

# DIVISION 16A - ELECTRICAL

## SECTION 16100

### BASIC MATERIALS AND METHODS

#### GENERAL REQUIREMENTS

Section 15050, GENERAL REQUIREMENTS FOR MECHANICAL AND ELECTRICAL WORK is hereby made an integral part of this division and section of the Specifications.

Scope: The Contractor shall provide all labor, materials and equipment necessary to install a complete electrical system as shown on drawings and as specified herein.

Standards: All materials and equipment provided shall be new and meet the standards of the NEMA and/or Underwriter's Laboratories, Inc. (UL), and shall bear their label wherever standards have been established and label service is available.

Connections: The Contractor shall make all final electrical connections to equipment, etc., (both Owner and Contractor furnished) and all other facilities and systems for the structure, including connections to utilities specified herein or shown on drawings.

#### RACEWAY AND FITTINGS

Electric metallic tubing: Tubing shall be lightweight cold rolled steel with a zinc coating on the outside and a protective coating on the inside. Fittings shall be steel and meet the same requirements for finish and materials as EMT. Fittings shall be of the approved compression ring type. Crimp-on, tap on, indenter, and set-screw fittings shall not be used. Die-cast fittings SHALL NOT be used. Box connectors shall have insulated throats.

Use: EMT may be used and installed in concrete slabs, and walls, where concealed or exposed within the building or above grade where not exposed to weather. EMT shall not be installed underground.

Rigid steel conduit: This conduit shall be standard weight, mild steel pipe, zinc coated. Fittings shall be threaded and shall meet all requirements of the conduit. Install plastic throat insulator or bushing at conduit terminations.

Use: Rigid steel conduit shall be installed in all concrete slabs, and walls (in sizes three inch and larger), and, in all sizes at all locations where exposed in mechanical rooms or where exposed to weather and other locations where designated on drawings.

## DIVISION 16A - ELECTRICAL

Liquid tight flexible conduit: This conduit shall have a flexible galvanized steel core with an extruded thermoplastic covering with special watertight connectors. Conduit shall be Anaconda "Sealtite" Type U.A. or equally approved.

Use: Liquid tight flexible conduit shall be used for all motor connections and other equipment subject to vibration, where exposed to weather and in Mechanical rooms and other areas designated on drawings.

Flexible Metal Conduit: This conduit shall be galvanized steel with screw-in fittings designed for this use. Squeeze type or set screw connections are not acceptable.

Use: Flexible Metal Conduit (minimum 1/2") shall be used only in indoor final connections to mechanical equipment (not to exceed 36") and final connections to recessed fluorescent fixtures (not to exceed 72"). Flexible conduit shall NOT be used for general raceway material. Use is as restricted above.

Nonmetallic Conduit: This conduit shall be Type 40, 90 deg. C., PVC (Polyvinyl Chloride) and shall conform to NEMA Specification TC-2, and shall be installed in accordance with Article 347 of N.E.C. Fittings and cement shall be by the same manufacturer as the conduit.

Use: PVC conduit shall be installed only in sand bed for underground installations. PVC conduit shall not be installed where exposed to weather, sunlight or mechanical damage and shall not extend more than four inches above finish floor or finish grade. ENT conduit not acceptable.

Intermediate Metallic Conduit: This type of conduit (IMC) shall not be used on this project.

### CONDUIT INSTALLATION REQUIREMENTS

Coordinate installation of raceways with building structure and other mechanical trades, complete with bends, fittings, junction and pull boxes to meet codes and make complete operating systems. Raceways 1" and larger shall not be run in concrete slab without approval of structural engineering.

A complete continuous raceway system shall be provided for pulling and installation of all wiring. All wiring shall be installed in raceways unless otherwise specified.

## DIVISION 16A - ELECTRICAL

In general, conduits shall be concealed in finished areas, and may be exposed in unfinished areas, run square to the building construction, and continuous from outlet to outlet, connected mechanically and electrically to assure grounding. Conduits shall be cut square, reamed to full size, shouldered without butting into couplings or fittings. The threads shall be of standard length and diameter required for the size of the conduit used and graphite bearing thread lubricant shall be used in making up the threads. Running threads will not be acceptable. Conduits shall have a smooth interior surface free of obstructions, shall be capped with conduit seals during the construction period, shall be uniformly sloped to eliminate trapped condensation, shall be thoroughly cleaned and dry before pulling any wire. Conduit installation shall clear hot pipes not less than 6 inches.

