SECTION 238126
SPLIT-SYSTEM AIR-CONDITIONERS & HEAT PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied custom color finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.

2. Gaskets: One set(s) for each access door.

1.6 QUALITY ASSURANCE

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.

1.7 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers, subject to compliance with requirements, provide products by one of the following:

1. All Splits:

a. Daikin
b. YORK; a Johnson Controls company
c. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Ducted Indoor Units

1. Concealed Evaporator-Fan Components:

a. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
b. Insulation: Faced, glass-fiber duct liner.
c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and electronic thermal-expansion valve. Comply with ARI 210/240.
d. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
e. Fan Motors:

1) Multispeed with internal thermal protection and permanent lubrication.

f. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

g. Condensate Drain Pans:

1) Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

2) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.

3) Depth: A minimum of 2 inches (50 mm) deep.

4) Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.

5) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.

a) Minimum Connection Size: NPS 1.

6) Pan-Top Surface Coating: Asphaltic waterproofing compound.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Horizontal Discharge Outdoor Units

1. Description: Factory assembled, single piece unit, capable of functioning as the outdoor component of an air-to-air cooling only, or heat pump system. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the compressor. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC.

a. Units shall be used in a refrigerant circuit matched to heat pump indoor fan coil units.

b. Units shall include accumulator, refrigerant metering device(s), reversing valve (heat pumps only) and controls.

2. Unit Cabinet: Constructed of galvanized steel, coated with a baked-enamel finish on inside and outside. Unit cabinet shall be capable of withstanding 500--hour salt spray test per Federal Test Standard No. 141 (method 6061).

a. Wind Baffles: Furnish.

b. Wall Mounting Kit: Furnish for outdoor units shown wall mounted or mounted on the outside of a structure on contract drawings.

c. Stacking Kit (not for Heat Pumps): Furnish for outdoor units shown stacked on contract drawings.

3. Fans: Direct-drive propeller type, discharging air horizontally. Fans shall blow air through the outdoor coil.

    a. Fan Motors: Totally-enclosed, single phase motors with class B insulation and permanently-lubricated bearings. Motor shall be protected by internal thermal overload protection.
    b. Fan Shaft: Corrosion resistant.
    c. Fan Blades: Metallic, statically and dynamically balanced.
    d. Fan Openings: Equipped with PVC-coated metal protective grille over fan.

4. Compressor, Inverter-Driven: Fully hermetic rotary scroll type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over--temperature and over--current. Compressor assembly shall be installed on rubber vibration isolators.

    a. Motor: NEMA rated class F, suitable for operation in a refrigerant atmosphere.
    b. Inverter Technology: Compressors shall be variable speed for multi-splits. Compressor speed will be adjusted to match load.
    c. Liquid Line Solenoid Valve: Provide for long refrigerant line applications.

5. Outdoor Coil: Constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed. Air--cooled condenser coils shall be leak tested at 573 psig.

6. Refrigeration Components: Components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator.

    a. Refrigerant: R410A Puron.
    b. Low-Ambient Kit (Field Installed): Furnish control to regulate fan-motor cycles in response to saturated condensing temperature of the unit. The control shall be capable of maintaining a condensing temperature of 100°F ± 10°F (37.78°C ± 5.5°C) with outdoor temperatures to -20°F (-28.9°C). Installation of kit shall not require changing the outdoor fan motor.

        1) Isolation Relay: For heat pumps, provide relay to ensure the pressure switch is bypassed when unit is running in heat pump mode.
        2) Winter Start Control: For cooling only units, provide an SPST delay relay which will bypass the low pressure switch for approximately (3) minutes to permit start-up for cooling operation under low load conditions at low ambient temperatures.

c. Crankcase Heater, Thermostatically Controlled: Furnish.
d. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.

