fire resistance rating of wall or floor.
 - 9. F rating.
 - 10. T rating, if available.

NOTE: Firestop Schedule is for information only, and will not be acted on for approval.
Refer to Sample Firestop Schedule bound in Appendix.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: The persons installing the firestopping and their supervisor shall be personally experienced in firestop work and shall have been regularly employed by a company installing firestopping for a minimum of 3 years.
- B. Pre-Installation Conference: Before the firestop work is scheduled to commence, a conference will be called by the Director's Representative at the Site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by related trade Contractors (if any), their qualified firestopping installers, and associated firestopping manufacturer's Company Field Advisors.
- C. Container/Package Labels: Include manufacturer's name and identifying product number, date of manufacturer, lot number, shelf life (if applicable), qualified testing and inspecting agency classification marking, curing time, and mixing instructions for multi-component materials.
- D. Company Field Advisor: Secure the services of a Company Field Advisor for the following:
 - 1. Render advice regarding suitability of firestopping materials and methods.
 - 2. Assist in completing firestop schedule.

3. Attend pre-installation conference.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping materials to the Site in original, new unopened containers or packages bearing manufacturer's printed labels.
- B. Store and handle firestopping materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, etc.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Temperature: Do not install firestopping materials when ambient or substrate temperatures are outside limits permitted by manufacturer of firestopping materials.
 2. Humidity and Moisture: Do not install the Work of this Section under conditions that are detrimental to the application, curing, and performance of the materials.
 3. Ventilation: Provide sufficient ventilation wherever firestopping materials are installed in enclosed spaces. Follow manufacturer's recommendations.

1.08 SEQUENCING AND SCHEDULING

- A. Leave exposed those firestopping installations that are to be concealed behind other construction until the Director's Representative has examined each installation.

PART 2 PRODUCTS

2.01 FIRESTOPPING-GENERAL

- A. Through-Penetration Firestop Devices, Forming Materials, And Fill, Void or Cavity Materials: As listed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 1. For firestopping exposed to moisture, furnish products that do not deteriorate when exposed to this condition.
 2. For firestopping systems exposed to view, furnish products with flame-spread values of less than 25 and smoke developed values less than 50, as determined per ASTM E 84.
- B. Accessories: Components required to install fill materials as recommended by the firestopping manufacturer for particular approved fire rated system.
- C. Identification Labels:

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1. Furnished by fire stopping manufacturer of suitable material for permanent field identification of through-penetration firestops.
2. Identify the following:
 - a. "WARNING - FIRESTOP MATERIAL".
 - b. Company Name.
 - c. Product Catalog number.
 - d. F rating.
 - e. T rating, if available.
3. Field fabricated labels are not acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine existing through-penetrations of floors, walls, partitions, ceilings and roofs in the Work areas.
- B. Where firestopping is missing or not intact, submit a written report to the Director's Representative describing the existing conditions.

3.02 PREPARATION

- A. Clean out openings immediately before installation of through-penetration firestopping. Comply with recommendations of firestopping manufacturer and the following requirements:
 1. Remove foreign materials from surfaces of openings, and from penetrating items that could interfere with adhesion of firestopping.
 2. Clean opening and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form release agents from concrete.
- B. Protection:
 1. Protect surfaces adjacent to through-penetration firestops with non-staining removable masking tape or other suitable covering to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or that would be caused by cleaning methods used to remove smears from firestopping materials.
- C. Substrate Priming:
 1. Prime substrates in accordance with the firestopping manufacturer's printed installation instructions using recommended products and methods.
 2. Do not allow primer to spill or migrate onto adjoining exposed surfaces.

3.03 INSTALLATION OF THROUGH PENETRATION FIRESTOPS

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- A. Use through-penetration firestop devices, forming materials, and fill, void or cavity materials to form through-penetration firestops to prevent the passage of flame, and limit temperature rise of the unexposed surface as detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 1. Where applicable design is not detailed in the Directories, use forming materials and fill, void or cavity material to form through-penetration firestop in accordance with approved printed details and installation instructions from the company producing the forming materials and fill, void or cavity material.
 - 2. If the construction type(s) of the building cannot be determined, provide firestopping with fire resistance ratings as specified in the Building Code of New York State, Tables 720.1(1), 720.1(2), 720.1(3), and 302.3.2.
- B. Provide through-penetration firestop systems with F ratings which shall equal or exceed the fire resistance rating of the penetrated building construction.
- C. Provide through-penetration firestop systems with T ratings, in addition to F ratings, at floors where the following conditions exist:
 - 1. Where firestop systems protect penetrations located outside the wall cavities.
 - 2. Where firestop systems protect penetrations located outside fire resistive shaft enclosures.
 - 3. Through-penetration firestop systems protecting floor penetrations require a T-rating of at least 1 hour, but not less than the required floor fire-resistance rating.
- D. Firestop through-penetrations of floors, walls, partitions, ceilings, and roofs.
- H. In areas where through-penetration items have been installed before the construction work, firestop the through-penetration items after the construction work has been completed. Furnish drawings or written information to the Construction Work Contractor covering the provisions to be made in the construction work to enable firestopping of the through-penetration items.
- I. Permanently affix label at each firestop. Use adhesive compatible with surface construction at firestop location.

3.04 CLEANING

- A. Clean off excess fill materials and sealants adjacent to penetrations by methods and cleaning materials recommended by manufacturers of firestopping products and of products in which penetrations occur.
- B. Remove masking tape as soon as practical so as not to disturb the firestopping's bond with substrate.
- C. Protect firestopping during and after curing period from contact with contaminating substances, or damage resulting from adjacent Work.

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- D. Cut out and remove damaged or deteriorated firestopping immediately, and install new materials as specified in firestop schedule.

END OF SECTION

SECTION 079200

JOINT SEALERS

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. EIFS 072400

1.02 SUBMITTALS

- A. Product Data: Catalog sheets, specifications, and installation instructions for each product specified except miscellaneous materials.
- B. Samples:
 - 1. Sealants: One pint or standard tube.
 - 2. Joint Fillers: 24 inch long full section.
 - 3. Gaskets: 24 inch long full section.
 - 4. Joint Primer/Sealer/Conditioners: One pint.
 - 5. Backer Rods: 24 inch long full section.
 - 6. Bond Breaker Tape: 24 inch long full section.
- C. Quality Control Submittals:
 - 1. Installer's Qualifications Data: Affidavit required under Quality Assurance Article.
 - 2. Company Field Advisor Data: Name, business address, and telephone number of Company Field Advisor.

1.03 QUALITY ASSURANCE

- A. Installer's Qualifications: The persons installing the sealants and their supervisor shall be personally experienced in the installation of sealants and shall have been regularly employed by a company engaged in the installation of sealants for a minimum of two years.
 - 1. Furnish to the Director the names and addresses of five similar projects which the foregoing people have worked on during the past two years.
 - 2. Furnish a letter from the sealant manufacturer, stating that the foregoing people are authorized to install the manufacturer's sealant materials and that the manufacturer's specifications are applicable to the requirements of this Project.
- B. Container Labels: Include manufacturer's name, trade name of product, kind of material, federal specification number (if applicable), expiration date (if applicable), and packaging date or batch number.
- C. Warranties:
 - 1. Silicone sealants: 20 years Weatherseal Warranty.

1.04 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Temperature: Unless otherwise approved or recommended in writing by the sealant manufacturer, do not install sealants at temperatures below 40 degrees F or above 85 degrees F for non silicone sealants and below minus 20 degrees F or above 125 degrees F for silicone sealants.
 - 2. Humidity and Moisture: Do not install the Work of this section under conditions that are detrimental to the application, curing, and performance of the materials.
- B. Protection:
 - 1. Protect all surfaces adjacent to sealants with non-staining removable tape or other approved covering to prevent soiling or staining.
 - 2. Protect all other surfaces in the Work area with tarps, plastic sheets, or other approved coverings to prevent defacement from droppings.

PART 2 PRODUCTS

2.01 SEALANTS

- A. Type 1 Sealant, any of the following generic types:
 - 1. One-part, low-modulus silicone sealant: Dow Corning 790, General Electric Silpruf, Pecora 864, Pecora 890, Pecora 890FTS.

2.02 JOINT FILLERS

- A. Closed Cell Neoprene Joint Filler: ASTM D 1056, Class SC (oil resistant and medium swell), 2 to 5 psi compression deflection.

2.03 MISCELLANEOUS MATERIALS

- A. Joint Primer/Sealer/Conditioner: As recommended by the sealant manufacturer for the particular joint surface materials and conditions.
- B. Backer Rod: Compressible rod stock of expanded, extruded polyethylene.
- C. Bond Breaker Tape: Polyethylene or other plastic tape as recommended by the sealant manufacturer; non-bonding to sealant; self adhesive where applicable.
- D. Cleaning Solvents: Oil free solvents as recommended by the sealant manufacturer. Do not use re-claimed solvents.
- E. Masking Tape: Removable paper or fiber tape, self-adhesive, non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine all joint surfaces for conditions that may be detrimental to the performance of the completed Work. Do not proceed until satisfactory corrections have been made.

3.02 PREPARATION

- A. Clean joint surfaces immediately before installation of sealant and other materials specified in this Section.
 - 1. Remove all loose materials, dirt, dust, rust, oils and other foreign matter that will impair the performance of materials installed under this Section.
 - 2. Remove lacquers, protective coatings and similar materials from joint faces with manufacturer's recommended solvents.
 - 3. Do not limit cleaning of joint surfaces to solvent wiping. Use methods such as grinding, acid etching or other approved and manufacturer's recommended means, if required, to clean the joint surfaces, assuring that the sealant materials will obtain positive and permanent adhesion.
- B. Priming Joint Surfaces:
 - 1. Prime joints which are to receive Type 1 Sealants.
 - 6. Do not allow the primer/sealer to spill or migrate onto adjoining surfaces.

3.03 JOINT BACKING INSTALLATION

- A. Install bond breaker tape in relaxed condition as it comes off the roll. Do not stretch the tape. Lap individual lengths.
- B. Install backer rod of sufficient size to fill the joint width at all points in a compressed state. Compress backer rod at the widest part of the joint by a minimum of 25 percent. Do not cut or puncture the surface skin of the rod.

