SECTION 16111
CONDUIT

PART 1 - GENERAL

1.1 Section Includes:

a. Rigid metal conduit and fittings.

b. Intermediate metal conduit and fittings.

c. Electrical metal tubing and fittings.

d. Flexible metal conduit and fittings.

e. Non- metallic conduit and fittings.

1.2 References:

a. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

b. ANSI C80.3 – Electrical Metallic Tubing, Zinc Coated.

c. ANSI/NEMA FB 1 - Fittings and Supports for Conduits and Cable Assemblies.

d. ANSI/NFPA 70 – National Electrical Code.

e. FS-WW-C-563 – Electrical Metallic Tubing.

f. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally-Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.

g. NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing.

h. FS-WW-C-581 – Specification for Galvanized Rigid Conduit.

i. FS-WW-C-566 - Specification for Flexible Metal Conduit.

j. FS-WC-1049A – Electrical Non-Metallic Conduit.

k. NEMA-TC-2 – Electrical Plastic Tubing and Conduit.

1.3 Delivery, Storage and Handling:

a. Deliver, store, protect, and handle Products to site under provisions of Section 16010.

Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

b. Protect PVC conduit from sunlight.

1.4 Project Conditions:

a. Verify that field measurements are as shown on Drawings.

b. Verify routing and termination locations of conduit prior to rough-in.

c. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 Conduit:

a. Minimum Size: ½ inch for above ground and 1 inch minimum for underground installations unless otherwise specified.

b. Underground conduit more than five feet from foundation wall shall be direct buried PVC Schedule 40 heavy wall rigid conduit.

c. Underground conduit within five feet of foundation wall or under four inch minimum concrete floor slab shall be PVC coated rigid steel conduit or concrete encased non-metallic PVC Schedule 40 heavy wall rigid conduit.

d. Underground conduit for utility company service shall be as directed by the servicing utility.

e. Conduit installed in concrete or masonry, exposed outdoor locations, damp locations, hazardous locations, or where subject to mechanical injury shall be galvanized rigid steel conduit.

g. Conduit installed in concealed dry interior locations above eight feet shall be electrical metallic tubing.

h. Conduit installed in exposed dry interior locations above eight feet shall be electrical metallic tubing.

i. Conduit installed to supply power to all mechanical equipment and rotating electric equipment shall be waterproof flexible steel conduit. Conduit shall be 12" minimum in length for 2" conduit and smaller; 18" minimum length for conduit larger than 2". Conduit shall be 36" maximum in length.

j. Flexible steel conduit shall be used for lighting fixture connection only, no lengths exceeding 6'-0" shall be permitted.

2.2 Metal Conduit:

a. Rigid Steel Conduit: Galvanized rigid steel; ANSI C80.1: Federal Spec. WW-C-581. Standard weight that is hot dipped, galvanized, electrogalvanized or sherardized, both inside and out, with threaded connections and couplings.

2.3 PVC Coated Metal Conduit:

a. Description: NEMA RN 1; rigid steel conduit with external PVC Coating, 20 mil thick, and internal galvanized surface.

b. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded type, material to match conduit.

2.4 Flexible Metal Conduit:

a. Description: Conduit - FS-WW-C-556; Steel. Manufactures from single standard weight steel, galvanized on all four sides prior to conduit and fabrication. Lightweight flexible steel conduit and aluminum flexible conduit are not acceptable. Include ground conductor in all runs.

b. Fittings: ANSI/NEMA FB 1; Die-cast fittings of the type that screw into the inside of the conduit with threaded edges at 90° to the fitting body.

2.5 Liquidtight Flexible Metal Conduit:

a. Description: Interlocked steel construction with moisture and oil-proof PVC jacket.

b. Fittings: ANSI/NEMA FB 1: liquid tight; integral insulated throat; provisions for ground continuity.

2.6 Electrical Metallic Tubing (EMT):

a. Description: ANSI C80.3; galvanized tubing; Federal Spec. WW-C-563.

b. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel rain-tight, compression, steel locking ring type with integral insulated throat.

2.7 Nonmetallic Conduit:

a. Description: NEMA TC 2; Federal Spec.WC-1094A; Schedule 40 PVC.

b. Fittings and Conduit Bodies: NEMA TC 3 to match conduit.

2.8 Conduit Supports:

a. Conduit clamps, straps, and supports: Steel or malleable iron, two-hole straps.