7. Controls & Safeties: Factory selected, assembled, and tested. Provide a time delay control sequence standard through the fan coil board, and automatic outdoor-fan motor protection.

a. Safeties:

1) Diagnostics provided by matched indoor unit.
2) Compressor motor current and temperature overload protection.
3) High pressure switch outdoor fan failure protection.
4) Low pressure protection.
5) Fusible plug to vent refrigerant safely in case of a fire.

8. Refrigerant Line Lengths: The unit shall be capable of 200 ft (61 m) maximum piping, a maximum lift (fan coil above) of 65 ft (19.8 m) and a maximum drop (fan coil below) of 150 ft (45.8 m). Furnish all accessories required to achieve these lengths.

a. Interconnecting Insulated Refrigerant Tubing: Furnish all tubing required.

9. Electrical Requirements: Unit control voltage to the indoor fan coil unit shall be 24 VDC. All power and control wiring to be installed per NEC and all local electrical codes.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and shown on drawings M-4.1 and M4.2.

B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

C. Integral condensate pump.

D. Additional accessories identified on equipment schedules.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment roof curb supports as detailed on drawings.

D. Install seismic restraints.

E. Install and connect pre-charged insulated refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 238216
AIR COILS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hydronic coils.

1.2 SUBMITTALS

A. Product Data: Include performance data, airside pressure drop, water pressure drop, and materials of construction.

B. ARI Certification.

C. Field quality control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. ASHRAE Compliance:

1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers, subject to compliance with requirements, provide products by one of the following:

1. Hot Water Reheat Coils:

a. Carrier.
b. York.
c. Trane.
d. Aerofin.

2.2 GENERAL

A. Minimum water velocity shall be 2.5 feet per second (fps) at design flow.

B. Certify coil performance in accordance with ARI Standard 410.

2.3 REHEAT COILS

A. Tubes: Copper, 1/2 inch O.D. by 0.016 inch wall thickness mechanically expanded into the fin collars.

B. Fins: 0.006 inch thick aluminum, bonded to tube.

C. Casing: No. 16 gage galvanized steel, with fully flanged duct connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine preliminary work required before air coils can be installed.

B. Coordinate with work of other Sections to make preliminary work acceptable for installation of air coils.

C. Do not begin installation until preliminary work is complete and in accordance with manufacturer's requirements.

D. Commencing air coil installation indicates that preliminary work is satisfactory for installation of air coils.

3.2 INSTALLATION

A. Install air coils in accordance with manufacturer's installation instructions.

B. Install coils level and plumb.

C. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

D. Straighten bent fins on air coils.

E. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

F. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

G. Install piping adjacent to coils to allow service and maintenance.

H. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping.

I. Control valves are specified in Section 230900, and other piping specialties are specified in Section 232113.

J. Provide insulated access doors in ductwork upstream and downstream of duct-mounted coils as specified in Section 233113.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

+ + END OF SECTION + +

SECTION 260500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.

2. Common electrical installation requirements.

3. Warranty.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. None

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions:

1. Ambient temperature: Not less than minus 22 deg. F and not exceeding 104 deg. F.

2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than 14 days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.

3. Do not proceed with interruption of electric service without Construction Manger's written permission.

4. Comply with NFPA 70E.

1.7 WARRANTY

A. Contractor shall provide manufacturer's standard warranty for all products supplied under Division 26 unless otherwise specified elsewhere in these documents. Manufacturer's warranty shall be a minimum of one year from date of substantial completion.

PART 2 - PRODUCTS

2.1 THROUGH WALL / THROUGH FLOOR FIRE STOP FITTING

A. Description: Firestop device for use in through-penetration firestop systems shall be classified for use in one, two, three and four-hour rated gypsum, concrete floors having a minimum 4 1/2" thick reinforced lightweight or normal weight.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Wiremold FS Series (Basis of Design).
b. Hilti

2. Listings: Under writers Laboratories, Inc., to UL 1479 (ASTM E814).

B. Product Materials

1. Box: 17 gauge, G90 steel

2. Intumescent Block: Shall be constructed of a graphite base material with expansion starting at 375 degrees F and an unrestrained expansion between six and twelve times. The intumescent block shall be securely held by the box in order to prevent tampering and damage during installation.