3.04 SEALANT INSTALLATION

- A. Except as shown or specified otherwise, install sealants in accordance with the manufacturer's printed instructions.
- B. Install sealants with ratchet hand gun or other approved mechanical gun. Where gun application is impractical, install sealant by knife or by pouring as applicable.

3.05 FIELD QUALITY CONTROL

- A. Test Samples:

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1. Where directed, for each 50 linear feet of joint installed, cut out and carefully remove a 6-inch-long sample of the undisturbed sealant and joint backer material from the newly installed Work. Remove the samples in the presence of the Director's Representative who will retain them for evaluating and testing.
2. Reseal cut out areas with the same materials.

3.06 CLEANING

- A. Immediately remove misapplied sealant and droppings from metal surfaces with solvents and wiping cloths. On other materials, remove misapplied sealant and droppings by methods and materials recommended in writing by the manufacturer of the sealant material.
- B. After sealants are applied and before skin begins to form on sealant, remove all masking and other protection and clean up remaining defacement caused by the Work.

END OF SECTION

SECTION 260501

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and installation instructions.
 - 1. For fire rated construction, prove that materials and installation methods proposed for use are in accordance with the listing requirements of the classified construction.

PART 2 PRODUCTS

2.01 RACEWAYS, FITTINGS AND ACCESSORIES

- A. Rigid Ferrous Metal Conduit: Steel, hot dipped galvanized on the outside and inside, UL categorized as Rigid Ferrous Metal Conduit (identified on UL Listing Mark as Rigid Metal Conduit - Steel or Rigid Steel Conduit), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.
- B. Intermediate Ferrous Metal Conduit: Steel, galvanized on the outside and enameled on the inside, UL categorized as Intermediate Ferrous Metal Conduit (identified on UL Listing Mark as Intermediate Metal Conduit or IMC), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.
- C. Electrical Metallic Tubing: Steel, galvanized on the outside and enameled on the inside, UL categorized as Electrical Metallic Tubing (identified on UL Listing Mark as Electrical Metallic Tubing), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.
- D. Flexible Metal Conduit: Galvanized steel strip shaped into interlocking convolutions, UL categorized as Flexible Metal Conduit (identified on UL Listing Mark as Flexible Steel Conduit or Flexible Steel Conduit Type RW), by AFC Cable Systems Inc., Anamet Electrical Inc., Electri-Flex Co., or International Metal Hose Co.
- E. Liquid-tight Flexible Metal Conduit: UL categorized as liquid-tight flexible metal conduit (identified on UL Listing Mark as Liquid-Tight Flexible Metal Conduit, also specifically marked with temperature and environment application data), by AFC Cable Systems Inc., Anamet Electrical Inc., Electri-Flex Co., or Universal Metal Hose Co.
- F. Surface Metal Raceway, Fittings and Accessories: By Thomas & Betts Corp., Mono-Systems Inc. or Wiremold Co. Area and conductor capacity indicated for each size raceway is for reference. Follow manufacturer's recommended raceway capacity for all types and sizes of conductors:

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1. Size 1: Nominal area .3 sq. in. min., 4 No. 12 THW max.; Thomas & Betts B400, Mono-Systems SMS 700, or Wiremold's V700.
 2. Size 2: Nominal area .75 sq. in. min., 11 No. 12 THW max.; Thomas & Betts SR250, Mono-Systems SMS2100, Wiremold's 2100.
 3. Size 3: Nominal area 2.8 sq. in. min., 43 No. 12 THW max.; Thomas & Betts SR500, Mono-Systems SMS3200, or Wiremold's G3000.
- G. Wireways, Fittings and Accessories:
1. NEMA 1 (Without Knockouts): Hoffman Enclosures Inc. Bulletin F-40, Hubbell/Wegmann's HSK, Lee Products Co.'s S Series, Rittal/Electromate's EW & EWHC Lay-In Wireway System, or Square D Co.'s Square-Duct Class 5100.
- H. Insulated Bushings, Plastic Bushings, and Insulated Grounding Bushings: By Appleton Electric Co., Cooper/Crouse-Hinds, OZ/Gedney Co., or Thomas & Betts Corp.
- I. Connectors and Couplings:
1. Locknuts: UL, steel/zinc electroplate; Appleton Electric Co.'s BL-50 Series, Cooper/Crouse-Hinds' 11 Series, OZ/Gedney Co.'s 1-50S Series, Raco Inc.'s 1002 Series, Steel City/T&B Corp.'s LN-101 Series, or Thomas & Betts Corp.'s 141 Series.
 2. Couplings (For Rigid Metal and IMC Conduit): Standard galvanized threaded couplings as furnished by conduit manufacturer, Allied Tube & Conduit Corp.'s Kwik-Couple, or Thomas & Betts Corp.'s Shamrock.
 3. Three Piece Conduit Coupling (For Rigid Metal and IMC Conduit): Steel, malleable iron, zinc electroplate; Allied Tube & Conduit Corp.'s Kwik-Couple, Appleton Electric Co.'s EC-50 Series, Cooper/Crouse-Hinds' 190M Series, OZ/Gedney Co.'s 4-50 Series, Raco Inc.'s 1502 Series, Steel City/T & B Corp.'s EK-401 Series, or Thomas & Betts Corp.'s 675 Series.
 4. Electrical Metallic Tubing Couplings and Insulated Connectors: Compression type, steel/zinc electroplate; Appleton Electric Co.'s TW-50CS1, TWC-50CS Series, Cooper/Crouse-Hinds' 1650, 660S Series, Raco Inc.'s 2912, 2922 Series, Steel City/T & B Corp.'s TC-711 Series, or Thomas & Betts Corp.'s 5120, 5123 Series.
 5. Flexible Metal Conduit Connectors: Arlington Industries Inc.'s Saddle-Grip, OZ/Gedney Co.'s C-8T, 24-34T, ACV-50T Series, or Thomas & Betts Corp.'s Nylon Insulated Tite-Bite Series.
 6. Liquid-tight Flexible Metal Conduit Connectors:
 - a. Dry, Damp Locations: Steel, malleable iron, zinc electroplate, insulated throat; Appleton Electric Co.'s STB Series, Cooper/Crouse-Hinds' LTB Series, OZ/Gedney Co.'s 4Q-50T Series, Raco Inc.'s 3512 Series, Steel City/T & B Corp.'s LT-701 Series, or Thomas & Betts Corp.'s 5332 Series.
 - b. Wet Locations: OZ/Gedney Co.'s 4Q-TG Series (hot-dip/mechanically galvanized), or Thomas & Betts Corp.'s 3322 Series (PVC coated).
- J. Conduit Bodies (Threaded):

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1. Dry, Damp Locations: Zinc electroplate malleable iron or cast iron alloy bodies with zinc electroplate steel covers; Appleton Electric Co.'s Unilets, Cooper/Crouse-Hinds' Condulets, OZ/Gedney Co.'s Conduit Bodies, or Thomas & Betts Corp.'s Conduit Bodies.
 2. Wet Locations: Malleable iron or cast iron alloy bodies and covers with hot dipped galvanized or other specified corrosion resistant finish; Cooper/Crouse-Hinds' Condulets (Corro-free epoxy powder coat), Thomas & Betts Corp.'s Conduit Bodies (hot dipped galvanized), or OZ/Gedney Co.'s Conduit Bodies (hot dipped galvanized). Stainless steel cover screws, covers gasketed to suit application.
- K. Expansion Fittings:
1. Dry, Damp Locations:
 - a. Malleable iron, zinc electroplate finish: Appleton Electric Co.'s XJ or OZ/Gedney Co.'s AX (TX for EMT), with external bonding jumper.
 - b. Electrogalvanized Steel: Cooper/Crouse-Hinds' XJG (XJG-EMT for EMT), or Thomas & Betts Corp.'s XJG, with internal grounding.
 2. Wet Locations: Cooper/Crouse-Hinds XJG (Corro-free epoxy powder coat), OZ Gedney Co.'s AX, EXE (end type, hot dipped galvanized), or Thomas & Betts Corp.'s XJG (hot dipped galvanized).
- L. Deflection Fittings:
1. Dry, Damp Locations: Appleton Electric Co.'s DF, Cooper/Crouse-Hinds' XD, or OZ/Gedney Co.'s Type DX.
 2. Wet Locations: Ductile iron couplings with hot dipped galvanized finish, neoprene sleeve, and stainless steel bands, Appleton Electric Co.'s CF; or bronze couplings, neoprene sleeve, and stainless steel bands, OZ/Gedney Co.'s Type DX.
- M. Sealing Fittings:
1. Dry, Damp Locations: Appleton Electric Co.'s EYS, ESU w/Kwiko sealing compound and fiber filler, Cooper/Crouse-Hinds' EYS, EZS w/Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EY, EYA with EYC sealing compound and EYF damming fiber, or Thomas & Betts Corp.'s. EYS w/Chico A sealing compound and Chico X filler.
 - a. Other Type Fittings: As required to suit installation requirements, by Appleton Electric Co., Cooper/Crouse-Hinds, OZ/Gedney Co, or Thomas & Betts Corp.
 2. Wet Locations: Malleable iron body with hot dipped/mechanically galvanized finish, neoprene sleeve, and stainless steel bands, Appleton electric Co.'s CF; or bronze couplings, neoprene sleeve, and stainless steel bands, OZ/Gedney Co.'s Type DX.
 - a. Horizontal: Cooper/Crouse-Hinds' EYS with Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EYD with EYC sealing compound and EYF damming fiber, or Thomas & Betts Corp.'s. EYS w/Chico A sealing compound and Chico X filler.
 - b. Vertical (with Drain): Cooper/Crouse-Hinds with Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EY, EYA with EYC sealing compound and EYF damming fiber, or

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- Thomas & Betts Corp.'s. w/Chico A sealing compound and Chico X filler.
- c. Other Type Fittings. As required to suit installation requirements, by Cooper/Crouse-Hinds, OZ/Gedney Co., or Thomas & Betts Corp. with hot dipped/mechanically galvanized finish or epoxy powder coat.
- N. Sealant for Raceways Exposed to Different Temperatures: Sealing compounds and accessories to suit installation; Appleton Electric Co.'s DUC, or Kwiko Sealing Compound with fiber filler, Cooper/Crouse-Hinds' Chico A Sealing Compound with Chico X fiber, Electrical Products Division 3M Scotch products, OZ Gedney Co.'s DUX or EYC sealing compound with EYF damming fiber, or Thomas & Betts Corp.'s Blackburn DX.
- O. Vertical Conductor Supports:
 - 1. Dry, Damp Locations: Kellems/Hubbell Inc.'s Conduit Riser Grips, or OZ/Gedney Co.'s Type M, Type R.
 - 2. Wet Locations: Kellems/Hubbell Inc.'s Conduit Riser Grips (stainless steel or tin coated bronze), or OZ/Gedney Co.'s hot dipped galvanized finish Type CMT or Type W.

