SECTION 16050 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 – GENERAL
1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all other sections of the Electrical Specifications apply to this section. This is typical for all sections of the Electrical Specifications.
1.2 SUBMITTAL
A. Not required for this section.
1.3 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. This requirement applies to all sections of the Electrical Specifications.
B. Comply with NFPA 70. This requirement applies to all sections of the Electrical Specifications.
1.4 COORDINATION
A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction.
B. Coordinate electrical service connections to components furnished by utility companies.
PART 2 – PRODUCTS
2.1 SUPPORTING DEVICES
A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
C. Slotted-Steel Channel Supports: Flange edges turned toward web.
D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C- clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps.
2.2 ELECTRICAL IDENTIFICATION
A. Identification Devices: A single type of identification product for each application category.
B. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).
C. Underground Warning Tape: Permanent, bright-colored, continuous-printed, detectable premarked vinyl tape.
D. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
E. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes.
PART 3 – EXECUTION
3.1 ELECTRICAL EQUIPMENT INSTALLATION
A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, Minimum 6'-6" is required. arrange and install components and equipment to provide the maximum possible headroom.
B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components.
D. Right of Way: Give to raceways and piping systems installed at a required slope.
3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION
A. Damp Locations and Outdoors: Hot-dip galvanized materials.
B. Dry Locations: Steel materials.
C. Support Clamps for PVC Raceways: Click-type clamp system.
D. Selection of Supports: Comply with manufacturer's written instructions.
E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.
3.3 SUPPORT INSTALLATION
A. Install support devices to securely and permanently fasten and support electrical components.
B. Install individual and multiple raceway hangers and riser clamps to support raceways.
C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
D. Size supports for multiple raceway installations so capacity can be increased by 25 percent.
E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
G. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers.
H. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
I. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies.
J. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Fasten equipment with components suitable for the mounting surface. indicated:
3.4 IDENTIFICATION MATERIALS AND DEVICES
A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents.
C. Identify raceways and cables with color banding as follows:
1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals.
3. Colors: As follows:
a. Fire Alarm System: Red.
b. Security System: Blue and yellow.
c. Telecommunication System: Green and yellow.
D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box.
E. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm), overall, use a single line marker.
F. Color-code secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

	208/120 V	480/277V
Phase A:	Black	Brown
Phase B:	Red	Orange
Phase C:	Blue	Yellow

G. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145.
H. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- high lettering for emergency instructions.
3.5 FIRESTOPPING
A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.
3.6 REFINISHING AND TOUCHUP PAINTING
A. Refinish and touch up paint.
1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
3.7 CLEANING AND PROTECTION
A. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
END OF SECTION

SECTION 16060 – GROUNDING AND BONDING

PART 1 – GENERAL
1.1 SUBMITTALS
A. Not required for this section
1.2 QUALITY ASSURANCE
A. Comply with NFPA 70 and UL 467.
PART 2 – PRODUCTS
2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Grounding Conductors, Cables, Connectors, and Rods:
a. Chance/Hubbell.
b. Copperweld Corp.
c. Erico Inc.; Electrical Products Group.
2.2 GROUNDING CONDUCTORS
A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
B. Material: Copper.
C. Equipment Grounding Conductors: Insulated with green-colored insulation.
D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
E. Grounding Electrode Conductors: Stranded cable.
F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
G. Bare Copper Conductors: Comply with the following:
1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
2.3 CONNECTOR PRODUCTS
A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.
PART 3 – EXECUTION
3.1 APPLICATION
A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
B. In raceways, use insulated equipment grounding conductors.
C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
3.2 EQUIPMENT GROUNDING CONDUCTORS
A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
B. Install equipment grounding conductors in all feeder and branch circuit conduits.
C. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
D. Water Heater: Install a separate equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
E. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
3.3 INSTALLATION
A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Any exterior mounted grounding conductors shall be enclosed in schedule 40 PVC
3.4 CONNECTIONS
A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
END OF SECTION