3. Adjustable Doors: Adjustable to prevent materials from penetrating the device if the device is empty or completely full. The doors shall be constructed of 16 gauge G90 steel with No. 10-32 screws to adjust the opening size.

4. Heat Shield: Where required for retrofit applications where a conduit extends more than 7/8" out of the wall, the manufacturer's recommended heat shield shall be used in order to maintain UL fire classifications. In cases where the heat shield is used, the fire stop device shall be installed onto the heat shield.

5. Split Conduit and Wall Plate: Where required for retrofit applications without a conduit, the split conduit assembly shall be used to protect the existing cables. After installing the split conduit within the wall, the firestop wall plate shall be installed to cover any irregularity in the hole, and the firestop device is then installed onto the conduit.

6. Finish: the firestop device shall be powder-coated red.

7. Sizes: the device shall be matched to the required trade size of conduit, between 2" and 4", EMT.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall

assemblies.

B. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

C. Cut sleeves to length for mounting flush with both surfaces of walls.

D. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

E. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

F. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

G. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping." Firestop assemblies shall carry the same (or greater) fire rating as the fire wall, floor, or ceiling assembly that is being penetrated.

H. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

3.3 THROUGH WALL / THROUGH FROM FIRE STOP FITTING

A. Adjustable through wall or through floor fittings shall be installed wherever cables pass through an opening in a rated structure. This shall include all data and telephone cables, MC cables, and any other cables which are not enclosed in conduit for the entire length of their run.

B. All fire stop fittings shall be installed in accordance with the UL Fire resistance Directory, along with all applicable codes and standards for general building, electrical and firestopping installation practices.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

+ + END OF SECTION + +

SECTION 260501
WORK IN EXISTING BUILDING

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED IN OTHER SECTION

A. Section 260500, Common Work Results for Electrical.

1.2 SUMMARY

A. Note that part of the construction is to be performed in existing facilities and that the Drawings generally show only new work that is required. The Drawings do not show in detail how the new work is to be installed because unknown obstructions to its installation may be disclosed as the work progresses. Perform the work indicated, and perform such additional work as may be required but is not specifically shown. Perform this work in such a manner as to overcome all obstructions and difficulties that are encountered. Perform such work in full cooperation with Architect, who will help decide at the site how this work is to be done.

1.3 FIELD CONDITIONS

A. Before submitting his bid, Contractor shall verify existing conditions in the field. Failure to do so shall not relieve Contractor of his obligation to pay for costs that may be incurred due to conditions that may affect the cost of installing his work.

B. Before ordering material or doing work, the Contractor shall correct and verify measurements, including existing lines, grades, pipes and duct elevations at the building and shall be responsible for the correctness of same. No extra compensation shall be allowed on account of differences between actual dimensions measured and those indicated on the drawings. Significant differences which may be found shall be submitted to the Architect/Engineer for consideration before proceeding with the work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Use products that are compatible with existing materials. Wherever possible, use products of the same manufacturer as existing materials.

PART 3 - EXECUTION

3.1 GENERAL

A. Check existing electrical installations and connect new work as indicated on drawings. Verify locations and capacities of existing facilities and rework these facilities as required to accommodate the new work. Make minor modifications to the work shown as required for compatibility.

B. Remove and/or relocate existing equipment as required by renovations. Reconnect disturbed facilities and place in operating condition.

1. In general, the drawings show only the major items to be removed. In addition to the items shown, remove associated conduit, wiring, fastenings and supports.

2. Disconnect electrically operated equipment which is to be removed and blank off wiring. Disconnect and reconnect electrically operated equipment which is to be reworked.

3. Where new construction interferes with existing outlets, remove the outlets and replace them with new outlets in the new construction. Extend existing wiring as required.

4. Where new interior building surfaces are installed, extend existing outlet boxes out to new surface with appropriate extension rings.