2.02 OUTLET, JUNCTION, AND PULL BOXES

- A. Galvanized Steel Outlet Boxes: Standard galvanized steel boxes and device covers by Appleton Electric Co., Beck Mfg./Picoma Industries, Cooper/Crouse-Hinds, Racor/Div. of Hubbell, or Steel City/T & B Corp.
- B. Galvanized Steel Junction and Pull Boxes: Code gage, galvanized steel screw cover boxes by Delta Metal Products Inc., Hoffman Enclosures Inc., Hubbell Wiegmann, Lee Products Co., or Rittal/Electromate.
- C. Threaded Type Boxes:
 - 1. Outlet Boxes:
 - a. For Dry, Damp Locations: Zinc electroplate malleable iron or cast iron alloy boxes by Appleton Electric Co., Cooper/Crouse-Hinds Co., OZ/ Gedney Co., or Thomas & Betts Corp. with zinc electroplate steel covers to suit application.
 - b. For Wet Locations: Malleable iron or cast iron alloy boxes with hot dipped galvanized or other specified corrosion resistant finish as produced by Cooper/Crouse-Hinds (hot dipped galvanized or Corro-free epoxy powder coat), OZ/Gedney Co. (hot dipped galvanized), or Thomas & Betts Corp. (hot dipped galvanized) with stainless steel cover screws, and malleable iron covers gasketed to suit application.
 - 2. Junction And Pull Boxes:
 - a. For Dry, Damp Locations: Zinc electroplate cast iron boxes by Appleton Electric Co., Cooper/Crouse-Hinds, OZ/Gedney Co., or Thomas & Betts Corp. with zinc electroplate steel or cast iron cover.
 - b. For Wet Locations: Cast iron boxes by Cooper/Crouse-Hinds' (hot dipped galvanized or Corro-free epoxy powder coat),

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- OZ/Gedney Co. (hot dipped galvanized), or Thomas & Betts Corp. (hot dipped galvanized) with stainless steel cover screws and cast iron cover gasketed to suit application.
3. Conduit Bodies, Threaded (Provided with a Volume Marking):
- a. For Dry, Damp Location: Zinc electroplate malleable iron or cast iron alloy bodies with zinc electroplate steel covers; Appleton Electric Co.'s Unilets, Cooper/Crouse-Hinds' Condulets, OZ/Gedney Co.'s Conduit Bodies, or Thomas & Betts Corp.'s Conduit Bodies.
- b. For Wet Locations: Malleable iron or cast iron alloy bodies with hot dipped galvanized or other specified corrosion resistant finish; Cooper/Crouse-Hinds' Condulets (hot dipped galvanized or Corro-free epoxy power coat), OZ/Gedney Co.'s Conduit Bodies (hot dipped galvanized), or Thomas & Betts Corp.'s Conduit Bodies (hot dipped galvanized) with stainless steel cover screws and malleable iron covers gasketed to suit application.
- D. Specific Purpose Outlet Boxes: As fabricated by equipment manufacturers for mounting their equipment thereon.
- E. Outlet Boxes and Related Products for Fire Rated Construction:
1. Parameters For Use of Listed Metallic Outlet or Switch Boxes: UL Electrical Construction Equipment Directory - Metallic Outlet Boxes (QCIT).
2. Wall Opening Protective Materials: As listed in UL Fire Resistance Directory - Wall Opening Protective Materials (CLIV), or UL Electrical Construction Equipment Directory - Wall Opening Protective Materials (QCSN).

2.03 CONDUCTORS AND ACCESSORIES

- A. Date of Manufacture: No insulated conductor more than one year old when delivered to the site will be acceptable.
- B. Acceptable Companies: American Insulated Wire Corp., BICC General Cable Industries Inc., Cerro Wire & Cable Co. Inc., Pirelli Cable Corp., Rome Cable Corp., or Southwire Co..
- C. Conductors: Annealed uncoated copper or annealed coated copper in conformance with the applicable standards for the type of insulation to be applied on the conductor. Conductor sizes No. 8 and larger shall be stranded.
- D. Types:
1. Electric Light and Power Wiring:
- a. General: Rated 600V, NFPA 70 Type FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, XHHW-2.
- b. THWN Gasoline and Oil Resistant: Polyvinylchloride insulation rated 600 V with nylon jacket conforming to UL requirements for type THWN insulation, with the words "GASOLINE AND OIL RESISTANT II" marked thereon.

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- c. USE, USE-2: Dual rated heat and moisture resistant insulation rated 600 V with jacket or dual purpose insulation/protective covering conforming to UL requirements for type USE service entrance cables.
 - 2. Class 1 Wiring:
 - a. No. 18 and No. 16 AWG: Insulated copper conductors suitable for 600 volts, NFPA 70 types KF-2, KFF-2, PAFF, PF, PFF, PGF, PGFF, PTFE, SF-2, SFF-2, TF, TFF, TFN, TFFN, ZF, or ZFF.
 - b. Larger than No. 16 AWG: Insulated copper conductors suitable for 600 volts, in compliance with NFPA 70 Article 310.
 - c. Conductor with other types and thickness of insulation may be used if listed for Class 1 circuit use.
 - 3. Class 2 Wiring:
 - a. Multiconductor Cables: NFPA 70 Article 725, Types CL2P, CL2R, CL2.
 - b. Other types of cables may be used in accordance with NFPA 70 Table 725-61 "Cable Uses and Permitted Substitutions", as approved.
 - 4. Class 3 Wiring:
 - a. Single Conductors No. 18 and No. 16 AWG: Same as Class 1 No. 18 and No. 16 AWG conductors, except that:
 - 1) Conductors are also listed as CL3.
 - 2) Voltage rating not marked on cable except where cable has multiple listings and voltage marking is required for one or more of the listings.
 - b. Multiconductor Cables: NFPA 70 Article 725, Types CL3P, CL3R, CL3.
 - c. Other types of cables may be used in accordance with NFPA 70, Table 725-61 "Cable Uses and Permitted Substitutions", as approved.
- E. Connectors:
 - 1. General: Connectors specified are part of a system. Furnish connectors and components, and use specific tools and methods as recommended by connector manufacturer to form complete connector system.
 - 2. Splices:
 - a. Spring Type:
 - 1) Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s B-Cap, Electrical Products Div./3M's Scotchlok Type Y, R, G, B, O/B+, R/Y+, or B/G+, or Ideal Industries Inc.'s Wing Nuts or Wire Nuts.
 - 2) Rated 150° C, 600V; Ideal Industries Inc.'s High Temperature Wire-Nut Model 73B, 59B.
 - b. Indent Type with Insulating Jacket:
 - 1) Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s Crimp Connectors, Ideal Industries Inc.'s Crimp Connectors, Penn-Union Corp.'s Penn-Crimps, or Thomas & Betts Corp.'s STA-KON.
 - c. Indent Type (Uninsulated): Anderson/Hubbell's Versa-Crimp, VERSAtile, Blackburn/T&B Corp.'s Color-Coded Compression

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- Connectors, Electrical Products Div./3M's Scotchlok 10000, 11000 Series, Framatome Connectors/Burndy's Hydent, Penn-Union Corp.'s BCU, BBCU Series, or Thomas & Betts Corp.'s Compression Connectors.
 - d. Connector Blocks: NIS Industires Inc.'s Polaris System, or Thomas & Betts Corp.'s Blackburn AMT Series.
 - e. Resin Splice Kits: Electrical Products Div./3M's Scotchcast Brand Kit Nos. 82A Series, 82-B1 or 90-B1, or Scotchcast Brand Resin Pressure Splicing Method.
 - f. Heat Shrinkable Splices: Electrical Products Div./3M's ITCSN, Raychem Corp.'s Thermofit Type WCS, or Thomas & Betts Corp.'s SHRINK-KON Insulators.
 - g. Cold Shrink Splices: Electrical Products Div./3M's 8420 Series.
 - 2. Gutter Taps: Anderson/Hubbell's GP/GT with GTC Series Covers, Blackburn/T&B Corp.'s H-Tap Type CF with Type C Covers, Framatome Connectors/Burndy's Polytap KPU-AC, H-Crimpit Type YH with CF-FR Series Covers, ILSCO's GTA Series with GTC Series Covers, Ideal Industries Inc.'s Power-Connect GP, GT Series with GIC covers, NSI Industries Inc.'s Polaris System, OZ/Gedney Co.'s PMX or PT with PMXC, PTC Covers, Penn-Union Corp.'s CDT Series, or Thomas & Betts Corp.'s Color-Keyed H Tap CHT with HTC Covers.
 - 3. Terminals: Nylon insulated pressure terminal connectors by Amp-Tyco/Electronics, Electrical Products Div./3M, Framatome Connectors/Burndy, Ideal Industries Inc., Panduit Corp., Penn-Union Corp., Thomas & Betts Corp., or Wiremold Co.
 - 4. Lugs:
 - a. Single Cable (Compression Type Lugs): Copper, one or 2 hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Framatome Connectors/Burndy's Hylug YA, Electrical Products Div./3M Scotchlok 31036 or 31145 Series, Ideal Industires Inc.'s CCB or CCBL, NSI Industries Inc.'s L, LN Series, Penn-Union Corp.'s BBLU Series, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.
 - b. Single Cable (Mechanical Type Lugs): Copper, one or 2 hole style (to suit conditions); Blackburn/T&B Corp.'s Color-Keyed Locktite Series, Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Locktite Series.
 - c. Multiple Cable (Mechanical Type Lugs): Copper, configuration to suit conditions; Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Color-Keyed Locktite Series.
- F. Tapes:
- 1. Insulation Tapes:
 - a. Plastic Tape: Electrical Products Div./3M's Scotch Super 33+ or Scotch 88, Plymouth Rubber Co.'s Plymouth/ Bishop Premium 85CW.