PART 3 - EXECUTION

3.1 Conduit Sizing, Arrangement and Support:

a. The size of the conduits for the various circuits shall be as indicated on the drawings and as required by Code for the size and number of conductors to be pulled therein. Where fill is not shown on drawings, size conduit for conductor type installed or for Type THW conductors, whichever is larger; ½ inch minimum size. Open ends shall be capped with approved manufactured conduit seals as soon as installed and kept capped until ready to pull in conductors. Where running thread connections are necessary, only approved manufactured conduit unions shall be used. Do not embed metal conduit in concrete or masonry construction, nor electrical metallic tubing in slabs on grade. Do not install any conduit in any concrete slab other than on grade.

b. Arrange conduit to maintain headroom and present a neat appearance.

c. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

d. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

e. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers. Maintain 12" distance minimum between main conduit runners and ceiling system grid.

f. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

g. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

h. Support conduits 1 inch and larger with pipe clamps either suspended from structural slabs with a rod with adjustable pipe ring, or mounted on wall from channel supports. Attach to concrete by expansion anchors. Powder actuated fastening devices are not permitted. Where two or more conduits 1-1/2 inch and larger or where 3 or more ¾ inch conduits are suspended from ceiling, use trapeze type hanger from rods.

i. Firmly support and fasten conduit in place. Support rigid metal conduit and electrical metallic tubing at maximum intervals of 10 feet and within 12 inches of every outlet box, cabinet and fitting. Support flexible metal conduit at maximum intervals of 4 feet and within 12 inch of every outlet box and fitting except for lengths of not over 2 feet at connections where flexibility is required.

j. Secure exposed conduit runs of concrete, plaster or other construction in place with cast conduit clamps affixed with expansion anchors or cadmium plated machine or lag screws.

k. Do not strap or fasten rigid or electrical metallic tubing to mechanical equipment subject to vibration or mounted on shock absorbing bases, including sprinkler or pneumatic pipe or tubing.

l. Provide independent support for conduit rising from floor for motor connection if over 18 inches above floor. Do not attach to motors, ductwork or mechanical equipment.

m. Conduits 1 inch and smaller which are installed above suspended ceilings shall not be secured to ceiling support wires. Support electrical, communication conduits and fixtures independent of ceiling suspension systems.

n. Exposed conduits to view shall be installed parallel to and perpendicular to the building structure.

o. Tag empty conduits at each accessible end with a permanent tag identifying the purpose of the conduit and the location of the other end. In wet, corrosive outdoor or underground locations, use brass, bronze, or copper 16 gage tags or lead tags secured to conduit ends with #16 or larger galvanized wire. Inscribe on the tags with steel punch dies clear and complete identifying information.

p. Bends:

1. Raceways for Sound System, Telephone System, LAN, and Video System cables shall be designed for installation of Fiber Optic cable.

2. All bends or elbows shall have a minimum radius as follows:

Conduit Size (inches)	Min. Radius (inches)
¾	12
1	12
1-1/4	18
1-1/2	18
2	24
2-1/2	24
Conduit Size (inches)	Min. Radius (inches)
3	36
3-1/2	36
4	48
5	48
6	48

3. Use factory ells at conduit bends 1-1/4" and larger. Alternative method: Use of precision conduit bending machine equivalent to Greenlee 'One Shot' or 'Smart Bender'.

4. Boxes where the cable changes direction shall be large enough to allow cables in the box to have a 12" minimum radius.

5. Make bends and offsets so the inside diameter is not effectively reduced. Make bends parallel or banked runs from the same center line so that the bends are parallel.

3.2 Conduit Installation:

a. Cut conduit square using a saw or pipe cutter; de-burr cut ends.

b. Bring conduit to the shoulder of fitting and couplings and fasten securely.

c. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.

d. Install no more than the equivalent of three 90-degree bends between boxes. Keep bends and offsets in conduit runs to an absolute minimum. For the serving utilities, make large radius bends to meet their requirements. Replace deformed, flattened or kinked conduit.

e. Use conduit bodies to make sharp changes in direction, as around beams.

f. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.

g. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

h. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

i. Provide No. 12 AWG insulated conductor or suitable pull string or rope in empty conduit, except sleeves and nipples.

j. Install expansion-deflection joints where conduit crosses building expansion or seismic joints and between building and walkway covers.

k. Where conduit penetrates fire-rated walls and floors, provide mechanical fire stop fittings with UL listed fire rating equal to wall or floor rating.

l. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.

m. Do not install conduit in slabs above grade.

n. PVC conduit shall not be used in any locations above grade.

o. From each panel or cabinet which is flush mounted in wall, stub from top of the panel a minimum of 5-3/4 inch conduits to the nearest accessible ceiling space or other accessible location and cap for future use unless noted otherwise on the drawings.

p. Flexible steel conduit is permitted in concealed dry interior locations at lighting fixture connections only. No length shall exceed 6'-0".

q. Seal conduit from exterior outlets at first interior junction to prevent moisture from entering the building through the conduit.

r. Use insulating fittings on conduits where entering pull boxes, junction boxes, outlet boxes, cabinets and similar enclosures, and for signal and telephone conduits terminated in cabinets or backboards.

s. Conduit risers and ell's through concrete shall be PVC wrapped GRC.