5. Where there is an interference with wall mounted equipment such as clocks, loudspeakers and bells, relocate the equipment and associated outlets to clear the interference.

6. Where parts of the existing wiring system are disrupted, rework wiring as required to re- energize loads that are to remain in operation. Cut the structure on each side of outlets to be removed, remove existing conduit and wiring, provide new conduit and wiring between remaining outlets, make final connections, and patch structure.

7. Where outlets are cut off from an existing feed, re-feed them from another direction if possible, and provide new conduit and wire if necessary.

C. Abandon existing lines where no longer required, and remove them where they interfere with new construction. Remove all wire from all abandoned conduits.

1. Remove wiring devices where shown on drawings and abandon boxes if they are in existing walls that are to remain. Provide blank cover plates for abandoned boxes, using cast corrosion resistant covers with gaskets for outdoor use.

2. Remove abandoned conduit and wiring that would be exposed in finished areas. Cut conduit flush with finished floor.

D. Promptly remove all used material from the site if it is no longer required. Where indicated, deliver used material to the Owner where directed on the site.

E. Cut openings in existing beams, floors, walls and other parts of the existing building without extra cost, regardless of the material encountered. Obtain approval of Construction Manager before cutting structural members, and reroute electrical work to avoid such cutting if directed by Construction Manager.

1. Saw cut and core drill existing concrete and paving. Cut reinforcing steel to provide a stub for connecting new reinforcing steel.

2. Where floors and fire rated walls are penetrated, fill openings and spaces with Fire Resistant Sealant to retard spread of fire and smoke.

F. Existing conduit already installed in the structure may be reused if it is in good condition.

1. Where new wire is to be installed in existing conduit, disconnect and remove all existing wire. Replace existing wire with new wire of the same general characteristics and appropriate insulation, and draw replacement wire into the conduit along with the new wire. Reconnect existing wire and check entire system, placing it in approved operating condition. Nylon insulated wire may be used if required to meet conduit fill requirements of NEC.

G. Schedule all interruptions to building services such as electric light and power, telephone and signal systems. Have schedules approved by Construction Manager/Owner before executing the interruption.

1. In general, no interruptions will be permitted during normal working hours; provide overtime work necessary to meet this requirement.

2. If interruptions must occur during normal working hours, provide temporary services as required to permit full and normal functioning of all facilities during the interruption.

H. Provide sleeves through existing walls where required for passage of wiring without conduit. Provide all sleeves required for passage of telephone wiring.

1. Refer to Section "Common Work Results for Electrical" for sleeves and firestop fittings.

I. Perform additional renovation work as described in subsequent Sections of the Specifications.

J. Provide other renovation work as required by job conditions.

3.2 TESTING

A. If Owner/Construction Manager wants to reuse existing electrical distribution equipment, substations, switchboards, distribution panelboards, transformers, motor control centers, starters, disconnects, lighting fixtures, etc., he shall engage an independent testing firm for the purpose of inspecting, testing and calibrating to assure that existing electrical equipment is operational and within industry and manufacturer's tolerances.

B. All testing shall be done in accordance with International Electrical Testing Association (NETA), ANSI/IEEE and ASTM standards and guidelines.

C. The testing firm shall provide all material, equipment, labor and technical supervision to perform such tests and inspections.

D. The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers and installers of equipment or systems evaluated by the testing firm.

E. The testing firm shall be regularly engaged in testing of electrical equipment devices, installations and systems.

F. The testing firm shall meet the criteria for Full Membership or be a Full Member company of the InterNational Electrical Testing Association.

G. The lead, on site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or the National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

H. The testing firm shall utilize technicians who are regularly employed by the firm for testing services.

I. The testing firm shall submit proof of the above qualifications with bid documents.

J. Any system, equipment, material or workmanship which is found defective on the basis of tests shall be reported to the Owner/Construction Manager.