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- b. Rubber Tape: Electrical Products Div./3M's Scotch 130C, or Plymouth Rubber Co.'s Plymouth/Bishop W963 Plysafe.
 2. Moisture Sealing Tape: Electrical Products Div./3M's Scotch 2200 or 2210, or Plymouth Rubber Co.'s Plymouth/Bishop 4000 Plyseal-V.
 3. Electrical Filler Tape: Electrical Products Div./3M's Scotchfil, or Plymouth Rubber Co.'s Plymouth/Bishop 125 Electrical Filler Tape.
 4. Color Coding Tape: Electrical Products Div./3M's Scotch 35, or Plymouth Rubber Co.'s Plymouth/Bishop Premium 37 Color Coding.
 5. Arc Proofing Tapes:
 - a. Arc Proofing Tape: Electrical Products Div./3M's Scotch 77, Mac Products Inc.'s AP Series, or Plymouth Rubber Co.'s Plymouth/Bishop 53 Plyarc.
 - b. Glass Cloth Tape: Electrical Products Div./3M's Scotch 27/Scotch 69, Mac Products Inc.'s TAPGLA 5066, or Plymouth Rubber Co.'s Plymouth/Bishop 77 Plyglas.
 - c. Glass-Fiber Cord: Mac Products Inc.'s MAC 0527.
- G. Wire-Pulling Compounds: To suit type of insulation; American Polywater Corp.'s Polywater Series, Electric Products Div./3M's WL, WLX, or WLW, Greenlee Textron Inc.'s Y-ER-EAS, Cable Cream, Cable Gel, Winter Gel, Ideal Industries Inc.'s Yellow 77, Aqua-Gel II, Agua-Gel CW, or Thomas & Betts Corp.'s Series 15-230 Cable Pulling Lubricants, or Series 15-631 Wire Slick.
- H. Wire Management Products: Cable clamps and clips, cable ties, spiral wraps, etc., by Catamount/T&B Corp., or Ideal Industries Inc.

2.04 WIRING DEVICES

- A. Local Switches:
 1. Single Pole, 15A, 120/277 V ac: Bryant's 4801, Crouse-Hinds/AH's 1891, General Electric's GE5931-1G, Hubbell's 1201, Leviton's 1201, Pass & Seymour's 15AC1, or Slater's 710-BR.
 2. Double Pole, 15A, 120/277 V ac: Bryant's 4802, Crouse-Hinds/AH's 1892, General Electric's GE5932-1G, Hubbell's 1202, Leviton's 1202, Pass & Seymour's 15AC2, or Slater's 712-BR.
 3. Three-Way, 15A, 120/277 V ac: Bryant's 4803, Crouse-Hinds/AH's 1893, General Electric's GE5933-1, Hubbell's 1203, Leviton's 1203, Pass & Seymour's 15AC3, or Slater's 713-BR.
 4. Four-Way, 15A, 120/277 V ac: Bryant's 4804, Crouse-Hinds/AH's 1894, General Electric's GE5934-1G, Hubbell's 1204, Leviton's 1204, Pass & Seymour's 15AC4, or Slater's 714-BR.
- B. Receptacles:
 1. Single Receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W): Bryant's 5251, Crouse-Hinds/AH's 5251, General Electric's 5251-1, Hubbell's 5251, Leviton's 5251, Pass & Seymour's 5251, or Slater's 5361-AG-BR.
 2. Duplex Receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W): Bryant's 5262, Crouse-Hinds/AH's 5252-S, General Electric's GEN5252-1, Hubbell's 5252, Leviton's 5252, Pass & Seymour's 5252, or Slater's 5252-AG-BR.

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3. Ground Fault Interrupter Receptacle Rated 15A (NEMA 5-15R), Circuit-Ampacity 20A: Bryant's GFR52FT, Crouse-Hinds/AH's 1591-F, General Electric's TGTR15B, Leviton's 6194, Pass & Seymour's 1591-F, or Slater's SIR-15-F-BR.

C. Wall Plates:

1. Stainless Steel Wall Plates (Type 302 stainless steel with satin finish): Bryant's 93 _____ Series, Crouse-Hinds/AH's 93 _____ Series, General Electric's 93 _____ Series, Hubbell's 93 _____ Series, Leviton's 910 _____ -40 Series, or Pass & Seymour's 93 _____ Series.
2. Chrome Wall Plates (.040 inch thick brass with polished chromium finish): General Electric's GE894 _____ -5 Series, Hubbell's 94 _____ Series, Pass & Seymour's 94 _____ Series.
3. Weatherproof Covers: Crouse-Hinds' WLRs, WLRD, Hubbell's 52 _____, 74 _____ Series, or Pass & Seymour's 45 _____ Series, or Thomas & Betts Corp.'s Red Dot Series
4. Covers for Threaded Type Boxes: Stamped sheet steel, gasketed device covers as produced by Crouse-Hinds Co., OZ/Gedney Co., or Thomas & Betts Corp.

2.05 SUPPORTING DEVICES

- A. Fasteners: Furnish all fasteners and hardware compatible with the materials and methods required for attachment of supporting devices.
1. Slotted Type Concrete Inserts: Galvanized pressed steel plate complying with ASTM A 283; box-type welded construction with slot designed to receive steel nut and with knockout cover, hot-dipped galvanized in compliance with ASTM A 123.
 2. Masonry Anchorage Devices: Expansion shields complying with FS FF-S-325, as follows:
 - a. Furnish lead expansion shields for machine screws and bolts 1/4 inch and smaller; head-out embedded nut type, single unit class, Group I, Type 1, Class 1.
 - b. Furnish lead expansion shields for machine screws and bolts larger than 1/4 inch in size; head-out embedded nut type, multiple unit class, Group I, Type 1, Class 2.
 - c. Furnish bolt anchor expansion shields for lag bolts, zinc alloy, long-shield anchors class, Group II, Type 1, Class 1.
 - d. Furnish bolt anchor expansion shields for bolts, closed-end bottom bearing class, Group II, Type 2, Class 1.
 3. Toggle Bolts: Tumble-wing type, complying with FS FF-B-588C, Type, class and style as required.
 4. Nuts, Bolts, Screws, Washers:
 - a. General: Furnish zinc-coated fasteners, with galvanizing complying with ASTM A 153 for exterior use or where built into exterior walls. Furnish fasteners for the type, grade and class required for the particular installation.
 - b. Standard Nuts and Bolts: Regular hexagon head type, complying with ASTM A 307, Grade A.
 - c. Lag Bolts: Square head type, complying with FS FF-B-561C.

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- d. Machine Screws: Cadmium plated steel, complying with FS FF-S-92.
 - e. Wood Screws: Flat head carbon steel, complying with FS FF-S-111.
 - f. Plain Washers: Round, general assembly grade carbon steel, complying with FS FF-W-92.
 - g. Lock Washers: Helical spring type carbon steel, complying with FS FF-W-84.
- B. "C" Beam Clamps:
 - 1. For 1 inch Conduit Maximum: B-Line Systems Inc.'s BG-8-C2, BP-8-C1 Series, or Caddy Fastener Div./Erico Products Inc.'s BC-8P and BC-8PSM Series.
 - 2. For 3 inch Conduit Maximum: Appleton Electric Co.'s BH-500 Series beam clamp with H50WB Series hangers, Kindorf/T&B Corp.'s 500 Series beam clamp with 6HO-B Series hanger, or OZ/Gedney Co.'s IS-500 Series beam clamp with H-OWBS Series hanger.
 - 3. For 4 inch Conduit Maximum: Kindorf/T&B Corp.'s E-231 beam clamp and E-234 anchor clip and C-149 series lay-in hanger, or Unistrut Corp.'s P2676 beam clamp and P-1659A Series anchor clip with J1205 Series lay in hanger.
 - 4. For Threaded Rods (100 lbs. load max.): Caddy Fastener Div./Erico Products Inc.'s BC-4A.
 - 5. For Threaded Rods (200 lbs. load max.): Appleton Electric Co.'s BH-500 Series, Kindorf/T&B Corp.'s 500 Series, or OZ/Gedney Co.'s IS-500 Series.
 - 6. For Threaded Rods (300 lbs. load max.): Kindorf/T&B Corp.'s E-231 beam clamp and E-234 anchor clip, or Unistrut Corp.'s P2676 beam clamp and P-1659A Series anchor clip.
- C. Fastener Fittings for Wood and Existing Masonry: Kindorf/T&B Corp.'s E-243, E-244, E-245, E-170, or Versabar Corp.'s VX-4310, VX-2308, VX-4308, VX-4309.
- D. Pipe Straps: Two hole steel conduit straps; Kindorf/T&B Corp.'s C-144 or C-280 Series.
- E. Pipe Clamps: One-hole malleable iron type clamps; Kindorf/T&B Corp.'s HS-400 Series, or OZ/Gedney Co.'s 14-50 Series.
- F. Channel Support System and Accessories: 12 gage galvanized steel channel and accessories; B-Line System Inc.'s B-22 (1-5/8 x 1-5/8 inches), B-12 (1-5/8 x 2-7/16 inches), B-11 (1-5/8 x 3-1/4 inches), Kindorf/T&B Corp.'s B-900 (1-1/2 x 1-1/2 inches), B-901 (1-1/2 x 1-7/8 inches), B-902 (1-1/2 x 3 inches), Unistrut Corp.'s, P-3000 (1-3/8 x 1-5/8 inches), P-5500 (1-5/8 x 2-7/16 inches), P-5500 (1-5/8 x 3-1/4 inches), or Versabar Corp.'s VA-1 (1-5/8 x 1-5/8 inches), VA-3 (1-5/8 x 2-1/2 inches).
- G. Supporting Fasteners (Metal Stud Construction): Metal stud supports, clips and accessories as produced by Caddy/Erico Products Inc.