SECTION 16120 – CONDUCTORS AND CABLES

PART 1 – GENERAL
1.1 QUALITY ASSURANCE
A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
B. Comply with NFPA 70.
PART 2 – PRODUCTS
2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
1. Wires and Cables:
a. American Insulated Wire Corp.; Leviton Manufacturing Co.
b. Carol Cable Co., Inc. c. Southwire Company.
2. Connectors for Wires and Cables:
a. AMP Incorporated.
b. General Signal; O-Z/Gedney Unit.
c. 3M Company; Electrical Products Division.
2.2 BUILDING WIRES AND CABLES
A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
B. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.
C. Conductor Material: Copper.
D. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No.10 AWG.
2.3 CONNECTORS AND SPLICES
A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated.
PART 3 – EXECUTION
3.1 EXAMINATION
A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables.
3.2 WIRE AND INSULATION APPLICATIONS
A. Service Entrance: Type XHHW in raceway.
B. Feeders: Above grade: Type THW/THWN, in raceway; Below grade: Type XHHW in raceway.
C. Branch Circuits: Type THHN/THWN, in raceway.
D. Fire Alarm Circuits: Type THHN/THWN, in raceway.
3.3 INSTALLATION
A. Remove existing wires from raceway before pulling in new wires and cables U.O.N..
B. 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.
C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
D. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."
E. Identify wires and cables according to Division 16 Section "Basic Electrical Materials and Methods."
3.4 CONNECTIONS
A. Conductor Splices: Keep to minimum.
B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
C. Use splice and tap connectors compatible with conductor material.
D. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
E. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
3.5 FIELD QUALITY CONTROL
A. Testing: After installation of wires and cables, and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
END OF SECTION

SECTION 16130 – RACEWAYS AND BOXES

PART 1 – GENERAL
1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
1.2 SUMMARY
A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
B. Related Sections include the following:
1. Division 16 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
2. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.
1.3 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. LFMC: Liquidtight flexible metal conduit.
D. RMC: Rigid Metal Conduit
E. RNC: Rigid Nonmetallic Conduit
F. FMC/MC: Flexible metal conduit.
1.4 SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
1.5 COORDINATION
A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction.
PART 2 – PRODUCTS
2.1 MANUFACTURERS
A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2.2 METAL CONDUIT AND TUBING
A. Acceptable Manufacturers:
1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
B. Rigid Steel Conduit: ANSI C80.1.
C. EMT and Fittings: ANSI C80.3. 1. Fittings: Set-screw or compression type.
D. LFMC: Flexible steel conduit with PVC jacket.
2.3 METAL WIREWAYS
A. Acceptable Manufacturers:
1. Hoffman.
2. Square D.
3. Wiremold
B. Material and Construction: Sheet metal sized and shaped as 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: Screw-cover type.
E. Finish: Manufacturer's standard enamel finish.
2.4 SURFACE RACEWAYS
A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
1. Acceptable Manufacturers:
a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.
2.5 BOXES, ENCLOSURES, AND CABINETS
A. Acceptable Manufacturers:
1. Spring City Electrical Manufacturing Co.
2. Thomas & Betts Corporation.
3. Walker Systems, Inc.; Wiremold Company (The).
B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
C. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
E. Floor Boxes: Sheet metal, fully adjustable, rectangular, sectionalized.
F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
PART 3 – EXECUTION
3.1 RACEWAY APPLICATION
A. Outdoors:
1. Exposed: Rigid steel or IMC
2. Concealed: Rigid steel or IMC
3. Underground, Single Run: RNC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures: NEMA 250, Type.
B. Indoors:
1. Exposed (>10' AFF): EMT
2. Exposed (Where subject to damage or < 10'AFF): IMC
3. Concealed: EMT, RNC, MC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Damp or Wet Locations: Rigid steel conduit.
6. Boxes and Enclosures: NEMA 250, Type 1, except as follows: a. Damp or Wet Locations: NEMA 250, Type 3R, metallic.
7. Concealed in walls or above ceiling: FMC C. Minimum Raceway Size: 3/4-inch trade size (DN 21).
3.2 INSTALLATION
A. Keep raceways at least 18 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
B. Complete raceway installation before starting conductor installation.
C. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
D. Install temporary closures to prevent foreign matter from entering raceways.
E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.
I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
J. Join raceways with fittings designed and approved for that purpose and make joints tight.
1. Use insulating bushings to protect conductors.
K. Terminations:
1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder.
L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 400-lb tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
M. Telephone and Signal System Raceways, 2-Inch Trade Size (DN 53) and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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. P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used beginning 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
O. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
3.3 PROTECTION
A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
END OF SECTION

