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PART 1 - GENERAL

1.1 TIME, MANNER AND REQUIREMENTS

A. The work to be done under this Section is shown on the drawings numbered: FA.1, and FA.2.

1.2 GENERAL REQUIREMENTS

A. Drawings and sections within Division 1—Requirements which are hereby made a part of this section of the specifications.
B. Refer to the drawings for further definition of location, extent, and details of the work described herein.
C. Cooperate and coordinate with all trades in execution of the work described in this Section, so as to provide coordination with all trades for items such as - clearance for equipment maintenance & operation, proper voltages, etc.
D. Where referred to, standard specifications of technical Societies, Manufacturer's Associations, and Federal Agencies shall include all amendments current as the date of issue of these Specifications.
E. The Electrical Contractor for work of this Section shall become familiar with other Sections of the Specifications to determine the type and extent of work there under which affects the work of this trade, whether or not such work is specifically mentioned in this Section.

1.3 WORK INCLUDED

A. Examine all Drawings and other Sections of Specifications for requirements that affect work of this Section 16786.
B. Perform work and provide materials and equipment as shown on the Drawings and as specified herein. Work shall include, but not be limited to, all labor, materials, tools, equipment, insurance, transportation, temporary protection, supervision, and incidental items required for a complete installation. Drawings and specifications form complimentary requirements; provide work specified and not shown on drawings and work shown on drawings and not specified as though explicitly shown on both. Completely coordinate work of this Section with work of other Sections and Trades to provide a complete and functional installation.
C. Provide all labor, equipment, material, implements and materials required to furnish and install all Electrical work, complete as shown on the drawings and noted herein. The following are major items of work included:
    1. Hoisting and rigging for equipment and materials specified herein.
    2. Core drilling, cutting and channeling for holes five (5) inches and less in diameter.
    3. Furnish and maintain in safe and adequate condition, all staging and scaffolding that is required for work of this section.
    4. Maintain temporary electrical system throughout building during construction.
    5. Grounding.
    6. Raceways and boxes.
    7. Raceway support system.
    8. Surface metal raceway (SMR) systems.
    9. Conductors and cables.
    10. Control / signal conductors.
    11. Electrical Supporting devices.
    12. Pull boxes.
    13. Junction boxes.
    14. Fire and Smoke Stopping. Coordinate materials and methods with Section 07841.
    15. Electrical identification, including but not limited to, nameplates, device markings, cable and conduit identification, etc.
    16. Fire alarm system.
    17. Submittals.
    18. Record Documents.
    19. Electrical acceptance tests.

20. Operation and Maintenance (O&M) Manuals.
21. System startup, demonstration and training.
22. All else shown and specified in the Fire Alarm System contract documents.

1.4 INTENT

A. Description in the Specifications, or the indication on the Drawings of equipment, materials, operation and methods, required that such items shall be of the quantity required, and the systems complete in every respect.
B. The Specifications shall be considered an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified. In the case of a conflict, the more stringent requirement shall be adhered to.
C. The Electrical Trade Contractor shall be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. The Electrical Trade Contractor shall provide fully qualified personnel to fulfill this requirement. The Electrical Trade Contractor shall be responsible for prompt replacement of defective materials, equipment and parts of equipment and related damages.

1.5 RELATED WORK

A. Examine all other sections of the Specifications and all drawings for the relationship of the work under this Section, the work of other trades and existing conditions. Cooperate with all trades and coordinate all work under this section therewith.
B. The following related items are included under Sections listed below:
    1. The Electrical Trade Contractor shall provide all hoisting and rigging for equipment and materials specified herein.
    2. The Electrical Trade Contractor shall provide all core drilling, cutting and channeling for electrical equipment requiring holes five (5) inches and less in diameter.
    3. The Electrical Trade Contractor shall furnish and maintain in safe and adequate condition, all staging and scaffolding that is required for work of this Section.
    4. In general, all fire alarm system wiring required for HVAC equipment interlock wiring shall be provided by the Electrical Contractor.
    5. The Electrical Trade Contractor shall provide all fire stopping related to Division 16 work.
    6. The Electrical Trade Contractor shall seal all penetrations through non-rated walls, ceilings, floors, etc related to Division 16 work.
    7. The Electrical Trade Contractor shall provide all fire alarm and line-voltage control wiring necessary to automatically unlock normally locked doors in the event of any fire alarm initiation.
C. Furnish the following materials to be installed under other SECTIONS.
    1. The Electrical Trade Contractor shall furnish and wire duct smoke detectors installed under SECTION 15600 - HEATING VENTILATION AND AIR-CONDITIONING.
D. Wire the following materials furnished and installed under other SECTIONS.
    1. Sprinkler alarm bell, flow, tamper, pressure and alarm switches furnished and installed under SECTION 13900 - FIRE SUPRESSION.

1.6 STANDARD OF MATERIALS AND WORKMANSHIP

A. Conditions of the Contract and Division 1, General Requirements, shall be made part of this Section:
    1. Workmanship and installation methods shall conform to the highest standard practice. Work shall be performed by skilled tradesmen under the direct supervision of fully qualified personnel.
    2. Install equipment in strict accordance with manufacturer's published recommendations.
    3. When requested, submit samples of materials proposed for review before proceeding with the work.
    4. Install equipment and materials to present a neat appearance. Install ducts and conduit parallel with or perpendicular to building planes.