2.06 SAFETY SWITCHES (SINGLE THROW)

- A. NEMA 1, 3R, 4 (Stainless Steel), 12: Cutler-Hammer Inc.'s DH, Federal Pacific Electric Co.'s Class 1240, General Electric Co.'s Type TH, Square D Co.'s Heavy Duty Series, or Westinghouse Electric Corp.'s H-600; having:
 - 1. Fuses or unfused as indicated on drawings.
 - 2. Fused switches equipped with fuseholders to accept only the fuses specified (UL Class RK-1, RK-5, or L).
 - 3. NEMA 1 enclosure unless otherwise indicated on drawing.
 - 4. 240 V rating for 120 V, 208 V, or 240 V circuits.
 - 5. 600 V rating for 277 V, or 480 V circuits.
 - 6. Solid neutral bus when neutral conductor is included with circuit.
 - 7. Ground bus when equipment grounding conductor is included with circuit.
 - 8. Current rating and number of poles as indicated on drawings.
- B. NEMA 4X: Crouse-Hinds Co.'s NST, Cutler-Hammer Inc.'s DH, General Electric Co.'s Type TH, Square D Co.'s Heavy Duty Series, or Westinghouse Electric Corp.'s H-600; having:
 - 1. Fuses, or unfused as indicated on drawings.
 - 2. Fused switches equipped with fuseholders to accept only the fuses specified (UL Class RK-1, RK-5, or L).
 - 3. Molded fiberglass-reinforced polyester NEMA 4X enclosure.
 - 4. 240 V rating for 120 V, 208 V, or 240 V circuits.
 - 5. 600 V rating for 277 V, or 480 V circuits.
 - 6. Solid neutral bus when neutral conductor is included with circuit.
 - 7. Ground bus when equipment grounding conductor is included with circuit.
 - 8. Current rating and number of poles as indicated on drawings.
- C. Fuses for Motor Circuits:
 - 1. Cartridge Type (250 Volts, 600 Amperes or Less): Dual element time-delay, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity:
 - a. Bussmann Mfg. Div./McGraw Edison Co.'s Type FRN-R.
 - b. Gould Inc. Circuit Protection Div. (Chase-Shawmut) Type AT-DER.
 - c. Littlefuse Inc.'s Type FLNR.
 - 2. Cartridge Type (600 Volts, 600 Amperes or Less): Dual element time-delay, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity:
 - a. Bussmann Mfg. Div./McGraw Edison Co.'s Type FRS-R.
 - b. Gould Inc. Circuit Protection Div. (Chase-Shawmut) Type ATS-DER.
 - c. Littlefuse Inc.'s Type FLSR.
- D. Fuses for Lighting and Heating Circuits:
 - 1. Cartridge Type (250 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity:
 - a. Bussmann Mfg. Div./McGraw Edison Co.'s Type KTN-R.

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- b. Gould Inc. Circuit Protection Div. (Chase-Shawmut) Type A2KR.
 - c. Littlefuse Inc.'s Type KLNK.
- 2. Cartridge Type (600 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity:
 - a. Bussmann Mfg. Div./McGraw Edison Co.'s Type KTS-R.
 - b. Gould Inc. Circuit Protection Div. (Chase-Shawmut) Type A6KR.
 - c. Littlefuse Inc.'s Type KLSR.

2.07 GROUNDING AND BONDING

- A. Ground Clamps (Cable to Pipe): Blackburn/T&B Corp.'s GUV, Framatome Connectors/Burndy Corp.'s GAR, GD, GP, GK, or OZ/Gedney Co.'s ABG, CG.
- B. Ground Clamps (Cable to Rod): Blackburn/T&B Corp.'s GG, GGH, JAB, JABH, GUV, Dossert Corp.'s GN, GPC, Framatome Connectors/Burndy Corp.'s GP, GX, GRC, or OZ/Gedney Co.'s ABG.
- C. Ground Lugs: Copper, one or 2 hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Framatome Connectors/Burndy's Hylug YA, Electrical Products Div./3M Scotchlok 31036 or 31145 Series, Ideal Industries Inc.'s CCB or CCBL, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.
- D. Exothermic Type Weld: Erico Inc.'s Cadweld Process, or Furseweld/T&B Corp.'s Exothermic Welding System.
- E. Compression Connectors: Amp Inc.'s Ampact Copper Grounding System, or Burndy Corp.'s Hyground System.
- F. Rod Electrodes: Copper clad (minimum .010 jacket) ground rods minimum 5/8 inches diameter by 8'-0" long.
- G. Plate Electrodes: Copper plates minimum 0.06 inches thick by 2'-0" square feet of surface area.
- H. Grounding Electrode Conductors and Bonding Conductors: Copper conductors, bare or insulated with THW, THW-2, XHHW, XHHW-2, THWN, THWN-2 or THHN insulation.
- I. Hardware: Silicon-bronze bolts, nuts, flat and lock washers etc. by Dossert Corp., Framatome Connectors/Burndy Corp., or OZ/Gedney Co.

2.08 NAMEPLATES AND TAGS

- A. General: Precision engraved letters and numbers with uniform margins, character size minimum 3/16 inch high.
 - 1. Phenolic: Two color laminated engraver's stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).

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2. Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.
3. Materials for Outdoor Applications: As recommended by nameplate manufacturer to suit environmental conditions.

PART 3 EXECUTION

3.01 RACEWAY INSTALLATION

- A. Number of Raceways: Do not change number of raceways to less than the number indicated on the drawings except when appropriate for advantageous reuse of existing exposed and concealed raceways (The contract documents do not indicate location, number, size or condition of existing raceways). Existing raceways may be reused if the following conditions are met:
 1. The existing raceway must be of adequate size for the new conductors to be installed therein (NFPA 70 Chapter 9, Tables 1, 4, & 5; Appendix C, Tables C1-C12a). More circuits may be enclosed by existing raceways than the circuiting shown on the drawings provided conductor sizes are increased to compensate for derating (adjustment factors) and other considerations required by NFPA 70 Article 310-15.
 2. Remove existing conductors.
 3. Demonstrate to the Director's Representative that the existing raceway is clear of obstructions and in good condition.
 4. Check ground continuity. When ground continuity of existing raceway is inadequate install insulated grounding bushings, grounding wedges, bonding straps, grounding jumpers or equipment grounding conductors to establish effective path to ground.
 5. Install insulated bushings to replace damaged or missing bushings. Replace non-insulated bushings with insulated bushings on raceway sizes 1 inch and larger.
 6. Install vertical conductor supports to replace existing or missing vertical conductor supports.
 7. Install extension rings on existing boxes when the number of new conductors installed therein exceeds NFPA 70 requirements.
 8. Furnish the Director's Representative with marked up drawings showing size and routing of existing raceways with number and size of new conductors installed therein. The drawings will be forwarded to the design engineer for verification of NFPA 70 compliance.
- B. Conduit Installed Concealed:
 1. Install conduit concealed unless otherwise indicated on the drawings.
 2. Existing Construction:
 - a. Run conduit in existing chases and hung ceilings.
 - b. If conduit cannot be installed concealed due to conditions encountered in the building, report such conditions and await approval in writing before proceeding.
 3. If any portions of the conduit system cannot be installed concealed due to conditions encountered in the building, report such conditions and await approval in writing before proceeding.

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- C. Conduits Penetrating Concrete Floor Slabs (Concrete slabs that are both ceilings and floors shall be treated as floor slabs):
 - 1. Provide a minimum of 2 inches between conduits that vertically penetrate elevated concrete slabs.
 - 2. Provide firestopping and spray on fireproofing at locations where conduits penetrate surface of floor slab and slab is part of fire rating required for construction.

- D. Conduit Installed Exposed:
 - 1. Install conduit exposed where indicated on the drawings. If not indicated, conduit may be installed exposed, as approved, in:
 - a. Unfinished spaces, and finished spaces housing mechanical or electrical equipment that is generally accessible only to facility maintenance personnel.
 - b. Areas where existing conduits have been installed exposed.
 - c. Areas where conduit cannot be installed concealed.
 - 2. Install conduit tight to the surface of the building construction.
Exception:
 - a. Where otherwise indicated or directed.
 - 3. Install vertical runs perpendicular to the floor.
 - 4. Install runs on the ceiling perpendicular or parallel to the walls.
 - 5. Install horizontal runs parallel to the floor.
 - 6. Do not run conduits near heating pipes.
 - 7. Installation of conduit directly on the floor will not be permitted.

- E. Conduit Size: Not smaller than 1/2 inch electrical trade size. Where type FEP, THHN, THWN, THWN-2, XHH, XHHW, or XHHW-2 conductors are specified for use, the minimum allowable conduit size for new Work shall be based on Type THW conductors.

- F. Raceways Exposed to Different Temperatures: Where portions of an interior raceway system are exposed to widely different temperatures, seal interior and exterior of raceway to prevent circulation of air from a warmer to a colder section through the raceway installation.
 - 1. Refrigerated Rooms: Install conduit body or junction box in the raceway system on warm side of refrigerated room. After conductors are installed, seal interior of the raceway at the conduit body or junction box.
 - 2. Heated Areas to Unheated Areas: After conductors are installed, seal interior of the raceway at the nearest conduit body, outlet or junction box in the heated area adjoining the unheated area.

- G. Conduit in Waterproofed Floors: Install conduit runs in waterproof floors to avoid penetrating the waterproofing. Avoid penetration of waterproofing with conduit risers so far as practicable.
 - 1. Where it is necessary to puncture the waterproofing for a conduit riser, install a standard weight steel pipe sleeve extending one inch above the finished floor level. Flash the steel pipe sleeve to the waterproofing with 16 ounce copper. Construct the flashing with a copper tube extending the full height of the sleeve, soldered to a copper base extending 6 inches in all directions from the sleeve.