SECTION 16140 – WIRING DEVICES

PART 1 – GENERAL
1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
1.2 SUMMARY
A. This Section includes receptacles, connectors, switches (manual and automatic), and finish plates.
1.3 DEFINITIONS
A. GFCI: Ground-fault circuit interrupter.
B. SPD: Surge Protection Device.
C. AFCI: Arc Fault Circuit Interruptor
1.4 SUBMITTALS
A. Product Data: For each product specified.
1.5 QUALITY ASSURANCE
A. Comply with NEMA WD 1.
B. Comply with NFPA 70.
1.6 COORDINATION
A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
1. Cord and Plug Sets: Match equipment requirements.
PART 2 – PRODUCTS
2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
1. Wiring Devices:
a. GE Company; GE Wiring Devices.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour/Legrand; Wiring Devices Div.
3. Automatic Timeswitches
a. Paragon
b. Tork
4. Lighting Contactor
a. Siemens
b. General Electric
c. Eaton/Cutler Hammer
d. Square-D
2.2 RECEPTACLES
A. Straight-Blade and Locking Receptacles: Heavy-Duty grade.
B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.
2.3 MANUAL SWITCHES
A. Snap Switches: Heavy-duty, quiet type.
B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
2.4 AUTOMATIC TIMESWITCHES (2-CIRCUIT MIN)
A. Features: 2-Channel, AM/PM Format, 1-minute resolution, LCD Display, 99 set point capability, Daylight Saving/Standard time, Leap Year correction, 30 day integral backup, manual over-ride for each channel, astronomic control of both channels with 1-99 minute offset. Provide minimum 10hr battery back-up for time-switch and programming
B. Enclosure: Nema 1 indoor or Nema 3R outdoor.
2.5 LIGHTING CONTACTORS
A. Features: Electrically-held, 20A Contacts, 480V/277V rated or as noted on drawings, suitable for the type of loads being switched, number of poles as indicated on the plan.
2.6 LIGHTING CONTROLLER (UP TO 8 CIRCUITS):
A. Features: (8) 20A 277V Relay outputs, 8 switch inputs min., master override, LCD display, internal Astronomic timeclock, Daylight Savings/Standard Times, Self-prompting keypad programming, 512 programs for 7 day programming, 32 holidays, Warn Off feature.
B. Enclosure: Nema 1 indoor, Nema 3R outdoor.
2.7 WALL PLATES
A. Single and combination types match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Unfinished Spaces: Smooth plastic. (U.O.N.)
2.8 FINISHES
A. Color: White, unless otherwise indicated or required by Code.
PART 3 – EXECUTION
3.1 INSTALLATION
A. Install devices and assemblies plumb and secure.
B. Install wall plates when painting is complete.
C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
D. Do not share neutral conductor on load side of dimmers.
E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.
F. Protect devices and assemblies during painting.
G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.
H. Mounting Heights: Heights above finished floor of devices shall be as indicated below, measured to the center of the device faceplate. If heights noted on the drawings differ from these, the drawings shall take precedence.
1. Outlets (power/communications/data): 18 inches.
2. Switches: 42 inches.
3. Wall phone: 42 inches.
3.2 IDENTIFICATION
A. Comply with Division 16 Section "Basic Electrical Materials and Methods."
1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.
3.3 CONNECTIONS
A. Connect wiring device grounding terminal to outlet box with bonding jumper.
B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
D. Tighten electrical connectors and terminals according to manufacturers published torque- tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.
3.4 FIELD QUALITY CONTROL
A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
END OF SECTION 16140

SECTION 16410 – ENCLOSED SWITCHES & CIRCUIT BREAKERS

PART 1 – GENERAL
1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
1.2 SUMMARY
A. This Section includes individually mounted enclosed switches and circuit breakers for motors and equipment disconnecting means.
B. Related Sections include the following:
1. Division 16 Section 16416 "Fuses" for fuses in fusible switches.
1.3 SUBMITTALS
A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain enclosed switches and circuit breakers of a single type through one source from a single manufacturer.
B. Comply with NEMA AB 1 and NEMA KS 1.
C. Comply with NFPA 70.
1.5 COORDINATION
A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
1.6 EXTRA MATERIALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Spare Fuses: Furnish one spare for every five installed, but not less than one set of three of each type and rating.
PART 2 – PRODUCTS
2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fusible Switches:
a. Eaton – Cutler Hammer
b. General Electric
c. Siemens
b. Square D
2. Molded-Case Circuit Breakers:
a. Eaton – Cutler Hammer
b. General Electric
c. Siemens
b. Square D
2.2 ENCLOSED SWITCHES
A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.
B. Enclosed, Fusible Switch: NEMA KS 1, Type HD, with clips to accommodate specired fuses, lockable handle with two padlocks, and interlocked with cover in closed position.
2.3 ENCLOSED CIRCUIT BREAKERS
A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Provide shunt-trip mechanism for each elevator circuit breaker disconnect. Requires approval of the elevator manufacturer prior to ordering.
2.4 ENCLOSURES
A. Description: Flush- or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2.5 FACTORY FINISHES
A. Manufacturer's standard prime-coat finish ready for field painting.
B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures before shipping.
PART 3 – EXECUTION
3.1 EXAMINATION
A. Examine surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION
A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
3.3 IDENTIFICATION
A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."
B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
3.4 CONNECTIONS
A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
C. 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 and UL 486B.
3.5 FIELD QUALITY CONTROL
A. Prepare for acceptance tests as follows:
1. Test insulation resistance for each enlosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line-and load-side circuit.
B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest. Certify compliance with test parameters.
3.6 ADJUSTING
A. Set field-adjustable circuit-breaker trip ranges.
3.7 CLEANING
A. Clean enclosed switches and circuit breakers internally, on completion of installation, in accordance with manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
END OF SECTION