5. Conceal conduit and cables in finished areas. Install work so as to require a minimum amount of furring.
6. Equipment, materials and work shall comply with the requirements of generally recognized agencies, including, but not limited to, agencies listed under SECTION 16786 Article CODES, STANDARDS AND REGULATIONS and shall conform to and be installed in strict accordance with Federal, State and Town requirements and shall meet all of the requirements of all authorities having jurisdiction.

1.7 ABBREVIATIONS AND DEFINITIONS

A. “EC” as mentioned herein means specifically “Electrical Trade Contractor” when used in conjunction with Trade Contractor, equipment, work or articles within this specification.
B. “HVAC” or “HV” or “AC” as mentioned herein means specifically “Heating, Ventilating and Air Conditioning” or “Heating and Ventilating” or “Air Conditioning” respectively, when used in conjunction with Trade Contractor, equipment, work or articles within this specification.
C. A.T.C. as mentioned herein means specifically Automatic Temperature Control as it refers to the manufacturer or description of work and equipment
D. “Provide” may be used in place of “furnish and install” and where used shall mean to deliver, furnish, erect, and connect up complete in readiness for regular operation, the particular work or equipment referred to, unless otherwise specified.
E. The term “Applicable Section Trade Contractor” or “A.S.C.” shall be understood to refer to a Trade Contractor or Trade Contractors other than the E or any Electrical Electrical Contractor.
F. “Shown on drawings" as used in the specifications shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.
G. “Material" as used in the specifications shall mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.
H. "Approved" or "Approval" shall mean the written approval of the Architect.
I. "Contract Documents" shall mean the entire set of Drawings, fire alarm narrative and Specifications as listed in the Table of Contents of the General Conditions including all bound and unbound material and all items officially issued to date such as addenda, bulletins, job modifications, sketches, etc.
J. “Specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
K. "Accessible" shall indicate ease of access with or without the use of ladders and without requiring extensive removal of other equipment, such as ductwork, piping, etc. to gain access. "Accessible Ceiling" indicates acoustic tile type hung ceilings. Concealed spline or sheetrock ceilings with access panels shall not be considered accessible ceilings.
L. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.
M. "Exposed" shall mean not installed underground or "Concealed" as defined above.
N. "Electrical Electrical Contractor" shall refer to the Electrical Contractor responsible for furnishing and installation of all work indicated on the Electrical Drawings and in the Electrical Specifications.
O. "Owner" or “OR” shall refer to the Owner or his designated representative.

1.8 EXAMINATION

A. Examine the Specifications and Drawings, including the Specifications and Drawings of other DIVISIONS before bid.
B. Before submitting bid, visit and examine the site where work is to be carried out and become familiar with all features and characteristics that affect the work of this SECTION.
C. Report in writing, any discrepancies or deficiencies which may adversely affect the work, at least six days prior to close of bid.
D. No allowance will be made for any difficulties encountered due to any features of the building, site or surrounding public and private property that existed up to the time of bid.

1.9 CODES, STANDARDS, AND REGULATIONS

A. Electrical work shall comply with the latest editions of the following codes which have been accepted by local authorities:
   1. 780 CMR Massachusetts Sate Building Code
   2. Massachusetts Energy Code
   3. NFPA 13 – Sprinkler Systems
   4. NFPA 70 - National Electrical Code with State Amendments
   5. NFPA 70E – Standard for Electrical Safety in the Workplace
   6. NFPA 72 - National Fire Alarm Code with State Amendments
   7. NFPA 101 - Life Safety Code
   8. ANSI C2 - National Electrical Safety Code
B. Electrical work shall comply with the current standards of the following organizations:
   1. ADA - Americans with Disabilities Act
   2. IEEE - Institute of Electrical and Electronics Engineers
   3. IES - Illuminating Engineering Society
   4. EIA/TIA - Electronic Industries Association/Telecommunications Industry Association
      a. EIA/TIA-568 Commercial Building Wiring Standard.
      b. EIA/TIA-569 Commercial Building Standard for Telecommunication Pathways and Spaces.
   5. OSHA - Occupational Safety and Health Act
   6. FM - Factory Mutual Association
   7. UL - Underwriters' Laboratories
   8. ANSI - American National Standards Institute
   9. NEMA - National Electric Manufacturers Association
   10. ASTM - American Society for Testing and Materials
   11. Owner’s Insurance Underwriter
C. When requirements listed in this Section conflict with each other, with the contract documents or with the requirements of applicable Codes, Standards or Regulations, the most stringent requirements shall be adhered to.
D. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies and Authorities Having Jurisdiction (AHJ) including local and state building, plumbing, mechanical, electrical, fire, and health department codes and standards.

1.10 DRAWINGS

A. The Drawings are schematic in nature and are intended to show approximate locations of apparatus, fixtures, devices, raceways, etc. in diagrammatic form. The Drawings are not intended to show Architectural and Structural details.
B. Do not scale drawings. Obtain any information requiring accurate dimensions from Architectural and Structural Drawings or from site measurements. Check locations and elevations before proceeding with work.
C. At no additional cost to the Owner, make all changes or additions to materials and/or equipment necessary to accommodate structural and architectural conditions.
D. Leave areas clear and unobstructed where space is indicated as reserved for future equipment.
E. Whether shown on the Drawings or not, provide adequate code required clearances, space and provision for servicing of equipment, removal and reinstallation.

1.11 PERMITTING AND UTILITY COMPANY CHARGES

A. Apply for, obtain and pay for all permits, inspections and fees required.
B. Be fully acquainted with and obey all Federal, State, and Municipal laws, by-laws, codes and regulations, and all authorities having jurisdiction.
C. Before starting any work, submit the required specifications and Drawings to the Governing Authorities for their approval. Comply with any requested changes as part of the Contract, and give any notification immediately of such changes.