Rigid conduit or electric metallic tubing shall not be rigidly connected to vibrating equipment. Use flexible conduit or Sealite.

Conduit installation above accessible ceilings shall be such that there will be no interference with the installation of lighting fixtures, air outlets or other devices. Conduit shall not be supported by ceiling grid or hanger wires, but shall be supported by an independent hanger from the structure. This is also a requirement of N.E.C. 300-11.

In general, conduit shall **not** be installed in or below slab except as specifically required for floor outlets, access to partial walls, etc. Route conduit overhead as close to structure as practical.

Conduit from circuit panel to first outlet or lighting fixture on a circuit shall be 3/4" minimum. Wiring from circuit breaker to first outlet shall be #10 AWG minimum.

Conduit installed underground, in concrete or masonry:

Joints shall be made liquid-tight and shall engage not less than five threads.

Conduit in concrete shall be placed so that no portion of the conduit or couplings are exposed, and at sufficient depth to prevent cracking or spalling. Conduit 1 inch or larger shall not be placed in walls or slabs except as specifically indicated.

Steel conduit underground which is not concrete encased shall be given cold applied protective tape coating, applied in accordance with manufacturer's instruction.

## DIVISION 16A - ELECTRICAL

Exposed conduit shall be parallel with, or at right angles to, building lines, beams or ceilings with symmetrical ends or metal boxes placed at changes in direction or at taps. All exposed conduit shall be painted as directed by engineer.

Connections to wiring enclosures - Conduits shall be secured to outlet boxes or wiring enclosures with double lock nuts. Where conduit boxes with threaded hubs are used, conduits shall engage at least five threads in the hubs. Plastic insulating bushings shall be used for rigid conduits and shall be similar to O.Z. Type A. Connectors with plastic insulated throats shall be used for electric metallic tubing termination.

Cable supports shall be installed at the top of vertical runs for conductors 4 AWG and larger, and otherwise where required by N.E.C.

### FASTENINGS

Fastenings for raceways and boxes shall be made by means of toggle or expansion bolts no smaller than 3/16" diameter, or wood screws no smaller than number 9 x 1" long.

Fastenings to masonry or concrete shall be made by means of machine screws no smaller than number 10-24 x 1-1/4" long screwed into lead expansion shields no smaller than 3/8" diameter x 5/8" long.

Lighting outlets supported independently by means of expandable bar hangers or metal strip framing system shall afford a safe and substantial support for the equipment, but not less than 200 pound holding strength without movement of the box in any circumstance.

Outlet, pull, or junction boxes shall be supported from joists or other structural framing (not finish wall or ceiling panels) by expandable bar hangers or metal strut framing system. Mounting of outlet boxes from one side is not acceptable. Provide continuous support from behind box or support from both sides. Use of devices which depend on wallboard for support, such as Caddy H2-3 (quick-mount support), are NOT acceptable.

Panels may be attached directly only to permanent structure walls. Support panels located on partition walls independent of the wall with metal strut framing system attached to permanent structure (slabs or framing members).

### EMPTY RACEWAY SYSTEMS

Provide grounded empty raceway systems with conduit, cabinets with plywood back liner, outlet boxes, junction boxes, backboards, and miscellaneous appurtenances required for complete system. Leave empty raceway systems complete with nylon pull string, minimum 2

## DIVISION 16A - ELECTRICAL

feet extra length at each end, properly tagged to indicate terminal points and length of runs (at junction boxes as well as terminations).

Systems shall meet requirements of, be accepted by, and be approved by the code authority, utility, equipment suppliers, Owner, Contractor or Subcontractor furnishing system equipment and wiring for the system involved.

Install minimum 3/4 inch size empty conduit unless otherwise indicated.

### WIRE AND CABLE (600 VOLT)

All wire and cable within the building shall conform to Article 310 of the N.E.C. for Type "THWN" or "THHN", 600 volt, copper wire. All panel and motor feeders shall be Type "THWN", except as noted on drawings. All wiring shall be installed in conduit unless otherwise specified.

Minimum wire size shall be #12 AWG, except control wiring (below 50 volts) which may be #14. 120 volt and above control wiring shall be #12 AWG minimum. No.14, 12, 10 AWG wire shall be single conductor copper. All conductors #8 and larger shall be stranded copper with double braid.

All conductors shall be of recent manufacturer (not older than six months) and shall be delivered to the building in original packages bearing the Underwriter's (U.L.) label and manufacturer's name.