3.3 Underground Duct Bank Installation:

a. Install top of duct bank minimum 30 inches below finished grade where subjected to vehicular traffic and no less than 24" under any circumstances. Adjust depth to avoid interference with gravity flow systems of any kind. Maintain minimum 12 inch clearance between duct bank and any gravity flow system.

b. A 2" wide yellow plastic warning tape 'CAUTION BURIED ELECTRICAL LINE BELOW" shall be installed 6" below finished grade in all trenches.

c. Duct lines shall have a continuous slope downward toward manholes and away from buildings with a pitch of not less than 4 inches in 100 feet. Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet, except that manufactured bends may be used at ends of short runs of 100 feet or less, and then only at or close to the end of run.

d. Terminate conduit in end bell at manhole and pull box entries.

e. Space the external surfaces of conduits within a bank a minimum of 3 inches apart except that sound, telephone, data and inter-communication circuits contained within non-metallic conduit shall have a minimum separation of 12 inches from any light or power circuits that parallel them within a bank.

f. Numbers and sizes of ducts shall be as indicated. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Manufactured steel 90-degree duct bends shall be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inches in diameter, and 36 inches for ducts 3 inches in diameter, 48 inches for ducts or greater in diameter unless noted otherwise in the Contract Documents. Long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, horizontally or vertically. Both curved and straight sections shall be used to form long sweep bends as required, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes, pull boxes or handholes. Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 5-mil brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion resistant 1-mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

g. Ducts shall be kept clean of concrete or slurry, dirt or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and have diameters ¼ inch less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used whenever and existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

END OF SECTION - 16111

SECTION 16123
BUILDING WIRE AND CABLE

PART 1 - GENERAL

1.1 Section Includes:

a. Building wire and cable.

b. Wiring connectors and connections.

1.2 References:

a. CEC-California Electrical Code.

1.3 Submittals:

a. Submit under provisions of Section 01340.

b. Product Data: Provide for each cable assembly type.

c. Test Reports: Indicate procedures and values obtained.

d. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.4 Qualifications:

a. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.

1.5 Regulatory Requirements:

a. Conform to requirements of CEC.

b. Furnish products listed as classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.6 Field Samples:

a. Provide under provisions of Section 01340.

b. Submit three lengths, each 18 inches of cable assembly from each reel.

c. Select each length to include complete set of manufacturer markings.

d. Attach tag indicating cable size and application information.

1.7 Project Conditions:

a. Verify that field measurements are shown on Drawings.

b. Conductor sized are based on copper. Aluminum conductors shall not be used.

c. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

d. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.8 Coordination:

a. Determine required separation between cable and other work.

b. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 Manufacturers - Building Wire and Cable:

a. Anaconda Power Cable.

b. Carol Cable.

c. Rome Wire and Cable.

d. Triangle Wire and Cable.

e. Alpha Wire.

f. Canada Wire.

2.2 Building Wire and Cable:

a. Description: Single conductor insulated wire.

b. Conductor: Copper.

c. Insulation Voltage Rating: 600 volts,

d. Insulation: CEC; Stranded wire, Type THWN or XHHW insulation for feeders and branch circuits #8 AWG and larger solid wire. Type THWN or XHHW insulation for feeders and branch circuits #10 AWG and smaller.

e. Select one type and use for entire installation, except as indicated for special purpose.

f. For conductors installed in areas subjected to temperatures exceeding 140 degrees F., including terminating in incandescent lighting fixtures and installed through or into housing containing ballasts, provide Type THWN.

g. For conductors installed in exposed conduit outside for buildings and conduit within or just under roofing material, provide Type XHHW.

h. Control Circuits for Mechanical Equipment: Use 600 volts Underwriters' Type THWN conductors except where subject to abnormally high temperatures such as on or near boilers. Under these conditions, use Type XHHW.

i. Conductor insulation shall be color coded to indicate phase leg, voltage and use.

j. Conductor insulation type, size and U.L. approved shall be printed with permanent white paint on conductor insulation, continually repeating.

k. Minimum Size of Conductors: #12 AWG copper, unless otherwise indicated.

l. Conductors shall be new and shall have been manufactured within 12 months of the date of delivery to the site and continuously stored where protected from the sun, heat or weather.

m. Deliver conductor to the site in their original cable reels or in their original unbroken packages.

n. Provide conductor packages and cable reels plainly marked or tagged with U.L. labels, AWG size, voltage rating, insulation type, type of stranding, manufacturer's name, trade name, and month and year when manufactured.