D. Where the Specifications, Instructions, or the Governing Authorities require any work to be tested, inspected or approved, give sufficient notice of its readiness for inspection, and, if the inspection is by a Governing Authority, of the date and time set for such inspection.
E. Inspections will be made promptly. If any work is covered up without consent, it shall, if required, be uncovered for examination and the required corrections made at not extra cost to the Owner.
F. Furnish any certificates necessary as evidence that the work conforms to the requirements of all authorities having jurisdiction.
G. Make changes, if required, to make the work conform to all laws, bylaws, codes, and regulations, as part of SECTION 16786 work.
H. Electrical Trade Contractor shall give all necessary notices, file and obtain all permits, pay all governmental taxes and fees. Trade Contractor shall also obtain all required Certificates of Inspection for his respective work and deliver same to Architect or Owner's Representative before request for acceptance of his portion of work is made and before final payment. Electrical Trade Contractor shall pay back charges from utility companies and other costs associated with his work.

1.12 SUBMITTALS

A. Submit shop drawings of all fire alarm system equipment and devices to be furnished under this contract within two weeks of signed contract and notice to proceed.
B. Submittals shall be emailed in Acrobat .PDF format. Shop drawings shall be the manufacturer's original marked up pages. Illegible, scanned documents will not be considered.
C. General: Follow the procedures specified in Division 1. Unless otherwise noted in Division 1 the required shop drawing submittals shall be reviewed and returned for two full or partial submissions as part of the base engineering scope of services. <u>All additional submittal reviews shall be billed to the Electrical Trade Contractor at $750.00 per submittal</u>.
D. Substitutions: The Division 16 Trade Contractor shall submit on the system, components, materials, manufacture, etc. utilized by the Engineer as the "Basis of Design." The exist buildings on the site campus are equipped with new fire alarm systems as manufactured by Notifier. The system provided under this contract shall be as manufactured by Notifier, no substitutions will be allowed.
E. When a substitution is allowed for items other than the Fire Alarm System by the Architect and/or Engineer it shall be the full responsibility of the Division 16 Trade Contractor to coordinate all differences with field conditions, owner, owners representatives, commissioning agent, other trades, etc. Any costs and schedule delays due to changes, modifications, redesigns, removal and replacement created by the Trade Contractor's substitution or failure to coordinate substitution shall be the responsibility of the Trade Contractor.
F. Shop drawings of equipment furnished under this Section shall include, but not be limited to, all items listed under Section 16786 – "WORK INCLUDED" and listed within this specification. Allow for two (2) weeks review time by the Architect.
G. Do not manufacture, deliver or install equipment and materials until final review of Shop Drawings has been completed.
H. Prior to submission of Shop Drawings, the Electrical Contractor shall thoroughly check each shop drawing to ascertain that it complies with the Contract requirements; that the electrical characteristics are correct; and that the dimensions of work submitted fit the available space. Any deviations from the Contract requirements shall be clearly noted on the Shop Drawings. The Electrical Contractor shall stamp each submittal with his firm's name, date and approval, thereby representing that the above has been complied with. Shop Drawings not so checked and stamped, shall be returned without being examined by the Architect. Review of the Shop Drawings shall not relieve the Electrical Contractor from the responsibility for departures from the Contract Documents. Errors in shop drawings shall be the sole responsibility of the Electrical Contractor whether the drawings are reviewed or not.
I. Be responsible for presenting the processing of shop drawings to suit manufacturing schedule of equipment and construction schedule of building.
J. Be responsible for the accuracy of equipment dimensions relative to available space, the performance and the electrical characteristics. When required, submit a complete comparison between accepted alternative equipment and materials, and that which is specified.
K. Each Shop Drawing shall indicate clearly the correct name and address of the project, the manufacturer and <u>using a red arrow</u> mark the catalog number of the item being furnished.

L. Upon receipt of approved Shop Drawings, distribute prints to all trades and manufacturers affected.
M. Keep one set of reviewed Shop Drawings on the site at all times.
N. Bind one set of the corrected “Reviewed” Shop Drawings in each Operation and Maintenance Instructions Manual. Refer to SECTION 01330 - SUBMITTALS, SECTION 01770- CLOSEOUT PROCEEDURES.
O. The Electrical Contractor shall submit to the Owner or Owner’s representative, any samples requested by the Owner. Submittal, review, and approval of samples shall be in accordance with the Conditions of the Contract.

1.13 REQUESTS FOR INTERPRETATION (RFIs)

A. Prepare Requests for Interpretation/Information (RFIs) in accordance to Division 1 and, in addition, adhere to the following:
B. RFIs shall originate with the Trade Contractor. RFIs submitted directly by sub-Trade Contractors will be returned with no response. RFIs sent directly to the engineer will be returned with no response. Incomplete RFIs will not be reviewed and will be returned for additional information.
C. If email RFI submissions are allowed by Division 1 then the RFI and Attachment(s) shall be in Adobe Acrobat PDF format.
D. Submit RFIs in format specified and in addition include:
    1. Specification Section number and title and related paragraphs, as appropriate.
    2. Drawing number, room name, structural grid coordinates and detail references, as appropriate.
    3. Field dimensions and conditions, as appropriate.
    4. Trade Contractor's suggested solution(s). If Trade Contractor's solution(s) impact the Contract Time or the Contract Sum, Trade Contractor shall state impact in the RFI.
    5. Attachments: Include 8 ½” x 11” copies of construction documents highlighting areas requiring interpretation. Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation and suggested solution(s).
        a. Supplementary drawings prepared by Trade Contractor shall be to scale and shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

1.14 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate installed conditions for:
    1. Major raceway systems, size and location, for both exterior and interior; locations of all devices; branch electrical circuitry;
    2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
    3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.15 OPERATION AND MAINTENANCE DATA

A. Prepare maintenance manuals in accordance with Section 01770 CLOSEOUT PROCEEDURES In addition to the requirements specified in Division 1, include the following information for equipment items:
    1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
    2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
    3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
    4. Servicing instructions and lubrication charts and schedules.