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2. The flashing will be integrated into the waterproofing by the Construction Contractor. Provide solid cast brass floor plates with chromium finish where pipe sleeves are exposed in rooms.
- H. Conduit in Hazardous Areas: Install Work in hazardous areas in accordance with NFPA 70.
1. Install sealing fittings in concealed conduit runs in a recessed box with blank face plate to match other face plates in the area.
- I. Raceway Schedule:
1. Rigid Ferrous Metal Conduit: Install in all locations unless otherwise specified or indicated on the drawings.
 2. Intermediate Ferrous Metal Conduit: May be installed in all dry and damp locations except:
 - a. Hazardous areas.
 - b. Where other type raceways are specified or indicated on the drawings.
 3. Electrical Metallic Tubing:
 - a. May be installed concealed as branch circuit conduits above suspended ceilings where conduit does not support fixtures or other equipment.
 - b. May be installed concealed as branch circuit conduits in hollow areas in dry locations, including:
 - 1) Hollow concrete masonry units, except where cores are to be filled.
 - 2) Drywall construction with sheet metal studs, except where studs are less than 3-1/2 inches deep.
 - c. May be installed exposed as branch circuit conduits in dry non-hazardous locations at elevations over 10'-0" above finished floor where conduit does not support fixtures or other equipment.
 4. Flexible Metal Conduit: Install equipment grounding conductor in the flexible metal conduit and bond at each box or equipment to which conduit is connected:
 - a. Use for final conduit connection to recessed lighting fixtures in suspended ceilings. Use 4 to 6 feet of flexible metal conduit (minimum size 1/2 inch) between junction box and fixture. Locate junction box at least 1 foot from fixture and accessible if the fixture is removed.
 - b. Use 1 to 3 feet of flexible metal conduit for final conduit connection to:
 - 1) Emergency lighting units.
 - 2) Dry type transformers.
 - 3) Motors with open, drip-proof or splash-proof housings.
 - 4) Equipment subject to vibration (dry locations).
 - 5) Equipment requiring flexible connection for adjustment or alignment (dry locations).
 - c. Use for concealed branch circuit conduits above existing non-removable suspended ceilings where rigid type raceways cannot be installed due to inaccessibility of space above ceiling.
 - d. May be installed concealed as branch circuit conduits in drywall construction with sheet metal studs, except where studs are less than 3-1/2 inches deep.

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5. Liquid-tight Flexible Metal Conduit: Install equipment grounding conductor in liquid-tight flexible metal conduit and bond at each box or equipment to which conduit is connected:
 - a. Use 1 to 3 feet of liquid-tight flexible metal conduit (UL listed and marked suitable for the installation's temperature and environmental conditions) for final conduit connection to:
 - 1) Motors with weather-protected or totally enclosed housings.
 - 2) Equipment subject to vibration (damp and wet locations).
 - 3) Equipment requiring flexible connection for adjustment or alignment (damp and wet locations).
6. Surface Metal Raceway: Use as exposed raceway system in finished spaces at locations indicated on the drawings.
 - a. Use surface metal raceway system of size required for number of wires to be installed therein. (Use specific size when indicated on the drawings).
 - b. Do not run raceway through walls that have a plaster finish nor through masonry walls or floors. Install a pipe sleeve, or a short length of conduit with junction boxes or adapter fittings for raceway runs through such areas. Run raceway along top of baseboards, care being taken to avoid telephone and other signal wiring. Where raceway crosses chair railing or picture molding, cut the chair railing or picture molding to permit the raceway to lie flat against the wall. Run raceway around door frames and other openings. Run raceway on ceiling or walls perpendicular to or parallel with walls and floors.
 - c. Secure raceway at intervals not exceeding 36 inches.
 - d. Install separate equipment grounding conductor for grounding of equipment. The raceway alone will not be considered suitable for use as an effective path to ground.
 - e. Outlet box covers for pendant mounted fluorescent fixtures may be omitted if the fixture canopy is notched to receive the raceway and the canopy fits snugly against the ceiling.
 - f. Where equipment is mounted on an outlet box and the equipment base is larger than the outlet box, provide finishing collar around equipment base and outlet box or provide finishing collar/outlet box:
 - 1) Finishing Collar: Same finish and peripheral dimensions as the equipment base, including provisions for mounting, slots to fit over raceway and of depth to cover outlet box and extend back to ceiling or wall.
 - 2) Combination Finishing Collar/Outlet Box: Same finish and peripheral dimensions as the equipment base to be mounted thereon, gage or thickness of metal as required by National Electrical Code, including provision for mounting and knockouts for entrance of raceway.
7. Wireways: May be used indoors in dry locations for exposed raceway between grouped, wall mounted equipment.

J. Fittings and Accessories Schedule:

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1. General:
 - a. Use fittings and accessories that have a temperature rating equal to, or higher than the temperature rating of the conductors to be installed within the raceway.
 - b. Use zinc electroplate or hot dipped galvanized steel/malleable iron or cast iron alloy fittings and accessories in conjunction with ferrous raceways in dry and damp locations, unless otherwise specified or indicated on the drawings.
 - c. Use malleable iron or cast iron alloy fittings and accessories having hot dipped/mechanically galvanized finish or other specified corrosion resistant finish in conjunction with ferrous raceways in wet locations, unless otherwise specified or indicated on the drawings.
 - d. Use insulated grounding bushings or grounding wedges on ends of conduit for terminating and bonding equipment grounding conductors (when required) if cabinet or boxes are not equipped with grounding/bonding screws or lugs.
 - e. Use caps or plugs to seal ends of conduits until wiring is installed (to exclude foreign material).
 - f. Use insulated grounding bushings on the ends of conduits that are not directly connected to the enclosure (such as stub-ups under equipment, etc.), and bond between bushings and enclosure with equipment grounding conductor.
 - g. Use expansion fittings where raceways cross expansion joints.
 - h. Use deflection fittings where raceways cross expansion joints that move in more than one plane.
 - i. Use 2 locknuts and an insulated bushing on end of each conduit entering sheet metal cabinet or box in dry or damp locations.
 - 1) Plastic bushing may be used in lieu of insulated bushing on 1/2 and 3/4 inch conduit.
 - 2) Terminate conduit ends within cabinet/box at the same level.
2. For Rigid and Intermediate Metal Conduit: Use threaded fittings and accessories. Use 3 piece conduit coupling where neither piece of conduit can be rotated.
3. For Electrical Metallic Tubing: Use compression type connectors and couplings.
4. For Flexible Metal Conduit: Use flexible metal conduit connectors.
5. For Liquid-tight Flexible Metal Conduit: Use liquid-tight connectors.
6. For Surface Metal Raceway: Use raceway manufacturer's standard fittings and accessories.
7. For Wireways: Use wireway manufacturer's standard fittings and accessories.

3.02 OUTLET, JUNCTION AND PULLBOX INSTALLATION

- A. Mounting Position of Wall Outlets For Wiring Devices: Unless otherwise indicated, install boxes so that the long axis of each wiring device will be vertical.

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- B. Height of Wall Outlets: Unless otherwise indicated, locate outlet boxes with their center lines at the following elevations above finished floor:

	MOUNTING HEIGHT
Lighting Fixtures	6'-0"
Lighting Fixtures in Stairway	7'-6"
Exit Lights	8'-0" where ceiling height allows a minimum of 6 inch clearance between ceiling and top of exit light. Otherwise mount exit light so that it's top is 6 inches below finished ceiling. Adjust height and clearances as required to suit installation over doors.
Night Lights	2'-0"
Hose Cabinet Lights	1'-0" above top of cabinet
Switches	4'-0"
Single & Duplex Receptacles	1'-6"*
Water Cooler Receptacles	2'-0"
Clock Receptacles	7'-6"
Range Receptacle	1'-6"
Special Purpose Receptacles	4'-0"
Thermostats	5'-0"
Manual Fire Alarm Boxes	4'-0"
Audible Notification Appliances	8'-0" where ceiling height allows a minimum of 6 inch clearance between ceiling and top of appliance. Otherwise mount appliance so that it's top is 6 inches below finished ceiling.
Visible Notification Appliances	Install outlet so that the bottom of the visible lens will be 6'-8" AFF.
Combination Audible/Visible Notification Appliances	Install outlet so that the bottom of the visual lens will be 6'-8" AFF, and the audible section will be above the visible section.
Radio	2'-0"
Television	2'-0"
Telecommunications	2'-0"
Telephone	2'-0"
Telephone Marked W.T.	Install outlet so that the highest operable part of the wall mounted telephone will not be more than 4'-0" AFF.

*In areas containing heating convectors, install outlets above convectors at height indicated on drawings.

- C. Supplementary Junction and Pull Boxes: In addition to junction and pull boxes indicated on the drawings and required by NFPA 70, provide supplementary junction and pull boxes as follows:
1. When required to facilitate installation of wiring.
 2. At every third 90 degree turn in conjunction with raceway sizes over 1 inch.

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3. At intervals not exceeding 100 feet in conjunction with raceway sizes over 1 inch.
- D. Box Schedule for Concealed Conduit System:
1. Non-Fire Rated Construction:
 - a. Depth: To suit job conditions and comply with NFPA 70 Article 370.
 - b. For Lighting Fixtures: Use galvanized steel outlet boxes designed for the purpose.
 - 1) For Fixtures Weighing 50 lbs. or Less: Box marked "FOR FIXTURE SUPPORT".
 - 2) For Fixtures More Than 50 lbs: Box listed and marked with the weight of the fixture to be supported (or support fixture independent of the box).
 - c. For Ceiling Suspended Fans:
 - 1) For Fans Weighing 35 lbs or Less: Marked "Acceptable for Fan Support."
 - 2) For Fans Weighing More Than 35 lbs, up to 70 lbs: Marked "Acceptable for Fan Support up to 70 lbs (or support fan independent of the box)."
 - d. For Junction and Pull Boxes: Use galvanized steel boxes with flush covers.
 - e. For Switches, Receptacles, Etc:
 - 1) Plaster or Cast-In-Place Concrete Walls: Use 4 inch or 4-11/16 inch galvanized steel boxes with device covers.
 - 2) Walls Other Than Plaster or Cast-In-Place Concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.
 2. Recessed Boxes in Fire Rated (2 hour maximum) Bearing and Nonbearing Wood or Steel Stud Walls (Gypsum Wallboard Facings):
 - a. Use listed single and double gang metallic outlet and switch boxes. The surface area of individual outlet or switch boxes shall not exceed 16 square inches.
 - b. The aggregate surface area of the boxes shall not exceed 100 square inches per 100 square feet of wall surface.
 - c. Securely fasten boxes to the studs. Verify that the opening in the wallboard facing is cut so that the clearance between the box and the wallboard does not exceed 1/8 inch.
 - d. Separate boxes located on opposite sides of walls or partitions by a minimum horizontal distance of 24 inches. This minimum separation distance may be reduced when wall opening protective materials are installed according to the requirements of their classification.
 - e. Use wall opening protective material in conjunction with boxes installed on opposite sides of walls or partitions of staggered stud construction in accordance with the classification requirements for the protective material.
 3. Other Fire Rated Construction: Use materials and methods to comply with the listing requirements for the classified construction.