2.3 Wiring Connectors:

a. Split Bolt Connectors:

1. ILSCO, Model SK.

2. Burndy, Model KSU.

3. Blackburn, Model HPS.

b. Solderless Pressure Connectors:

1. ILSCO, Model SLUH.

2. Model SLUH.

3. Panduit, Model LAM.

c. Spring Wire Connectors:

1. Buchanan, Models 31, 33, 35, and 37.

2. 3M

3. Ideal Wirenut.

d. Compression Connectors:

1. Burndy, Model HYLUG/HYLINK.

2. Panduit, Model LAA.

3. Blackburn, Model ATL.

PART 3 - EXECUTION

3.1 Examination:

a. Verify that interior of building has been protected from weather.

b. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 Preparation:

a. Completely and thoroughly swab raceway before installing wire.

3.3 Wiring Methods:

a. Concealed Dry Interior Locations: Use only building wire, Type THWN or XHHW insulation, in raceway.

b. Exposed Dry Interior Locations: Use only building wire, Type THWN or XHHW insulation, in raceway.

c. Above Accessible Ceilings: Use only building wire, Type THWN or XHHW insulation, in raceway.

d. Wet or Damp Interior Locations: Use only building wire, Type THWN or XHHW insulation, in raceway.

e. Exterior Locations: Use only building wire, Type THWN or XHHW insulation, in raceway.

f. Underground Installations: Use only building wire, Type THWN or XHHW insulation, in raceway.

g. Use wiring methods indicated on Drawings.

3.4 Installation:

a. Install products in accordance with manufacturers instructions.

b. Use solid conductor for feeders and branch circuits 10 AWG and smaller.

c. Use stranded conductors for control circuits.

d. Use conductor not smaller than 12 AWG for power and lighting circuits.

e. Use conductor not smaller that 16 AWG for control circuits.

f. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

g. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

h. Pull conductors into raceway at same time.

i. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

j. Protect exposed cable from damage.

k. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables form structure. Do not rest cable on ceiling panels.

l. Use suitable cable fittings and connectors.

m. Neatly train and lace wiring inside boxes, equipment, and panel boards.

n. Clean conductor surfaces before installing lugs and connectors.

o. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. Keep splices in underground junction boxes, manholes, and manholes to an absolute minimum. Where splices are necessary, use resin pressure splices and resin splicing kits manufactured by the 3M Company to totally encapsulate the splice. Arrange the splicing kit to minimize the effects of moisture.

p. Use suitable reducing connectors or mechanical connector adaptors for connecting existing aluminum conductors to copper conductors.

q. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

r. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

s. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

t. Conductor Identification. All secondary branch circuit conductors (No. 10 AWG & smaller) throughout the project shall be provided with color coded insulation as follows:

208Y	Phase	480Y/277
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

u. Conductors No. 8 and larger shall be black with bands of colored, nonaging, plastic tape to color code the conductors, utilizing the same scheme as for branch circuits. The bands shall occur within each enclosure where a tap, splice or termination is made.

v. Color code control wire insulation and label each termination.

w. Conductor Support. Provide conductor supports as required by Code and recommended by the cable manufacturer. Where required, provide cable supports in vertical conduits similar to OZ Type CMT, and provide the lower end of conduit with OZ Type KVF ventilators.

x. For control wiring, conform to the wiring diagrams shown on the mechanical drawings and the manufacturer's wiring diagram to control the equipment in the manner specified under Division 15. Color code all control wiring.

y. Where conductors in conduit pass through exterior walls, a sealing compound of moisture-resistant material shall be applied in the ends of the conduits to seal around the conductors.

z. Tag conductors of power circuits and the various signal and sound systems, such as fire alarm, phone, etc. Tags shall be pre-marked, self-adhesive wraparound cloth Type EZ Code, Brady PERMA-CODE, or equal. Conductors shall be tagged in each junction box, pull box, wireway or auxiliary gutter and at each device, motor outlet, panelboard, switchboard or other conductor termination. Tags shall show feeder number size, phase and origin.

aa. Megger tests shall be taken on feeder conductors and on conductor for motors over 15 HP. Test shall be made in presence of Project Inspector and prior to connection of equipment. Written reports shall be submitted to Architect. Conductors testing below manufacturer's standards shall be replaced.

bb. Wiring within equipment enclosures shall be neatly grouped and laced or taped together.

cc. For larger power cable and wires which do not have color coded jackets, install 2 inches minimum width bands of adhesive non-fading coloring tape over the cables and wires at their terminations and in the manholes, wireways, junction boxes and outlet boxes. Colors shall be permanent and shall withstand cleaning.

dd. Capacity of conductors #2 AWG and smaller shall be based on the 60 degrees C. rating and conductors larger than #2 AWG shall be based on the 75 degrees C. rating.