SECTION 16430 – ELECTRICITY METERING

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 equipment for electricity metering by utility company and electricity metering by Owner.
1.3 DEFINITIONS
A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
B. PC: Personal computer.
1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: For electricity-metering equipment.
1. Dimensioned plans and sections or elevation layouts.
1.5 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.
1.6 DELIVERY, STORAGE, AND HANDLING
A. Receive, store, and handle modular meter center according to NECA 400.
1.7 COORDINATION
A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.
PART 2 – PRODUCTS
2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY
A. Meters will be furnished by utility company.
B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
C. Meter Sockets: Comply with requirements of electrical-power utility company.
D. Meter Sockets: Comply with requirements of electrical-power utility company. Steady-state and short-circuit current ratings shall meet indicated circuit ratings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
c. Siemens Energy & Automation, Inc.
d. Square D; a brand of Schneider Electric.
2. Comply with requirements of utility company for meter center.
3. Housing: NEMA 250, Type 3R enclosure.
E. Minimum Short-Circuit Rating: As specifies on the drawings per the local utility
1. Main Disconnect Device: Circuit breaker, Fully rated
2. Main Disconnect Device: Fusible switch, Fully Rated.
3. Meter Socket: Comply with requirements of electrical-power utility company.
4. Surge Protection: Comply with requirements of electrical-power utility company and the NEC.
2.2 EQUIPMENT FOR ELECTRICITY METERING BY OWNER
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
1. E-Mon; a division of Hunt Power.
2. National Meter Industries.
3. Osaki Meter Sales, Inc.
4. Square D; a brand of Schneider Electric.
B. General Requirements for Owner's Meters:
1. Comply with UL 1244.
2. Meters used for billing shall be labeled revenue grade, complying with requirements in ANSI C12.20.
3. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
4. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
5. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
6. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
a. Type: solid core.
7. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
8. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to [BAS] <Insert signal destination> input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.
C. Kilowatt-hour/Demand Meter: Electronic single and three phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours, current time and date, current demand and historic peak demand, time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.
PART 3 – EXECUTION
3.1 INSTALLATION
A. Comply with equipment installation requirements in NECA 1.
B. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
3.2 IDENTIFICATION
A. Comply with requirements for identification
1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant typewritten card with occupant's name.
3.3 FIELD QUALITY CONTROL
A. 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.
B. Electricity metering will be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.
END OF SECTION 16430

TEXAS ENGINEER FIRM REGISTRATION #F-15201
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NO.	DESCRIPTION	DATE
1	FINAL SCHEME	02.01.19
2	REV.FINAL SCHEME	02.07.19
3	PERMIT	05.24.19

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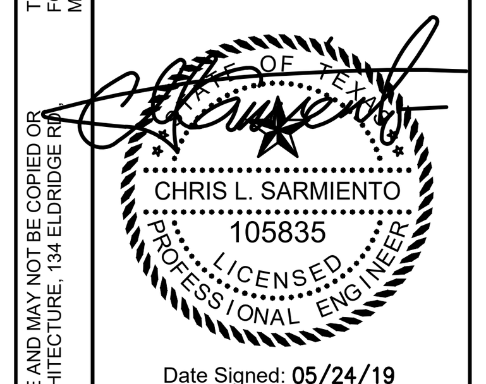

Date Signed: 05/24/19

Project No.	1801.74
Date	02/11/19
Drawn by	JG
Checked by	NL

Sheet No.
E0.2