All conductors shall be continuous from outlet to outlet, and no splices shall be made except in boxes accessible for maintenance. Routing of circuits shall be left to the discretion of the Contractor. However, circuit numbers shall be as shown on drawings. A maximum of 3 circuits or 3 phases to include neutral and ground shall be installed in any one conduit.

On single phase, 3 wire systems, the use of a common neutral for more than two circuits shall not be acceptable. On three phase, 4 wire systems, the use of a common neutral for more than three circuits shall not be acceptable. The neutral size shall be the same size as the phase conductors unless specifically noted. Isolated ground circuits shall be installed with an independent ground and independent neutral which shall not combine with any other circuit. Where the total distance for branch circuits from the panel boards to the center of the circuit load exceeds the following, increase conductor sizes: 1 - 75 feet (#12 AWG); 76 - 110 feet (#10 AWG); 111 - 185 feet (#8 AWG).

Branch circuit wiring from panelboard to the first outlet on a circuit shall be #10 AWG minimum installed in 3/4" conduit minimum.

## DIVISION 16A - ELECTRICAL

Conductor sizes shown on drawings are based on copper. Under no condition, will aluminum conductors be acceptable.

No open wiring shall be installed in environmental air spaces (supply and return air plenums).

Conductors shall be color coded in accordance with the requirements of the NEC and as follows:

### COLOR-PHASE TABLE FOR INSULATED WIRE:

120/208V System Color	Phase	277/480V System Color
Black	A	Brown
Red	B	Orange
Blue	C	Purple
White	Neutral	White or Grey
Green	Ground	Green
Yellow	Switch leg return	Yellow

### OUTLET BOXES

Furnish and install all outlet boxes at each outlet location as shown on drawings and as required in this Division in accordance with Article 370 of the National Electric Code.

Outlet boxes shall be galvanized steel with knockout, as manufactured by Appleton, Walkerduct, Steel City or equal approved.

Metal supports and other accessories shall be furnished and installed as required for each box. Ceiling and bracket fixture boxes, where required, shall be equipped with fixture studs.

Wall outlets in exposed block or masonry construction shall be equipped with extension and device mounting straps in order to provide an opening which can be covered by the device plate without the use of mortar or other filler material.

The volume of outlet boxes shall be in accordance with the N.E.C. requirements, but shall be no smaller than 4 inches square in any case. Provide plaster extension rings as required for single and double outlet boxes as required.

To prevent noise transmission between rooms, outlet boxes shall NOT be mounted back to back. Provide minimum 6' offset between boxes.

## DIVISION 16A - ELECTRICAL

Weatherproof outlets shall have cast metal boxes with gaskets.

See "Fastenings" for special support of outlet boxes.

### WIREWAYS, PULL AND JUNCTION BOXES

Wireways, junction and pull boxes indicated and required shall be fabricated in accordance with NEMA and National Electric Code requirements with respect to material, gauges, dimensions and methods of fastening. Wireways, junction and pull boxes shall bear U.L. Label.

Provide at locations required by the National Electric Code, and at those locations required to facilitate the pulling of wire.

Interior boxes shall be stamped or fabricated galvanized steel. Boxes located in weatherproof areas shall be cast metal with threaded hubs and bolted gasketed covers.

Exterior boxes shall be Hot-dipped galvanized complete with weatherproof covers and rubber or neoprene gaskets.

Exposed interior boxes shall be finished in standard gray enamel, sides and backs spot welded in position, and have removable screw covers.

Conduits entering boxes shall be through tight-fitting bored or punched holes, or threaded hubs, and shall be secured firmly.

Covers in finished areas shall have prime coat.

The volume of the boxes shall be in accordance with the N.E.C. requirements, but shall be no smaller than 4 inches square in any case.

Boxes shall be accessible at job completion. Boxes with covers in finished areas shall be located as approved by the Engineer and shall be finished with finished flange trim.

### PAINTING

All exposed conduit, boxes, etc., shall be painted in color as directed by engineer. All surface mounted panels shall be painted. See architectural specifications for paint type and application.

## DIVISION 16A - ELECTRICAL

### LABELING, IDENTIFICATION AND COLOR CODING

All 277 volt and 480 volt equipment installed on this project shall be labeled showing voltage. This shall include, but is not limited to, motors, disconnects, panels, lighting fixtures and raceway system.

Labeling shall be accomplished by stencil with red paint.

All wiring shall be color coded by phase and voltage.

END OF SECTION