3.5 Interface With Other Products:

a. Identify wire and cable under provisions of Section 16195.

b. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.6 Field Quality Control:

a. Inspect wire and cable for physical damage and proper connection.

b. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

c. Verify continuity of each branch circuit conductor.

END OF SECTION - 16123

SECTION 16130
BOXES

PART 1 - GENERAL

1.1 Section Includes:

a. Wall and ceiling outlet boxes.

b. Floor boxes.

c. Pull and junction boxes.

1.2 References:

a. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

b. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

c. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.

d. CEC - California Electrical Code.

e. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 Project Record Documents:

a. Accurately record actual locations and mounting heights of outlet, pull, and junction boxes.

1.4 Project Record Documents:

a. Conform to requirements of CEC.

b. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.5 Project Conditions:

a. Verify field measurements are as shown on Drawings.

b. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

c. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

PART 2 - PRODUCTS

2.1 Outlet Boxes:

a. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel. Outlet boxes and covers shall be pressed sheet and plugged holes, and shall be hot dipped

galvanized or sherardized. For boxes concealed in walls or ceiling, provide the solid gang, galvanized or sherardized pressed steel knockout type. Outlet boxes shall be used as pull boxes wherever possible and junction boxes or pull boxes shall be installed only as required by the drawings or specification. Sectional boxes shall not be used. Light outlet boxes shall be equipped with fixture-supporting device, as required by the unit to be installed.

b. Exposed boxes in mechanical areas and exposed to weather shall be cast in metal weatherproof, with grounding terminal, threaded hubs and gaskets. Type FS or FD series.

c. Telephone outlets shall be a minimum of 4 inches square by 1-1/2 inches deep, or as required by telephone system installer. Computer outlet boxes shall be two gang, 1-1/2 inches deep.

d. Switch Outlets: Use solid gang boxes for three or more switches for mounting behind a common single plate.

e. Fire alarm boxes shall be 4 inches square with plaster rings to suit type of device.

f. CATV, outlet boxes shall be 4 inches square by 1-1/2" deep.

g. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

h. Cast Boxes: NEMA FB 1, Type FD, aluminum, cast feralloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.

2.2 Floor Boxes:

a. Floor Boxes: ANSI/NEMA OS1, fully adjustable

b. Material: Formed steel.

c. Conform to regulatory requirements for concrete-tight floor boxes.

2.3 Pull and Junction Boxes:

a. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

1. Exposed locations - NEMA 3R-Type.

b. Surface-Mounted Cast Metal Box: NEMA 250, Type 4 flat-flanged, surface-mounted junction box.

1. Material: Galvanized cast iron.

c. In-Ground Cast Concrete Box: Outside flanged, recessed cover box for flush mounting.

1. Material: Galvanized cast iron.

2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.

3. Cover Legend: ELECTRIC or as noted.

PART 3 - EXECUTION

3.1 Installation:

a. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

b. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

c. Install pull boxes and junction boxes above accessible ceiling and in unfinished areas only.

d. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

e. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Section 07210 and as indicated on the Drawings.

f. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

g. Use flush mounting outlet boxes in finished areas.

h. Do not install flush mounting boxes back-to-back in fire-rated walls; provide minimum 24 inch horizontal separation.

i. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

j. Use stamped steel bridges to fasten flush mounting outlet box between studs.

k. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

l. Use adjustable steel channel fasteners for hung ceiling outlet box.

m. Do not fasten boxes to ceiling support wires.

n. Support boxes independently of conduit except cast box that is connected to two ridge metal conduits both supported within 12 inches of box.

o. Use gang box where more than one device is mounted together. Do not use sectional box.

p. Use gang box with plaster ring for single device outlets.

q. Use cast outlet box in exterior locations exposed to the weather and wet locations, and where located in block or concrete walls.

r. Provide acoustic blanket or membrane around outlet boxes and switches located in offices, party walls, or walls indicated on architectural drawings as acoustical walls.

s. Secure recessed boxes for ceiling outlets with galvanized steel bar hangers specifically manufactured for the purpose to ceiling channels with 18 gauge steel wire.

t. Single gang wall outlet boxes located at metal studs shall have hangers specifically manufactured for installing outlet box. Screws through boxes will not be acceptable.

u. Single or multiple wall outlet boxes located between studs shall be secured in place with bar hangers running between studs.