1.16 COORDINATION

A. Fully coordinate with other trades to ensure that work is carried out in the best interests of all concerned. Install work in proper sequence to conserve headroom and space.
B. Coordinate work with other trades to provide maximum accessibility for maintenance and operation of all equipment installed by all trades.
C. Give notices of requirements for holes, recessed openings, pits and chases.
D. Coordinate electrical power, control and interlock wiring requirements with the HVAC, Plumbing and Fire Protection Trade Contractors, and Owner's Equipment two (2) weeks after receipt of signed contract to allow proper coordination between trades.
E. Verify smoke and damper actuator requirements with the general Trade Contractor and Division 15 Trade Contractors before ordering any equipment and/or installation of any electrical equipment.
F. Coordinate Duct Smoke detector sampling tube lengths and requirements with HVAC Trade Contractor.
G. Coordinate sprinkler flow switch and tamper switch locations and requirements with fire protection Trade Contractor.

1.17 FIRE ALARM SIGNAL SERVICE

A. The new Fire Alarm Control panel shall be connected to two (2) leased telephone lines in accordance with NFPA 72 for reporting all alarm signals to a central station monitoring company.
B. The electrical Trade Contractor shall be responsible to submit and review a complete set of fire alarm drawings and specifications to the local authorities having jurisdiction (AHJ). The results of the meeting shall be documented in a report and shall indicate any changes requested by the local AHJ's. The report shall be submitted as a shop drawing submittal.

1.18 PROTECTION

A. Protect all electrical equipment, system and work from damage. Keep all equipment dry and clean at all times.
B. Cover openings in equipment, and conduits, with caps or heavy gauge plastic sheeting until final connections are made.
C. Correct at no cost to the Owner, any damage caused by improper storage, handling, or installation of equipment and materials.
D. Protect equipment, conduit and temporary services provided under Section 16786 from weather damage.

1.19 GUARANTEE

A. All equipment, material and workmanship shall be unconditionally guaranteed, as set forth in the Contract, or for longer periods when stated in the Specifications. Extensions to the standard equipment warranty periods shall be arranged by the Electrical Trade Contractor to enable the period to commence upon beneficial usage by the Owner.
B. If any equipment or material does not match the manufacturer's published data or specifically supplied rating schedules during performance tests, replace without delay the defective equipment or materials. Bear all associated costs and adjust all components at no charge to the Owner and adjust all components to achieve the proper rating.
C. Correct defects and deficiencies, and pay for resulting damage to Mechanical or other work, and to property and person, which appear or originate during the guaranteed period
D. The Owner shall give notice of observed defects promptly in writing.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.
2. Metal Items for Use in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.

B. Steel channel supports have 9/16-inch (14-mm) diameter holes at a maximum of 8 inches (203 mm) o.c., in at least 1 surface.
1. Fittings and accessories mate and match with channels and are from the same manufacturer.

C. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or "click"-type hangers.

2.2 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Wires and Cables:
a. American Insulated Wire Corp.; Leviton Manufacturing Co.
b. BICC Brand-Rex Company.
c. Carol Cable Co., Inc.
d. Senator Wire & Cable Company.
e. Southwire Company.
2. Connectors for Wires and Cables:
a. AMP Incorporated.
b. General Signal; O-Z/Gedney Unit.
c. Monogram Co.; AFC.
d. Square D Co.; Anderson.
e. 3M Company; Electrical Products Division.

B. Building Wires and Cables
1. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 “INSTALLATION OF CONDUCTORS AND CABLES”, "Wire and Insulation Applications" paragraph.
2. Rubber Insulation Material: Comply with NEMA WC 3.
3. Thermoplastic Insulation Material: Comply with NEMA WC 5.
4. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.
5. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
6. Conductor Material: Copper.
7. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.

C. Connectors and Splices
1. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 “INSTALLATION OF CONDUCTORS AND CABLES”, "Wire and Insulation Applications" paragraph.

2.3 RACEWAYS AND BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Metal Conduit and Tubing:
a. Alflex Corp.
b. Anamet, Inc.; Anaconda Metal Hose.
c. Anixter Brothers, Inc.
d. Carol Cable Co., Inc.
e. Cole-Flex Corp.
f. Electri-Flex Co.
g. Flexcon, Inc.; Coleman Cable Systems, Inc.
h. Grinnell Co.; Allied Tube and Conduit Div.

i. Monogram Co.; AFC.
j. Spiraduct, Inc.
k. Triangle PWC, Inc.
l. Wheatland Tube Co.