K. The testing firm shall maintain a written record of all tests and shall assemble and certify a final test report for Owner/Construction Manager.

1. The test report shall include the following:

a. Summary of project;
b. Description of equipment tested;
c. Description of test;
d. Test results;
e. Analysis and recommendations.

3.3 EXISTING PANELBOARDS

A. Where panelboards are to be replaced in existing buildings, existing cabinets shall also be replaced unless otherwise noted. Rework existing wiring as required to fit the new panelboard, and replace all wire damaged in the process. Repair structure to satisfaction of Construction Manager/Owner.

3.4 EXISTING LIGHTING FIXTURES

A. Repair all existing lighting fixtures that are to remain in renovated areas, and place in approved operating condition. Replace broken and inoperative parts, and rewire the equipment if necessary. Replace all lamps in lighting fixtures.

+ + END OF SECTION + +

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.

2. Connectors, splices, and terminations rated 600 V and less.

3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.

2. Cerrowire.

3. General Cable Corporation.

4. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

D. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC, metal-clad cable, Type MC, with ground wire.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Hubbell Power Systems, Inc.

3. O-Z/Gedney; EGS Electrical Group LLC.

4. 3M; Electrical Products Division.

5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, Type AC or Type MC.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. 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.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

+ + END OF SECTION + +

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. 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.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Bare Grounding Conductor:

1. No. 4 AWG minimum, soft-drawn copper.

D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters,

dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass

water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).

5. Substations and Pad-Mounted Equipment: 5 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

+ + END OF SECTION 260526 + +

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

3. Fitting and Accessory Materials: Same as channels and angles

4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of

threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided

with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69]

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Qualification Data: For professional engineer and testing agency.

C. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Alflex Inc.

3. Allied Tube & Conduit; a Tyco International Ltd. Co.

4. Electri-Flex Co.

5. Manhattan/CDT/Cole-Flex.

6. Maverick Tube Corporation.

7. O-Z Gedney; a unit of General Signal.

8. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket, U.L. listed for its purpose.

G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Fittings for EMT: Steel Compression type for 2" trade size and smaller, set-screw type for 2 1/2" and larger.

2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Arnco Corporation.

3. CANTEX Inc.

4. CertainTeed Corp.; Pipe & Plastics Group.

5. Condux International, Inc.

6. ElecSYS, Inc.

7. Electri-Flex Co.

8. Lamson & Sessions; Carlon Electrical Products.

9. Manhattan/CDT/Cole-Flex.

10. RACO; a Hubbell Company.

11. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.

2. Hoffman.

3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. 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.

D. Wireway Covers: Hinged type unless otherwise noted.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.

2. Lamson & Sessions; Carlon Electrical Products.

B. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

C. 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.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Butler Manufacturing Company; Walker Division.
b. Enduro Systems, Inc.; Composite Products Division.
c. Hubbell Incorporated; Wiring Device-Kellems Division.
d. Lamson & Sessions; Carlon Electrical Products.
e. Panduit Corp.
f. Walker Systems, Inc.; Wiremold Company (The).
g. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.

2. EGS/Appleton Electric.

3. Erickson Electrical Equipment Company.

4. Hoffman.

5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.

6. O-Z/Gedney; a unit of General Signal.

7. RACO; a Hubbell Company.

8. Robroy Industries, Inc.; Enclosure Division.

9. Scott Fetzer Co.; Adalet Division.

10. Spring City Electrical Manufacturing Company.

11. Thomas & Betts Corporation.

12. Walker Systems, Inc.; Wiremold Company (The).

13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

J. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit

2. Concealed Conduit, Aboveground: Rigid steel conduit

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:

a. Loading dock.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: IMC.

7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.

8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.

9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.

10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch- trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of

refrigerated spaces.

2. Where otherwise required by NFPA 70.

L. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F <Insert temperature> temperature change.
d. Attics: 135 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

O. Set metal floor boxes level and flush with finished floor surface.

P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

+ + END OF SECTION 260533 + +