v. Nails shall not be used to support outlet boxes.

w. Secure recessed pressed steel boxes in place with steel hangers specifically manufactured for the purpose. Fully or partially hammer driven screws are not permitted.

x. Use extension rings with blank covers for making exposed conduit connections to flush wall or ceiling boxes.

y. For boxes not specified or indicated, use boxes and mounting height as required by equipment and recommended by equipment manufacturer.

z. For outlets flush in exterior walls, use weatherproof joints and connections all around.

aa. Do not locate outlet boxes not containing a circuit device in any public space. Place these boxes in storage rooms, electrical closets, or above accessible ceilings.

bb. Covers for flush outlets shall finish flush with plaster or other furnished surface. Provide 24 gage or heavier galvanized steel liner to produce flush condition, where necessary.

cc. For boxes installed in concrete, provide the type specifically designed for the purpose to prevent entrance of concrete and to permit placement of box and conduit without displacing reinforcing steel. Coordinate all installations with structural engineer.

dd. Use boxes of sufficient size to legally accommodate all devices and conductors contained therein. Use no box smaller than 4 inches square by 1-1/2 inches deep, unless otherwise indicated.

ee. Accurately place and securely fasten outlet boxes to the structural members. In concrete or drywall construction, set recessed boxes so that the front of the plaster ring or front of the box for those without plaster rings is not more than 1/8 inch behind the final finished surface. Provide box extensions at all outlet boxes where architectural drawings call for tackable wall cover.

ff. Provide approved factory make knockout seals in the boxes where unused knockouts are not intact. Provide recessed threaded plugs in unused hubs of cast boxes.

gg. Label the cover of each accessible junction box with panel and circuit designation and function.

hh. Multiple gang boxes containing 277 volt switches or containing switches of different system voltages shall have a barrier between each switch.

ii. Paint the outside and inside of boxes containing fire alarm devices with red paint.

jj. Use cast floor boxes for installations in slab on grade; formed steel boxes are a cceptable for other installations.

kk. Set floor boxes level.

ll. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.

1. Interior Dry Locations: Use hinged enclosure under provisions of Section 16160.

2. Other Locations: Use surface-mounted cast metal box.

3. Exposed Exterior Locations: NEMA 3R-Type.

mm. All boxes shall be covered with outlet box protectors, to keep plaster and dirt from entering boxes. If plaster does get in box, it shall be removed prior to pulling wires.

3.2 Interface With Other Products:

a. Coordinate locations and sizes of required access doors.

b. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

c. Coordinate mounting heights and locations of outlets mounted above corners, benches and backsplashes.

d. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.3 Adjusting:

a. Adjust floor box flush with finish flooring material.

b. Adjust flush-mounting outlets to make front flush with finished wall material.

c. Install knockout closure in unused box opening.

END OF SECTION -16130

SECTION 16141
WIRING DEVICES

PART 1 - GENERAL

1.1 Section Includes:

a. Wall switches.

b. Wall dimmers

c. Receptacles

d. Occupancy Sensors

e. Wall plates and box covers

f. Time Switches.

g. Floor box service fittings.

1.2 References:

a. NEMA WD 1 - General Purpose Wiring Devices.

b. NEMA WD 6 - Wiring Device Configurations.

c. CEC - California Electrical Code.

1.3 Submittals:

a. Submit under provisions of Section 01340.

b. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

c. Manufacturer's Instructions:

1. Indicate application conditions and limitations of used stipulated by product testing agency specified under regulatory requirements.

2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

1.4 Qualifications:

a. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years experience.

1.5 Regulatory Requirements:

a. Conform to requirements of CEC.

b. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.6 Extra Materials:

a. Provide two of each style, and finish wall plate.

b. Provide two protective rings.

c. Provide two carpet rings.

PART 2 - PRODUCTS

2.1 Wall Switches:

a. Manufacturers:

1. Hubbell, 1200 Series

2. Pass and Seymour, 20 AC Series.

3. General Electric, 595X Series.

4. Bryant, 4900 Series.

5. Leviton, 1200 Series.

b. Description: NEMA WD 1, heavy duty, AC only general-use snap switch.

c. Device Body: White plastic with toggle handle.

d. Indicator Light: Lighted handle type switch, red color handle.

e. Locator Light: Lighted handle type switch; green color handle.

f. Voltage Rating: 120-277 volts, AC.

g. Current Rating: 20 amps or as indicated on drawings.

h. Ratings: Match branch circuit and load characteristics.