2. Nonmetallic Conduit and Tubing:
   a. Anamet, Inc.; Anaconda Metal Hose.
   b. Arnco Corp.
   c. Breeze-Illinois, Inc.
   d. Cantex Industries; Harsco Corp.
   e. Certainteed Corp.; Pipe & Plastics Group.
   f. Cole-Flex Corp.
   g. Condux International; Electrical Products.
   h. Electri-Flex Co.
   i. George-Ingraham Corp.
   j. Hubbell, Inc.; Raco, Inc.
   k. Lamson & Sessions; Carlon Electrical Products.
   l. R&G Sloan Manufacturing Co., Inc.
   m. Spiraduct, Inc.
   n. Thomas & Betts Corp.
3. Conduit Bodies and Fittings:
   a. American Electric; Construction Materials Group.
   b. Crouse-Hinds; Div. of Cooper Industries.
   c. Emerson Electric Co.; Appleton Electric Co.
   d. Hubbell, Inc.; Killark Electric Manufacturing Co.
   e. Lamson & Sessions; Carlon Electrical Products.
   f. O-Z/Gedney; Unit of General Signal.
   g. Scott Fetzer Co.; Adalet-PLM.
   h. Spring City Electrical Manufacturing Co.
4. Metal Wireways:
   a. Hoffman Engineering Co.
   b. Keystone/Rees, Inc.
   c. Square D Co.
5. Surface Metal Raceways:
   a. Airey-Thompson Co., Inc.; A-T Power Systems.
   b. American Electric; Construction Materials Group.
   c. Butler Manufacturing Co.; Walker Division.
   d. Wiremold Co. (The); Electrical Sales Division.
   e. United Telecom; Premier Telecom Products, Inc.
   f. Wiremold Co. (The); Electrical Sales Division.
6. Boxes, Enclosures, and Cabinets:
   a. American Electric; FL Industries.
   b. Butler Manufacturing Co.; Walker Division.
   c. Crouse-Hinds; Div. of Cooper Industries.
   d. Electric Panelboard Co., Inc.
   e. Erickson Electrical Equipment Co.
   f. Hoffman Engineering Co.; Federal-Hoffman, Inc.
   g. Hubbell Inc.; Killark Electric Manufacturing Co.
   h. Hubbell Inc.; Raco, Inc.
   i. Lamson & Sessions; Carlon Electrical Products.
   j. O-Z/Gedney; Unit of General Signal.
   k. Parker Electrical Manufacturing Co.
   l. Robroy Industries, Inc.; Electrical Division.
   m. Scott Fetzer Co.; Adalet-PLM.
   n. Spring City Electrical Manufacturing Co.
   o. Thomas & Betts Corp.
   p. Woodhead Industries, Inc.; Daniel Woodhead Co.

B. Metal Conduit And Tubing
   1. Rigid Steel Conduit: ANSI C80.1.
   2. Rigid Aluminum Conduit: ANSI C80.5.
   3. IMC: ANSI C80.6.
   4. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
   5. Plastic-Coated IMC and Fittings: NEMA RN 1.
   6. EMT and Fittings ANSI C80.3.
      a. Fittings: Set-screw or compression type.
      b. Fittings: Set-screw type.
      c. Fittings: Compression type.
      d. Fittings: Compression type for conduit size up to 1 ¼", set screw type for conduit size 1 ½" and above.
   7. FMC: Aluminum.
   8. FMC: Zinc-coated steel.
   9. LFMC: Flexible steel conduit with PVC jacket.
   10. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

C. Nonmetallic Conduit And Tubing
   1. ENT: NEMA TC 13.
   2. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
   3. ENT and RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
   4. LFNC: UL 1660.

D. Metal Wireways
   1. Material: Sheet metal sized and shaped as required.
   2. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
   3. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
   4. Wireway Covers: Screw-cover type.
   5. Finish: Manufacturer's standard enamel finish.

E. Surface Raceways
   1. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
   2. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

F. Outlet And Device Boxes
   1. Sheet Metal Boxes: NEMA OS 1.
   2. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.

G. Pull and Junction Boxes
   1. Small Sheet Metal Boxes: NEMA OS 1.
   2. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

H. Enclosures And Cabinets
   1. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
      a. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
      b. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
   2. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

2.4 ELECTRICAL IDENTIFICATION

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. American Labelmark Co.; Labelmaster Subsidiary.
   2. Brady USA, Inc.; Industrial Products Div.

3. Calpico, Inc.
4. Carlton Industries, Inc.
5. Champion American, Inc.
6. Cole-Flex Corp.
7. D&G Sign and Label.
8. EMED Co., Inc.
9. George-Ingraham Corp. (The).
10. Grimco, Inc.
11. Ideal Industries, Inc.
12. Kraftbilt.
13. LEM Products, Inc.
14. Markal Corp.
15. National Band & Tag Co.
16. Panduit Corp.
17. Radar Engineers.
18. Ready Made Sign Co.; Cornerstone Direct Corp. Div.
19. Seton Name Plate Co.
20. Standard Signs, Inc.

B. Engraved Nameplates And Signs
   1. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
   2. Engraving stock, melamine plastic laminate, 1/16-inch (1.6-mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick for larger sizes.
      a. Engraved Legend: Black letters on white face.
      b. Punched for mechanical fasteners.
   3. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.
   4. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396-inch (1-mm), galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6.4-mm) grommets in corners for mounting.
   5. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers. Adhesives will not be allowed.