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- E. Box Schedule for Exposed Conduit System:
1. Dry and Damp Locations: Use zinc electroplate or hot dipped galvanized threaded type malleable iron or cast iron alloy outlet, junction, and pullboxes or conduit bodies provided with a volume marking in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.
 - a. Galvanized steel boxes may be used in conjunction with conduit sizes over 1 inch in non-hazardous dry and damp locations.
 - b. Galvanized steel boxes may be used in conjunction with electrical metallic tubing where it is allowed (specified) to be installed exposed as branch circuit conduits at elevations over 10'-0" above finished floor.
 2. Wet Locations: Use threaded type malleable iron or cast iron alloy outlet junction, and pullboxes or conduit bodies (provided with a volume marking) with hot dipped galvanized or other specified corrosion resistant coating in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.
 - a. Use corrosion resistant boxes in conjunction with plastic coated rigid ferrous metal conduit.
 3. Finishing Collar or Combination Finishing Collar/Outlet Box (Surface Mounted Equipment Used With Exposed Raceway):
 - a. Use finishing collar where surface mounted equipment is installed on an exposed raceway outlet box and the equipment base is larger than the outlet box.
 - b. Use combination finishing collar/outlet box where surface mounted equipment is not indicated to be installed on an exposed raceway outlet box, but raceway cannot be run directly into equipment body due to equipment design.
- F. Specific Purpose Outlet Boxes: Use to mount equipment when available and suitable for job conditions. Unless otherwise specified, use threaded type boxes with finish as specified for exposed conduit system, steel (painted) for surface metal raceway system and galvanized steel for recessed installations.

3.03 CONDUCTOR INSTALLATION

- A. Install conductors in raceways after the raceway system is completed.
- B. Do not change, group or combine circuits other than as indicated on the drawings except as permitted when reusing existing raceways.
- C. Common Neutral Conductor:
1. A common neutral may be used for 2 or 3 branch circuits where the circuits are indicated on the drawings to be enclosed within the same raceway, provided each branch circuit is connected to a different phase in the panelboard.
 2. Exceptions: The following circuits shall have a separate neutral:
 - a. Circuits containing ground fault circuit interrupter devices.
 - b. Circuits containing solid state dimmers.
 - c. Circuits recommended by equipment manufacturers to have separate neutrals.

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- D. Conductor Size: Install conductors of size shown on drawings. Where size is not indicated, the minimum size allowed is:
1. For Electric Light and Power Branch Circuits: No. 12 AWG.
 2. For Class 1 Circuits:
 - a. No. 18 and No. 16 AWG may be used provided they supply loads that do not exceed 6 amps (No. 18 AWG), or 8 amps (No. 16 AWG).
 - b. Larger than No. 16 AWG: Use to supply loads not greater than the ampacities given in NFPA 70 Section 310-15.
 3. For Class 2 Circuits: Any size to suit application.
 4. For Class 3 Circuits: No. 18 AWG.
- E. Color Coding:
1. Color Coding for 120/208 Volt Electric Light and Power Wiring:
 - a. Color Code:
 - 1) 2 wire circuit - black, white.
 - 2) 3 wire circuit - black, red, white.
 - 3) 4 wire circuit - black, red, blue, white.
 - b. White to be used only for an insulated grounded conductor (neutral). If neutral is not required use black and red, or black, red and blue for phase to phase circuits.
 - 1) "White" for Sizes No. 6 AWG or Smaller:
 - a) Continuous white outer finish, or:
 - b) Three continuous white stripes on other than green insulation along its continuous length.
 - 2) "White" for Sizes Larger Than No. 6 AWG:
 - a) Continuous white outer finish, or:
 - b) Three continuous white stripes on other than green insulation along its continuous length, or:
 - c) Distinctive white markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install white color coding tape at terminations, and at 1' 0" intervals in gutters, pullboxes, and manholes.
 - c. Colors (Black, Red, Blue):
 - 1) For Branch Circuits: Continuous color outer finish.
 - 2) For Feeders:
 - a) Continuous color outer finish, or:
 - b) Color coding tapes encircling the conductors, installed on the conductors at time of their installation. Install color coding tapes at terminations, and at 1' 0" intervals in gutter, pullboxes, and manholes.
 2. Color Coding For 277/480 Volt Electric Light and Power Wiring:
 - a. Color Code:
 - 1) 2 wire circuit - brown, gray.
 - 2) 3 wire circuit - brown, yellow, gray.
 - 3) 4 wire circuit - brown, yellow, orange, gray

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- b. Gray to be used only for an insulated grounded conductor (neutral). If neutral is not required use brown and yellow, or brown, yellow and orange for phase to phase circuits.
 - 1) "Gray" For Sizes No. 6 AWG or Smaller.
 - a) Continuous gray outer finish.
 - 2) "Gray" For Sizes Larger Than No. 6 AWG:
 - a) Distinctive gray markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install gray color coding tape at terminations, and at 1' 0" intervals in gutters, pullboxes, and manholes.
 - c. Colors (Brown, Yellow, Orange):
 - 1) For Branch Circuits: Continuous color outer finish.
 - 2) For Feeders:
 - a) Continuous color outer finish, or:
 - b) Color coding tapes encircling the conductors, installed on the conductors at the time of their installation. Install color coding tapes at terminations, and at 1' 0" intervals in gutters, pullboxes, and manholes.
 - 3. More Than One Nominal Voltage System Within A building: Permanently post the color coding scheme at each branch-circuit panelboard.
 - 4. Existing Color Coding Scheme: Where an existing color coding scheme is in use, match the existing color coding if it is in accordance with the requirements of NFPA 70.
 - 5. Color Code For Wiring Other Than Electric Light and Power: In accordance with ICEA/NEMA WC-30 "Color Coding of Wires and Cables". Other coding methods may be used, as approved.
- F. Identification: Use tags to identify feeders and designated circuits. Install tags so that they are easily read without moving adjacent feeders or require removal of arc proofing tapes. Attach tags with non-ferrous wire or brass chain.
- 1. Interior Feeders: Identify each feeder in pullboxes and gutters. Identify by feeder number and size.
 - 2. Exterior Feeders: Identify each feeder in manholes and in interior pullboxes and gutters. Identify by feeder number and size, and also indicate building number and panel designation from which feeder originates.
 - 3. Street and Grounds Lighting Circuits: Identify each circuit in manholes and lighting standard bases. Identify by circuit number and size, and also indicate building number and panel designation from which circuit originates.
- G. Use wire management products to bundle, route, and support wiring in junction boxes, pullboxes, wireways, gutters, channels, and other locations where wiring is accessible.
- H. Equipment Grounding Conductor:
- 1. Install equipment grounding conductor:
 - a. Where specified in other Sections or indicated on the drawings.

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- b. In conjunction with circuits recommended by equipment manufacturers to have equipment grounding conductor.
 2. Equipment grounding conductor is not intended as a current carrying conductor under normal operating circumstances.
 3. Color Coding For Equipment Grounding Conductor:
 - a. Color Code: Green.
 - b. "Green" For sizes No. 6 AWG or Smaller:
 - 1) Continuous green outer finish, or:
 - 2) Continuous green outer finish with one or more yellow stripes, or:
 - 3) Bare copper (see exception below).
 - c. "Green" For Sizes Larger Than No. 6:
 - 1) Stripping the insulation or covering from the entire exposed length (see exception below).
 - 2) Marking the exposed insulation or covering with green color coding tapes.
 - 3) Identify at each end and at every point where the equipment grounding conductor is accessible.
 - d. Exception For use of Bare Copper: Not allowed for use where NFPA 70 specifically requires equipment grounding conductor to be insulated, or where specified in other Sections or indicated on the drawings to be insulated.
- I. Arc Proofing: Arc proof feeders installed in a common pullbox or manhole as follows:
 1. Arc proof new feeders.
 2. Arc proof existing feeders that are spliced to new feeders.
 3. Arc proof each feeder as a unit (except feeders consisting of multiple sets of conductors).
 4. Arc proof feeders consisting of multiple sets of conductors by arc proofing each set of conductors as a unit.
 5. Arc proof feeders with half-lapped layer of 55 mils thick arc proofing tape, random wrapped or laced with glass cloth tape or glass-fiber cord. For arc proofing tape less than 55 mils thick add layers to equivalent of 55 mils thick arc proofing tape.
- J. Conductor Schedule - Types and Use:
 1. Electric Light and Power Circuits:
 - a. FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, or XHHW-2: Wiring in dry or damp locations (except where special type insulation is required).
 - b. THWN, THWN-2, XHHW, XHHW-2, USE, or USE-2: Wiring in wet locations (except where type USE or USE-2 insulated conductors are specifically required, or special type insulation is required).
 - c. THHN, THWN or THWN-2: Wiring installed in existing raceway systems (except where special type insulation is required).
 - d. THHN, THW-2, THWN-2, XHHW, or XHHW-2: Wiring for electric discharge lighting circuits (fluorescent, HID), except where fixture listing requires wiring rated higher than 90° C.