2.2 Wall Dimmers:

a. Manufacturers:

1. Lutron Nova Series

2. Lightolier Neptune Series.

3. Prescolite Horizon Series.

b. Description: NEMA WD 1, Type I, semiconductor dimmer for incandescent lamps.

c. Device Body: White plastic with linear slide.

d. Voltage: 120 volts.

e. Power Rating: 1000 Watts.

f. Power Rating: Match load shown on Drawings; 1000 Watts minimum.

g. Accessory Wall Switch: Match Dimmer Appearance.

2.3 Receptacles:

a. Single Convenience Receptacle:

1. Hubbell 5351
2. Pass and Seymour 5362
3. General Electric 5362
4. Bryant 5362
5. Leviton 5362

b. Duplex Convenience Receptacle:

1. Hubbell 5362
2. Pass and Seymour 5362
3. General Electric 5362
4. Bryant 5362
5. Leviton 5362

c. GFCI Receptacle:

1. Hubbell 5362
2. Pass and Seymour 5362
3. General Electric 5362
4. Bryant 5362
5. Leviton 5362.

d. Isolated Ground Receptacle:

1. Hubbell IG5362
2. Pass and Seymour IG6300
3. General Electric 5362.
4. Bryant
5. Leviton

6. Eagle

2.4 Occupancy Sensors:

a. Ceiling mounted dual technology, Watt Stopper #DT-300 Series.

b. Wall mounted, Watt Stopper #PW-100 and #PW-200 Series.

2.5 Wall Plates:

a. Plates shall be brushed stainless steel and supplied for every local switch, receptacle, telephone and data outlet, wall speaker outlet, etc. Type shall be equal to Pass & Seymour Type 430 except where noted otherwise on drawings.

b. Weatherproof Cover Plate: Gasketed cast metal with hinged gasket device cover.

c. Plates shall be engraved and fitted, when specified for:

1. More than two gangs.

2. Equipment that cannot be seen from the locations.

3. All lock type switches.

4. All receptacles other than 120 volts.

5. All pilot switches.

6. Switches in locations from which the equipment or circuits controlled cannot be readily seen.

7. Manual motor starting switches.

8. Where so indicated on the drawings.

9. As required on all control circuit switches, such as heater controls, etc.

2.6 Time Switches:

a. Manufacturers:

1. Intermatic ET800CR series.

2. Paragon.

3. Tork.

b. Description: AC programmable electronic time clock. (astronomic).

c. Input Voltage: 120 V

d. Poles: 10A, 120V, number as indicated. (4 pole minimum).

e. Enclosure: Type as required to meet installation.

f. Configuration: 365 day electronic, programmable.

g. Accessories: Photocell control as indicated. Intermatic ET 7000C Series.

2.7 Floor Mounted Service Fittings:

a. Flush Cover Convenience Receptacle:

1. Hubbell.

2. Pass and Seymour.

3. General Electric

4. Material: Aluminum.

5. Configuration: Duplex flap opening.

PART 3 - EXECUTION

3.1 Examination:

a. Verify outlet boxes are installed at proper height.

b. Verify wall openings are neatly cut and will be completely covered by wall plates.

c. Verify floor boxes are adjusted properly.

d. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 Preparation:

a. Provide extension rings to bring outlet boxes flush with finished surface.

b. Clean debris from outlet boxes.

3.3 Installation:

a. Install products in accordance with manufacturer's instructions.

b. Install devices plumb and level.

c. Install switches with OFF position down.

d. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

e. Do not share neutral conductor on load side of dimmers.

f. Install receptacles with grounding pole on top.

g. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

h. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

i. Connect wiring devices by wrapping conductors around screw terminal.

j. Use jumbo size plates for outlets installed in masonry walls.

k. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

l. Install protective rings on active flush cover service fittings.

m. Engrave and fill plates at control switch locations where mechanical equipment cannot be seen from location.

3.4 Interface With Other Products:

a. Coordinate location of outlet boxes provided under Section 16130 to obtain mounting heights indicated on Drawings.

b. Install wall switch 48 inches above finished floor unless otherwise indicated on drawings.

c. Install convenience receptacle 18 inches above finished floor unless otherwise indicated on drawings.

d. Install convenience receptacle 6 inches above counter unless otherwise indicated on drawings.

e. Install dimmer 48 inches above finished floor unless otherwise indicated on drawings.

f. Install telephone jack 18 inches above finished floor unless otherwise indicated on drawings.

g. Install telephone jack for wall telephone 48 inches above finished floor unless otherwise indicated on drawings.

3.5 Field Quality Control:

a. Inspect each wiring device for defects.

b. Operate each wall switch for defects.

c. Operate each wall switch with circuit energized.

d. Test each receptacle device is energized.

e. Test each GFCI receptacle device for proper operation.

f. Verify that each telephone jack is properly connected and circuit is operational.

3.6 Adjusting:

a. Adjust devices and wall plates to be flush and level.

END OF SECTION - 16141

SECTION 16160
CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 Work Included:

a. Hinged cover enclosures.

b. Cabinets.

c. Terminal blocks and accessories.

1.2 References:

a. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

b. ANSI/NEMA ICS 1 – Industrial Control and Systems.

c. ANSI/NEMA ICS 4 – Terminal Blocks for Industrial Control Equipment and Systems.

d. ANSI/NEMA ICS 6 – Enclosures for Industrial Control Equipment and Systems.

1.3 Submittals:

a. Submit product data under provisions of Section 01340.

b. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS 1.

PART 2 - PRODUCTS

2.1 Hinged Cover Enclosures:

a. Construction: NEMA 250; Type 1, for dry interior locations and Type 3R, for exterior and damp locations, or as indicated on drawings.

b. Finish: Manufacturer's standard enamel finish.

c. Covers: Continuous hinge, held closed by flush latch operable by key.

d. Panel for Mounting Blocks or Electrical Components: 14 gage steel, white enamel finish.

2.2 Cabinets:

a. Cabinet Boxes: Galvanized steel with removable endwalls, 24 inches wide, 30 inches high, 4 inches deep or as indicated on the drawings. Provide ¾ inch thick plywood backboard painted matte white, for mounting terminal blocks.

b. Cabinet Fronts: Steel, flush type with concealed trim clamps, concealed hinge and flush lock keyed to match branch circuit panelboard; finish in gray backed enamel.

2.3 Terminal Blocks and Accessories:

a. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.

b. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

c. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 Fabrication:

a. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.

b. Provide knockouts on enclosures.

c. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

PART 3 - EXECUTION

3.1 Installation:

a. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.

b. Provide accessory feet for free-standing equipment enclosures.

c. Install trim plumb.

END OF SECTION - 16160

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.1 Work Included:

a. Conduit and equipment supports.

b. Fastening hardware.

1.2 Coordination:

a. Coordinate size, shape and location of concrete pads.

1.3 Quality Assurance:

a. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 Material:

a. Support Channel: Galvanized.

b. Hardware: Corrosion resistant

PART 3 - EXECUTION

3.1 Installation:

a. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, preset inserts, beam clamps. Do not use spring steel clips and clamps.

b. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

c. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

d. Do not use powder-actuated anchors.

e. Do not drill structural steel members.

f. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

g. In wet locations electrical and communication rooms shall install floor-standing electrical equipment on concrete pads.

h. Install surface-mounted cabinets and panelboards with minimum of six anchors. Provide steel channel supports to stand cabinet one inch off wall.

i. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

J. Anchors for floor mounted equipment shall be wedge type.

END OF SECTION - 16190

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 Work Included:

a. Nameplates.

b. Wire and cable markers.

1.2 Materials:

a. Submit shop drawings under provisions of Section 01340.

b. Include schedule for nameplates.

PART 2 - PRODUCTS

2.1 Materials:

a. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.

b. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.1 Installation:

a. Degrease and clean surface to receive nameplates.

b. Install nameplates parallel to equipment lines.

c. Secure nameplates to equipment fronts using screws, or rivets. Secure nameplate to inside face of recessed panelboards doors in finished locations.

d. Embossed type will not be permitted for any application.

3.2 Wire Identification:

a. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit panel and feeder number for power and lighting circuit, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

3.3 Nameplate Engraving Schedule:

a. Provide nameplates to identify all circuits in the service distribution and power distribution panelboards; branch circuit panelboards; separately mounted starting switches; disconnecting switches; motor control pushbutton stations; selector switches; terminal cabinets; telephone cabinets, etc. Clearly identify on the nameplate the equipment such as "Air Handling Unit AH-1" and "Hot Water Cir. Pump P-1" in lieu of abbreviated plan references such as "AH-1" or "P-1".

b. Provide nameplates to identify all electrical distribution and control equipment, and loads served. Minimum letter height as scheduled below.

c. Panelboards, Switchboards and Motor Control Centers: ¼ inch; identify equipment designation. 1/8 inch; identify voltage rating and source.

d. Individual Circuit Breakers, Switches, and Motor Starters In Panelboards, Switchboards, and Motor Control Center; 1/8 inch; identify circuit and load served, including location.

e. Individual Circuit Breakers, Enclosed Switches, and Motor Starters: 1/8 inch; identify load served.

f. Transformers: ¼ inch; identify equipment designation. 1/8 inch; identify primary and secondary voltages, primary source, and secondary load and location.

END OF SECTION - 16195