C. Miscellaneous Identification Products
   1. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:
      a. Minimum Width: 3/16 inch (5 mm).
      b. Tensile Strength: 50 lb (22.3 kg) minimum.
      c. Temperature Range: Minus 40 to 185 deg F (Minus 4 to 85 deg C).
      d. Color: As indicated where used for color coding.
   2. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. BBA Corp.
      c. Best-Lites; Best Power Technology, Inc.
      d. Chloride Systems.
      e. Dual-Lite.
      f. Exide Lightguard.
      g. Holophane Corp.
      h. Hubbell Lighting Corp.
      i. Kaufel Group Co.; Emergi-Lite, Inc. Div.
      j. Kaufel Group Co.; Lightalarms Electronics Corp. Div.

k. Lithonia Lighting Emergency Lighting Systems.

2.5 GROUNDING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Apache Grounding; Nashville Wire Products.
   2. Boggs: H. L. Boggs & Co.
   3. Chance: A. B. Chance Co.
   4. Dossert Corp.
   5. Erico Inc.; Electrical Products Group.
   6. Galvan Industries, Inc.
   7. Hastings Fiber Glass Products, Inc.
   8. Heary Brothers Lightning Protection Co.
   9. Ideal Industries, Inc.
   10. ILSCO.
   11. Kearney.
   12. Korns: C. C. Korns Co.
   13. Lightning Master Corp.
   14. Lyncole XIT Grounding.
   15. O-Z/Gedney Co.
   16. Raco, Inc.
   17. Salisbury: W.H. Salisbury & Co., Utility.
   18. Thomas & Betts, Electrical.
   19. Utilco Co.
B. Grounding and Bonding Products
   1. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
C. Wire and Cable Grounding Conductors
   1. Comply with Division 16 Section "Wires and Cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
      a. Material: Copper Only.
   2. Equipment Grounding Conductors: Insulated with green color insulation.

2.6 FIRE ALARM SYSTEM

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), and wiring as shown on the drawings and specified herein.
B. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
D. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).
E. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
F. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.
G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Notifier – No substitutions
H. Equipment and material, general:

1. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.
2. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
3. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

I. Description of System
1. Include the following system functions and operating features plus those additional functions and features required by the authorities having jurisdiction:
   a. Priority of Signals: Accomplish automatic response functions by the first address initiated. Alarm functions resulting from initiation by the first device are not altered by subsequent alarms. The highest priority is an alarm signal. Supervisory and trouble signals have second- and third-level priority respectively. Higher-priority signals take precedence over signals of lower priority, even though the lower-priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.
   b. Non-interfering: Zone, power, wire, and supervise the system so a signal on one device does not prevent the receipt of signals from any other device. All zones are manually resettable from the FACP only after the initiating device or devices are restored to normal. Systems that require batteries or battery back-up for the programming function are unacceptable.
   c. Fire Alarm Control Panel (FACP) Response: The manual or automatic operation of an alarm-initiating device causes the FACP to transmit an appropriate signal including the following:
   d. General alarm.
   e. Fire-suppression system operation alarm.
   f. Fan shutdown.
   g. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service.
   h. Silencing at the FACP: Switches provide capability for acknowledgment of alarm, supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal and light a light-emitting diode (LED). Subsequent zone alarms shall cause the audible signal to sound again until silenced by switch operation. Restoring alarm, supervisory, and trouble conditions to normal extinguishes the associated LED and causes the audible signal to sound again until restoration is acknowledged by switch operation.
   i. Loss of primary power sounds a trouble signal at the FACP. The FACP indicates when the fire alarm system is operating on an alternate power supply.
   j. Loss of primary power at the FACP sounds a trouble signal. An emergency power light is illuminated when the system is operating on an alternate power supply.
   k. FACP Alphanumeric Display: Displays plain-English-language descriptions, locations and addresses of initiating devices, alarms, trouble signals, supervisory signals, monitoring actions, system and component status, and system commands.
   l. General Alarm: A system general alarm includes the following:
   m. Indicating the general alarm condition at the FACP.
   n. Identifying the device that is the source of the alarm at the FACP.
   o. Initiating audible and visible alarm signals throughout the building.
   p. Stopping supply and return fans serving zone where alarm is initiated.
   q. Initiating transmission of alarm signal to remote central station via the digital communicator.
   r. Manual station alarm operation initiates a general alarm.
   s. Water-flow alarm switch operation Initiates
   t. A general alarm

u. The location-indicating light to flash for the device that has operated.
v. Smoke detection initiates a general alarm.
w. Heat detection initiates a general alarm.
x. Sprinkler valve tamper switch operation causes or initiates the following:
y. A supervisory, audible, and visible "valve tamper" signal indication at the FACP.
z. The location-indicating light to flash for the device that has operated.
aa. Transmission of supervisory signal to remote central station.

J. Addressable Devices
1. Alarm-Initiating Devices: Classified as addressable devices according to NFPA 72.
a. Communication Transmitter and Receiver: Integral to device. Provides each device with a unique identification and capability for status reporting to the FACP.
b. External Addressable Interface Unit: May be used where specified devices are not manufactured and labeled with integral multiplex transmitter and receiver. Arrange to monitor status of each device individually.

K. Manual Pull Stations
1. Description: Double-action type, fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.
a. Station Reset: Key or wrench operated, double pole, double throw, switch rated for the voltage and current at which it operates. Stations have screw terminals for connections.