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- e. THWN Marked "Gasoline and Oil Resistant": Wiring to gasoline and fuel oil pumps.
 - f. USE, or USE-2: Wiring indicated on the drawings to be direct burial in earth.
 - g. USE, or USE-2 Marked "Sunlight Resistant":
 - 1) Service entrance wiring from overhead service to the service equipment.
 - 2) Wiring exposed to the weather and unprotected (except where special type insulation is required).
 - 2. Class 1 Circuits: Use Class 1 wiring specified in Part 2 (except where special type insulation is required).
 - 3. Class 2 Circuits: Use Class 2 wiring specified in Part 2 (except where special type insulation is required).
 - 4. Class 3 Circuits: Use Class 3 wiring specified in Part 2 (except where special type insulation is required).
- K. Connector Schedule - Types And Use:
- 1. Temperature Rating: Use connectors that have a temperature rating, equal to, or greater than the temperature rating of the conductors to which they are connected
 - 2. Splices:
 - a. Dry Locations:
 - 1) For Conductors No. 8 AWG or Smaller: Use spring type pressure connectors, indent type pressure connectors with insulating jackets, or connector blocks (except where special type splices are required).
 - 2) For Conductors No. 6 AWG or Larger: Use connector blocks or uninsulated indent type pressure connectors. Fill indentions in uninsulated connectors with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with heat shrinkable splices or cold shrink splices.
 - 3) Gutter Taps in Panelboards: For uninsulated type gutter taps fill indentions with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with gutter tap cover.
 - b. Damp Locations: As specified for dry locations, except apply moisture sealing tape over the entire insulated connection (moisture sealing tape not required if heat shrinkable splices or cold shrink splices are used).
 - c. Wet Locations: Use uninsulated indent type pressure connectors and insulate with resin splice kits, cold shrink splices or heat shrinkable splices. Exception: Splices above ground which are totally enclosed and protected in NEMA 3R, 4, 4X enclosures may be spliced as specified for damp locations.
 - 3. Terminations:
 - a. For Conductors No. 10 AWG or Smaller: Use terminals for:
 - 1) Connecting wiring to equipment designed for use with terminals.
 - b. For Conductors No. 8 AWG or Larger: Use compression or mechanical type lugs for:

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- 1) Connecting cables to flat bus bars.
- 2) Connecting cables to equipment designed for use with lugs.
- c. For Conductor Sizes Larger Than Terminal Capacity On Equipment: Reduce the larger conductor to the maximum conductor size that terminal can accommodate (reduced section not longer than one foot). Use compression or mechanical type connectors suitable for reducing connection.

3.04 WIRING DEVICE INSTALLATION

- A. Local Switches:
 1. Install switches indicated Sa, Sb, Sc, etc, for control of outlets, with corresponding letters on the same circuit.
 2. Where more than one switch occurs at same location in a 120 volt system, arrange switches in gangs and cover with one face plate.
 3. Install switches in a 277 volt system in separate single boxes if voltage between exposed live metal parts of adjacent switches exceeds 300 volts.
 4. Install single and double pole switches so that switch handle is up when switch is in the "On" position.
- B. Receptacles:
 1. Install receptacles with ground pole in the down position.
- C. Wall Plates:
 1. Install wall plates on all wiring devices in dry locations, with finish to match hardware in each area.
 2. Install 5/8 inch bushed wall plates on telephone outlets.
- D. Weatherproof Covers: Install weatherproof covers on wiring devices in damp and wet locations.
- E. Nameplates: Install phenolic or embossed aluminum nameplate on each special purpose receptacle indicating phase, ampere and voltage rating of the circuit. Attach nameplate with rivets or vandal resistant fasteners to wall plate or to wall above receptacle. Wall plates may be engraved with required data in lieu of separate nameplates.
- F. Mats: Where flush plates are required over outlet boxes that cannot be set deep enough for the plates to fit closely over the finished wall surfaces, provide oak mats to fill the space between the finished wall surface and the plate.

3.05 SUPPORTING DEVICE INSTALLATION

- A. Attachment of Conduit System:
 1. Wood Construction: Attach conduit to wood construction by means of pipe straps with wood screws or lag bolts.
 2. Masonry Construction: Attach conduit to masonry construction by means of pipe straps and masonry anchorage devices.
 3. Steel Beams: Attach conduit to steel beams by means of "C" beam clamps and hangers.

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4. Multiple Parallel Conduit Runs: Use channel support system.
 5. Conduit Above Suspended Ceiling: Do not rest conduit directly on runner bars, T-bars, etc. Support conduit from ceiling supports or from construction above suspended ceiling.
- B. Metal Stud Construction: Attach raceways and boxes to metal studs by means of supporting fasteners manufactured specifically for the purpose.
1. Support and attach outlet boxes so that they cannot torque/twist. Either:
 - a. Use bar hanger assembly, or;
 - b. In addition to attachment to the stud, also provide far side box support.
- C. Support of Lighting Fixtures:
1. General: Support fixtures with suitable accessories.
 2. Number of Supports (Fluorescent Fixtures):
 - a. Support individual fluorescent fixtures less than 2 feet wide at 2 points. Support continuous row fluorescent fixtures less than 2 feet wide at points equal to the number of fixtures plus one. Uniformly distribute the points of suspension over the row of fixtures.
 - b. Support individual fluorescent fixtures 2 feet or wider at 4 corners. Support continuous row fluorescent fixtures 2 feet or wider at points equal to twice the number of fixtures plus 2. Uniformly distribute the points of suspension over the row of fixtures.

3.06 SAFETY SWITCH INSTALLATION

- A. Install switches so that the maximum height above the floor to the center of the operating handle does not exceed 6'-6".
- B. Identify each safety switch, indicating purpose or load served:
1. NEMA 1 Enclosures: Rivet or bolt nameplate to the cover.
 2. NEMA 12 Enclosures: Rivet or bolt and gasket nameplate to the cover.
 3. NEMA 3R, 4, 4X Enclosures: Attach nameplate to the cover using adhesive specifically designed for the purpose, or mount nameplate on wall or other conspicuous location adjacent to switch. Do not penetrate enclosure with fasteners.
- C. Paint switches used for the fire protective signaling system with red paint and identify - "FIRE ALARM CIRCUIT CONTROL".
- D. Paint switches used for oil burner emergency switch with red paint and identify "OIL BURNER".

3.07 GROUNDING AND BONDING

- A. Connections:
1. Make grounding and bonding connections, except buried connections, with silicone-bronze hardware and ground clamps, ground lugs or compression connectors, to suit job conditions.

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2. For buried connections use exothermic type weld or compression connectors.

END OF SECTION

SECTION 260923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Photoelectric switches.
 - 2. Outdoor motion sensors.
 - 3. Lighting contactors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Field quality-control reports.
- C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Description: Solid state; one set of NO dry contacts rated to operate connected load, complying with UL 773, and compatible with lighting control panelboard.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 3. Time Delay: Thirty-second minimum, to prevent false operation.
 - 4. Mounting: 1/2-inch threaded male conduit.
 - 5. Failure Mode: Luminaire reverts to timer control.

2.2 OUTDOOR MOTION SENSORS

- A. Description: Solid-state outdoor motion sensors.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. PIR or Dual-technology (PIR and ultrasonic) type, weatherproof. Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.. Comply with UL 773A.
 - 3. Voltage: Match the circuit voltage type.
 - 4. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260501 "Basic Electrical Materials And Methods." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260501 "Basic Electrical Materials And Methods."
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 260943.23

RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes lighting control panels using mechanically held relays for switching.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each relay panel and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail wiring partition configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of relays.
 - 5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
 - 6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
 - 7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.

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2. Program Software Backup: On USB drive or Username and password for manufacturer's support website.
3. Device address list.
4. Printout of software application and graphic screens.
5. Testing and adjusting of panic and emergency power features.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of standalone multipreset modular dimming controls that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.
- B. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.
- C. Electrical Components, Devices, and Accessories: Listed and labeled by a qualified testing agency, and marked for intended location and application.
- D. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- E. Comply with UL 916.

2.2 LIGHTING CONTROL RELAY PANELS

- A. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.
- B. Lighting Control Panel:
 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 2. A vertical barrier separating branch circuits from control wiring.
- C. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
 1. Timing Unit:

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- a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
 - c. Four independent schedules, each having 24 time periods.
 - d. Schedule periods settable to the minute.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 - f. 10 special date periods.
 2. Sequencing Control with Override:
 - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
 - c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 3. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.
- D. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be three-wire, 24-V ac.
- E. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.
- F. Operator Interface:
1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
 2. Log and display relay on-time.
 3. Connect relays to one or more time and sequencing schemes.

2.3 MANUAL SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
1. Match color and style specified in Section 260501 "Basic Electrical Materials And Methods."
 2. Integral green LED pilot light to indicate when circuit is on.
 3. Internal white LED locator light to illuminate when circuit is off.
- B. Wall Plates: Single and multigang plates as specified in Section 260501 "Basic Electrical Materials And Methods."

- C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.4 FIELD-MOUNTED SIGNAL SOURCES

- A. Photoelectric Switches: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 260501 "Basic Electrical Materials And Methods."
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Install panels and accessories according to NECA 407.
- F. Mount panel cabinet plumb and rigid without distortion of box.
- G. Perform startup service.
- H. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.2 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260501 "Basic Electrical Materials And Methods."
- B. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

- C. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260501 "Basic Electrical Materials And Methods."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
- B. Acceptance Testing Preparation:
 - 1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Lighting control panel will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.4 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION

SECTION 262815

CIRCUIT BREAKERS FOR EXISTING PANELBOARDS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Not required.

PART 2 PRODUCTS

2.01 CIRCUIT BREAKERS

- A. Similar to existing circuit breakers.
- B. Compatible with existing panelboard.
- C. Number of poles and ampere trip rating as indicated on drawings.
- D. Complete with accessories required for installation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install new circuit breakers in existing panelboards where indicated.
- B. Add new circuits equally across phases to prevent overloading any phase in the panelboard. After new and existing circuits are energized, take current reading on panelboard feeder during a heavy usage time period. If phases are substantially unbalanced, rearrange both new and existing circuits in panelboard to equally distribute load between all phases, and provide new typewritten directory indicating equipment controlled by each circuit breaker.

END OF SECTION

SECTION 265619

LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

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- 3. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For luminaire supports.
 - 1. Include design calculations for luminaire supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale and coordinated.
- B. Product Certificates: For each type of the following:
 - 1. Luminaire.
 - 2. Photoelectric relay.
- C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 FIELD CONDITIONS

- A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.7 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

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- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. CRI of minimum 70, unless otherwise noted. CCT of 4000 K.
- G. L70 lamp life of minimum 35,000 hours.
- H. Nominal Operating Voltage: 120 V ac.
- I. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- J. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- F. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.

2.3 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Install lamps in each luminaire.
- C. Fasten luminaire to structural support.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- F. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- G. Coordinate layout and installation of luminaires with other construction.
- H. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- I. Comply with requirements in Section 260501 "Basic Electrical Materials And Methods" for wiring connections and wiring methods.

3.2 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260501 "Basic Electrical Materials And Methods."

3.4 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION