

SECTION 16120
CONDUCTORS

PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

- A. The general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 General Requirements, apply to work specified in this Section.
- B. Requirements of Section 16050, "Basic Electrical Materials and Methods," apply to this Section.

1.02 SUMMARY

- A. Work Included: Furnishing, installation and termination of conductors required for power feeders, branch circuits, control wiring, fire alarm system, rated 600 volts and below.
 - 1. Installation includes placement, splicing, terminating conductors, identification, testing, and verification of each circuit, cable, and conductor.
 - 2. Termination includes attaching each conductor in its designated location using the specified materials, and insulating the entire connection where specified or required by the application. Terminate spare conductors on spare terminals on the applicable terminal blocks.
- B. Related Work Specified in Other Sections:
 - 1. Raceways, Section 16130.
 - 2. Boxes, Section 16135.
 - 3. Wiring devices, Section 16140.
 - 4. Electrical identification, Section 16075.
 - 5. Grounding, Section 16060
 - 6. Lighting, Section 16500.
 - 7. Fire alarm wiring : Section 13850.
 - 8. Electric control systems for HVAC equipment, Division 15. Furnishing and installation of control wiring between field installed devices, including motor starters, control panels, control and pilot devices, thermostats, relays, pressure and float switches and similar appurtenances is specified as Division 15 work, and shall be performed in accordance with applicable provisions of this section, 16120.

1.03 REFERENCED CODES AND STANDARDS

- A. National Fire Protection Association: NFPA 70 - National Electrical Code.
- B. Underwriter's Laboratories:
 - 1. UL 4: Armored Cable.
 - 2. UL 62: Flexible Cord and Fixture Wire.
 - 3. UL 83: Thermoplastic-Insulated Wires and Cables.

4. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
5. UL 486B: Wire Connectors for Use with Aluminum Conductors.

C. Insulated Cable Engineers Association: ICEA S-61-402, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 5)

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's illustrated product literature and technical specifications for each type of conductor provided on this project.
- B. Power Distribution Riser Diagram and Panelboard Schedules, Drawings E4.01 and E8.01: Submit the revised drawings showing the sizes of aluminum wire and conduits to be substituted, and a schedule comparing the designed copper wire ampacity and conduit sizes with the ampacity and conduit sizes of the proposed aluminum feeders.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Conductors: Comply with requirements of the National Electrical Code for fabrication and use.

PART 2 - MATERIALS

2.01 MANUFACTURERS

- A. Branch circuit conductors: Furnish complying products by one of the following manufacturers:
 1. Cablex, Inc.
 2. Houston Wire and Cable.
 3. Pirelli Cable Corp.
- B. MC Cable: Furnish complying products by one of the following manufacturers:
 1. AFC.
 2. Alliance Cable.
 3. Alcatel.
 4. Cablec Corporation.
- C. Low Tension Cable: Furnish complying products by one of the following manufacturers:
 1. Belden.
 2. Cablex, Inc.
 3. West Penn Wire Corp.
- D. Lugs and Wire Connectors: Furnish complying products by one of the following manufacturers:
 1. Buchanan
 2. Ideal

3. Burndy
4. Thomas and Betts.

2.02 FEEDERS

- A. Feeder Conductors: Copper wire, soft drawn, annealed, 98% conductivity, rated at 600 volts and complying with reference Electrical Code. Copper conductors #8 AWG and larger shall be stranded.
- B. Insulation for feeder conductors installed in raceways: Types THWN or XHHW.
- C. Conductor Material: copper conductors No. 2 AWG and larger can be substituted with aluminum conductors of equivalent size.

2.03 BRANCH CIRCUIT WIRING

- A. General: Furnish conductors for branch circuit wiring which conform with referenced Electrical Code.
- B. Branch circuit conductors: Copper wire, soft drawn, annealed, 98% conductivity, rated 600 volts. Conductors #8 AWG and larger shall be stranded. Conductors #10 AWG and smaller shall be solid.
 1. Insulation for branch circuits installed in raceway: Types THWN, THHN or XHHW.
 2. For wiring in high temperature areas (i.e. boiler rooms), furnish conductors with maximum operational temperature of 90°C.
 3. For wiring within lighting fixtures, furnish conductors with maximum operating temperature 150°C, Type SF-1 and SF-2.
- C. Metal Clad Cable (Type MC): 600 volt copper conductors with THWN-THHN insulation and full size insulated green jacket grounding conductor.

2.04 LOW TENSION WIRING

- A. Fire Alarm, Class 1 and Class 2 Control System Wiring: Solid copper wire, single conductors, rated 600 volts.
- B. Conductor Size:
 1. Circuits at 120 volt AC: Minimum #14 AWG wire.
 2. Circuits at 24 volt AC or DC: Minimum size as required by system manufacturer.
- C. Insulation: Types THHN or XHHW for conductors #14 AWG and larger installed in raceway.
- D. Fire alarm wiring: Metal clad cable (Type MC) approved for fire-protective signaling circuits, where it is allowed.

2.05 CONNECTORS

- A. For copper wire No 14 through No. 8 AWG, solid or stranded, furnish screw-on pressure type connectors incorporating zinc-coated spring and insulating vinyl jacket with skirt.
- B. For copper wire No. 6 AWG and larger, furnish bolt-on mechanical lugs with hex socket screws.

2.06 SUPPORTS

- A. Cable Supports for Metallic Sheathed Cable: Basket weave or other supports approved by cable manufacturer; O.Z./Gedney or approved equal.

2.07 ACCESSORIES

- A. Cable Ties: Furnish one of the following, or equal:
 - 1. Thomas & Betts "Ty-Raps"
 - 2. Holub Industries, Inc., "Quick-Wrap"
 - 3. Burndy "Unirap"
- B. Electrical Tape: Vinyl plastic, weatherproof electrical tape; 3M "Scotchbrand No. 88" or equal by Permacel or Plymouth Company.

2.08 COLOR CODING

- A. Feeders and branch circuits:

- 1. Use following color coding:

<u>Phase</u>	<u>208/120 Volts</u>	<u>480/277 Volts</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Grey
Ground	Green	Green

- 2. Conductors #8 AWG or smaller: Continuous color coding.

- B. Low Tension Conductors: Color code as required by each system manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect job conditions and related work and report to the Architect, in writing, any conditions which may adversely affect conductor installation.
- B. Do not proceed with installation until these conditions have been corrected.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install work in conformance with the printed specifications and installation instructions of each manufacturer and with the approved shop drawings.

3.03 INSTALLATION OF BRANCH CIRCUIT AND LOW TENSION CONDUCTORS

- A. Install all power and 120 volt control wire and cable in approved raceways as specified in Sections 16130 and 16132, and as approved by Authorities having jurisdiction. When low tension wiring is run exposed, install it in conduit.
- B. Wire Size: Install minimum No. 12 AWG for power and lighting circuits; except install minimum No. 10 AWG for 120 volts 20 ampere branch circuits of more than 75 feet, and 277 volt 20 ampere branch circuit of more than 150 feet from first outlet to panelboard.
- C. Wire from point of service connection to receptacles, lighting fixtures, devices, equipment, outlets for future extension, and other electrical apparatus as shown on the drawings. Provide slack wire for connections where required. Tape ends of wires and provide blank covers for outlet boxes designed for future use.
- D. Insulation: In wet locations, use only type THWN or XHHW. In dry locations, install type THWN, THHN or XHHW.
- E. Metal clad cable, type MC may be used as permitted by the referenced Electrical Code for branch circuit wiring above suspended ceilings for connections of the lighting fixtures, and from a junction boxes in the ceiling space to the outlets and switches location in the dry wall partitions. MC cable shall not be used for branch circuit homeruns.
- F. Bundle conductors #10 and smaller in branch circuit panelboards and signal cabinets.
- G. Homerun Circuits: Follow homerun circuit numbers shown on the drawings to connect circuits to panelboards. Where homerun circuit numbers are not shown on the drawings, divide similar types of connected loads among phase busses so that currents in each phase are within 10% of each other during normal usage. Wire branch circuit homerun with two or three circuits and common neutrals to circuit breakers in such a manner that each of the circuits is fed from a different phase. Do not combine circuits so that any homerun has more than three circuits (total of five wires) installed in one conduit, unless the circuit conductors are derated in strict accordance with the referenced Electrical Code.
- H. Properly group feeders, branch circuit and auxiliary system wiring passing through pull boxes and/or being made up in panelboards; neatly bind each group of wires together with plastic cable ties, and trim loose ends of the ties.
- I. Peel branch circuits and auxiliary system wiring out of the wiring gutters at the terminal cabinet and panels at 90 degrees to circuit breakers and terminal lugs before making connections.
- J. Splices and Terminations:

1. Make splices and joints by means of UL-listed, solderless connectors rated 600 volt, of sizes and types required by manufacturer's recommendations, with temperature ratings equal to that of wire.
 2. Attach copper wire to panelboards, disconnect switches and other electrical equipment by means of bolt-on lugs with hex screws. Properly size lugs; do not cut strands from a conductor in order to fit conductor into a lug.
- K. Identification: Label branch circuits in pull and junction boxes and at cable terminations in the panelboards. Use non-ferrous tags or labels stamped or printed to correspond with markings on the drawings or marked so that cable may be identified readily. If suspended tags are provided, attach with nylon line or cable lacing.
- L. Connect branch circuits to the breakers in multi-phase panelboards as required to balance loads.
- M. Low Tension Cables: Provide separation from power wiring and lighting fixtures as follows:
1. Lighting fixtures - at least 6 inches.
 2. Power branch circuit wiring with MC type cable - at least 12 inches.
 3. Power branch circuit wiring in metal conduit - at least 6 inches.
- N. Cable Supports:
1. Provide cable supports for vertical feeders as required by the referenced Electrical Code.
 2. Support and secure metal-clad cable Type MC at intervals not exceeding 6 feet and within 12 inches from every outlet box, junction box or cabinet.
 3. Support metal clad cable Type MC with cable supports equal to Caddy WMX-6, MX-3, and clamps equal to Caddy 449. Where cables are supported by the structure and only need securing in place, then cable ties will be acceptable.
- O. Aluminum Conductors: Use high compression type connectors to make connections to aluminum conductors. Do not use mechanical lugs to terminate aluminum conductors. Select connector size to exactly fit each conductor; install using approved hydraulic tool to bring uniform pressure on all sides of the joint and ensure a permanent, high conductivity connection. Where connections are made between aluminum and copper, make provision to prevent electrolytic action and coat conductors with oxidation inhibitor before installing connectors. At lug terminations, use Belleville washers.

END OF SECTION 16120