L. Smoke Detectors
1. General: Comply with UL 268. Include the following features:
a. Factory Nameplate: Serial number and type identification.
b. Operating Voltage: 24-V dc, nominal.
c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
d. Plug-in Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.
e. Integral Visual Indicating Light: Connect to indicate detector has operated.
f. Remote Controllability: Individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.
2. Photoelectric Smoke Detectors: Include the following features:
a. Detector Sensitivity: Between 2.5- and 3.5-percent-per-foot (0.008- and 0.011-percent-per-mm) smoke obscuration when tested according to UL 268.
b. Sensor: An infrared detector light source with matching silicon-cell receiver.
3. Duct Smoke Detector: Ionization type.
a. Sampling Tube: Design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied.
b. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

M. Other Detectors
1. Thermal Detector: Combination fixed-temperature and rate-of-rise unit with mounting plate arranged for outlet box mounting; 135 deg F (57 deg C) fixed-temperature setting, except as indicated.

N. Alarm-Indicating Devices
1. General: Equip alarm-indicating devices for mounting as indicated. Provide terminal blocks for system connections.
2. Horns: Electric-vibrating-polarized type, operating on 24-V dc, with provision for housing the operating mechanism behind a grille. Horns produce a sound-pressure level of 90 dB, measured 10 feet (3 m) from the source.
3. Visual Alarm Devices: Synchronous, Xenon strobe lights with clear or nominal white polycarbonate lens. Mount lenses on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch (25-mm) high letters on the lens.
a. Devices have a minimum light output as indicated on the Drawings.
b. Strobe Leads: Factory connected to screw terminals.

c. Combination devices consist of factory-combined, audible and visual alarm units in a single mounting assembly.

4. Remote Alarm Indicator: LED type, mounted flush in a single gang wall plate.
   a. Connected to indicate the alarm operation of a single detector or other device.
   b. Legend: "Alarm."

O. Central Fire Alarm Control Panel (FACP)
1. General: Comply with UL 864.
2. Cabinet: Lockable steel enclosure. Arrange panel so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of panels and field wiring. Identify each enclosure by an engraved, red, laminated, phenolic-resin nameplate. Lettering on the enclosure's nameplate shall not be less than 1 inch (25 mm) high. Identify individual components and modules within the cabinets with permanent labels.
3. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in cards. Construction requiring removal of field wiring for module replacement is unacceptable.
4. Control Modules: Types and capacities required to perform all functions of the fire alarm systems. Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.
5. Indicating Lights: An LED test switch for each FACP section illuminates all LED devices on that section of the control panel. Manual toggle test switches or push test-buttons do not require a key to operate. Alarm and supervisory signals light a red LED of the associated zone. Trouble signals light an amber LED for the associated zone.
6. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm or trouble condition still exists.
7. Alphanumeric Display and System Controls: Arrange to provide the basic interface between human operator at the FACP and addressable system components, including annunciation and supervision. A display with a minimum of 32 characters shows alarm, supervisory, and component status messages. Arrange keypad for use in entering and executing control commands.
8. Instructions: Printed or typewritten instruction card mounted behind a lexan plastic or glass cover in a stainless-steel or aluminum frame. Install the frame in a location observable from the FACP. Include interpretation and appropriate response for displays and signals, and briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

P. Emergency Power Supply
1. General: Components include valve-regulated, recombinant lead acid battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 10 years, minimum.
2. General: Components include nickel-cadmium-type battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 20 years, minimum.
3. Battery capacity is adequate to operate the complete alarm system in normal or supervisory (nonalarm) mode for a period of 24 hours. At the end of this period, the battery has sufficient capacity to operate the system, including alarm-indicating devices in either alarm for a period of 15 minutes.
4. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining the batteries at full charge. In the event batteries are fully discharged, the charger recharges them completely within 4 hours. Charger output is supervised as part of system power supply supervision.
5. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

Q. Wire
1. Wire: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   a. Low-Voltage Circuits: No. 16 AWG, minimum.
   b. Line-Voltage Circuits: No. 12 AWG, minimum.

2.7 TOUCHUP PAINT

A. For Equipment: Provided by equipment manufacturer and selected to match equipment finish.
B. For Nonequipment Surfaces: Matching type and color of undamaged, existing adjacent finish.

PART 3 - INSTALLATION

3.1 EXAMINATION

A. Verify that field measurements and circulating arrangements are as shown on Drawings.
B. Verify that all obsolete equipment, wiring. Raceways, equipment and devices have been completely demolished and removed from the site.

3.2 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.
B. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.3 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
B. Refer to equipment specifications, drawings, elevations and shop drawings to verify rough-in requirements.

3.4 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
    1. Coordinate electrical systems, equipment, and materials installation with other building components.
    2. Verify all dimensions by field measurements.
    3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
    4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
    5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work.
    6. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
    7. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
    8. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
    9. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.5 ELECTRICAL SUPPORTING METHODS

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
B. Dry Locations: Steel materials.
C. Support Clamps for PVC Raceways: Click-type clamp system.
D. Conform to manufacturer's recommendations for selecting supports.

E. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of at least 4; 200-lb- (90-kg-) minimum design load.

3.6 INSTALLATION OF ELECTRICAL SUPPORTING DEVICES

A. Install devices to securely and permanently fasten and support electrical components.
B. Raceway Supports: Comply with NFPA 70 and the following requirements:
   1. Conform to manufacturer's recommendations for selecting and installing supports.
   2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
   3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
   4. Spare Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.
   5. Support individual horizontal raceways with separate, malleable iron pipe hangers or clamps.
   6. Hanger Rods: 3/8-inch diameter or larger threaded steel, except as otherwise indicated.
   7. Spring Steel Fasteners: Specifically designed for supporting single conduits or tubing. May be used in lieu of malleable iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to channel and slotted angle supports.
   8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminals.
C. In open overhead spaces, cast boxes threaded to raceways need not be separately supported, except where used for fixture support; support sheet-metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
D. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Perform fastening according to the following:
   1. Fasten by means of machine screws, welded threaded studs, or spring-tension clamps on steel.
   2. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.

3.7 INSTALLATION OF CONDUCTORS AND CABLES

A. Wire and Insulation Applications
   1. Branch Circuits: Type THHN/THWN, in raceway.
   2. Fire Alarm Circuits:
      a. FPLR, in “red” conduit.
      b. Class 1 Control Circuits: Type THHN/THWN, in raceway.
      c. Class 2 Control Circuits: Type THHN/THWN, in raceway.
B. Installation
   1. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
   2. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
   3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
   4. Identify wires and cables according to Division 16 Section "Electrical Identification."
C. Connections
   1. Conductor Splices: Not allowed.
   2. Wiring at Outlets: Install conductor at each outlet, leave at least 8 inches of slack.
   3. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

D. Field Quality Control
   1. Testing Agency: Engage a Manufacturer's technician to perform field quality-control testing.
   2. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.8 INSTALLATION OF RACEWAYS AND BOXES

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
B. Wiring Methods
   1. Outdoors: Use the following wiring methods:
      a. Exposed: Rigid steel or IMC.
      b. Concealed: Rigid steel or IMC.
      c. Underground, Single Run: Schedule 80 PVC.
      d. Underground, Grouped: Schedule 80 PVC.
      e. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
      f. Underground schedule 80 PVC to within 5 feet of turning up from underground transition to RSC to equipment. Schedule 80 PVC will be allowed exposed within Main Electric Room.
      g. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
   2. Indoors: Use the following wiring methods:
      a. Exposed: EMT
      b. Concealed: EMT, ENT, or RNC.
      c. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
      d. Damp or Wet Locations: Rigid steel conduit.
      e. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
      f. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
      g. Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.
C. Installation
   1. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
   2. Minimum Raceway Size: 3/4-inch trade size (DN21).
   3. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
   4. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
   5. Install raceways level and square and at proper elevations. Provide adequate headroom.
   6. Complete raceway installation before starting conductor installation.
   7. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
   8. Use temporary closures to prevent foreign matter from entering raceways.
   9. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
   10. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
   11. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
   12. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
   13. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
      a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

b. Space raceways laterally to prevent voids in concrete.
c. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
d. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

14. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
    a. Run parallel or banked raceways together, on common supports where practical.
    b. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
15. Join raceways with fittings designed and approved for the purpose and make joints tight.
    a. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
    b. Use insulating bushings to protect conductors.
16. Tighten set screws of threadless fittings with suitable tools.
17. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
18. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
19. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

D. Protection
    1. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
        a. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
        b. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

E. Cleaning
    1. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.9 INSTALLATION OF ELECTRICAL IDENTIFICATION

A. Install identification devices according to manufacturer's written instructions.
B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
D. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.
E. Install identification as follows:
    1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high lettering on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use lettering 2 inches (51 mm) high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment.

3.10 INSTALLATION OF FIRE ALARM SYSTEMS

A. Manual Pull Stations: Mount semiflush in recessed back boxes with operating handles 48 inches (1220 mm) above the finished floor or lower as indicated.
B. Water-Flow Detectors and Valve Supervisory Switches: Connect interface modules for each sprinkler valve station required to be supervised.
C. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches (100 mm) from a side wall to the near edge. Install detectors located on the wall at least 4 inches (100 mm), but not more than 12 inches (300 mm), below the ceiling. For exposed solid-joist construction, mount detectors on the bottom of the joists. On smooth ceilings, install detectors not over 30 feet (9 m) apart in any direction. Install detectors no closer than 60 inches (1520 mm) from air registers.
D. Audible/Visual Alarm-Indicating Appliances: Install not less than 80 inches above the finished floor nor less than 6 inches (150 mm) below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit.
E. FACP: Flush mount with top of cabinet not more than 72 inches (1830 mm) above the finished floor.
F. Install system according to NFPA standards referenced in Parts 1 and 2 of this Section.
G. Fire Alarm Power Supply Disconnect: Paint red and label "FIRE ALARM." Provide with lockable handle or cover.
H. WIRING INSTALLATION
    1. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways, Boxes, and Cabinets." Conceal raceway except in unfinished spaces and as indicated.
    2. Wiring within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
    3. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
    4. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and a different color code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visual alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
I. Field Quality Control
    1. Manufacturer's Field Service: Provide services of a factory-authorized service representative to perform all programming and supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
    2. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
    3. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.
    4. Final Test Notice: Provide a 10-day minimum notice to the Owner, Engineer and Barnstable Fire Department in writing when the system is ready for final acceptance testing by same.
    5. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72. Minimum required tests are as follows:
        a. Verify the absence of unwanted voltages between circuit conductors and ground.
        b. Test all conductors for short circuits using an insulation-testing device.

c. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
d. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
e. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
f. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
g. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
h. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

6. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
7. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.
8. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

J. Cleaning And Adjusting
1. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

K. Demonstration
1. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.
a. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of 8 hours' training.
b. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
c. Schedule training with Owner with at least 7 days' advance notice.

3.11 TOUCHUP PAINTING

A. Thoroughly clean damaged areas and provide primer, intermediate, and finish coats to suit the degree of damage at each location.
B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

* * * END OF SECTION 16786 * * *