16120

WIRES AND CABLES, LOW VOLTAGE

PART 1- GENERAL

1.1 DESCRIPTION:

A. This section includes the furnishing, installation, and connection of the power, lighting, system, and control wiring.

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (POWER AND LIGHTING):

A. Cable and Wire: Fed. Spec. J-C-30, except as hereinafter specified. All conductors shown on plans are sized for copper. UL label required. American, Southwire, Essex, or equal, rated 600 volts, finished with fadeless color coding and bearing Underwriters label.

All cable and wiring shall be continuous between electrical equipment. Splices shall not be added except as required for taps in branch circuits or as approved by the engineer. No splices will be allowed within panelboards and switchboards.

B. Single Conductor:

1. Soft annealed copper.

2. All conductors #8 gauge and larger shall be stranded unless noted otherwise All conductors #10 gauge and smaller may be solid or stranded unless noted otherwise on the drawings. Stranded conductors may be used only on devices and lugs that are U.L. listed for use with stranded conductors.

3. Minimum size No. 12, except where larger sizes are shown. (Size No. 14 minimum for controls).

C. Insulation:

1. Wires for general use within the building shall be type THHN or type THWN, 90 degree rated except where called for otherwise on the drawings. Type THHN or type THWN shall be used at the temperature rating of equipment termination lugs, environmental conditions, and as

Code allows. Wires for other than general use shall be as hereinafter specified for specific services.

D. Multiconductor Cables:

1. Comply with NEMA WC 70; Exterior sheath shall be color coded to distinguish between cable voltages and quantity of phase conductors.
2. Type AC Cable, Armored cable, shall comply with UL 1479 and UL 4 with green grounding conductors in addition to Armor/Bond wire ground combination. Cables shall be listed for use in environmental air space in accordance with NFPA 70 Article 300.
3. Type MC Cable, Metal-clad cable; shall comply with UL 1479 and UL 1569 with green grounding conductors. Cables shall be listed for use in environmental air space in accordance with NFPA 70 article 300.

E. An equipment grounding conductor, sized per NEC Article "Grounding", shall be installed in each conduit containing phase conductors.

F. Color Code:

1. All conductors shall be identified by circuit number and color coding at all termination points and splices. All conductors shall be identified in all pull and junction boxes by the following method of color coding. Means of identification shall be permanently posted at each branch circuit panel with a nameplate identifying color coding system used in that panelboard.

Phase	208/120V	480/277V	240V.	240/120V
A	Black	Brown	Black	Black
B	Red	Orange	Red	Red
C	Blue	Yellow	Blue**	
Neutral	White	Gray*		White
Ground	Green	Green	Green	Green
Iso. Grd	Green w/Yellow	Green w/Yellow	Green w/Yellow	Green w/Yellow

* or white with colored (other than green) tracer.
**Identify 'High Leg' per N.E.C.

2. Use solid color compound or solid color coating for No. 6 and smaller branch circuit conductors and neutral sizes.

3. Phase conductors No. 4 and larger color code using one of the following:

   a. Solid color compound or solid color coating.

   b. Colored as specified using 3/4-inch wide tape. Apply tape in two layers, half overlapping turns for a minimum of three-inches for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type. Where any conductor is or can be supplied from an emergency system, the Contractor shall mark each conductor with an additional two layers, one-half lapped, of purple colored vinyl electrical tape.

   c. Yellow stripe on isolated ground may be 1/4-inch wide yellow tape on top of green.

4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

5. Provide plastic engraved color code legend on each panelboard and switchboard per NEC Article “Branch Circuits”, “Identification Of Ungrounded Conductors”.

6. All improperly color coded conductors will be completely replaced at no additional cost to Owner.

F. See riser diagrams and/or other sections of the Specifications for types and ratings for sound, fire alarm, control and other special cables.

G. Where quantities of conductors in a raceway system are not specifically indicated, provide the number as required to maintain function, control and number of circuits as indicated.

H. All isolated ground circuits shall be provided with separate phase, neutral, and ground conductors (no shared neutrals or grounds). All isolated ground circuits shall be installed in separate raceways from all other circuiting.

I. Where multiple sets of conductors are indicated, do not install the same phase conductors in the same raceway. Each raceway shall be provided with A, B, C phase conductors, neutral (if indicated), and ground (if indicated).

J. Where GFCI circuit breakers are used, provide a separate neutral conductor for the GFCI circuit. (Not a shared neutral with another circuit).

2.2 SPLICES AND JOINTS:

A. In accordance with UL 486 A, B, D and NEC.

B. Splices and taps for #6 and larger conductors shall be made with block type terminations (with insulating jacket) or with split bolt connectors, covered and completely insulated with a minimum of three half-lapped layers of Scotch No. 33+ (105 degree C) plastic electrical tape or by approved insulated fastener. All splices and taps having irregular surfaces shall be properly padded with Scotchfil putty before application of insulating plastic tape. Scotchlok electrical pre-insulated spring pressure connectors or equal may be used for up to #8 conductors.

2.3 CONTROL WIRING:

A. All control wiring shall be copper, solid or stranded, #14 Ga. or larger depending upon current requirements, with insulation type for 90 C. rating. Where stranded conductors are used, provide with spade type insulated copper terminals. Unless noted otherwise on the Mechanical drawings or herein, all mechanical control wiring for all systems shall be routed within conduit, shall be of the same insulation type and shall be continuous between outlets and boxes (with no splices or taps into conduit). All line and low voltage mechanical control wiring, conduit, connections, and/or terminations are by the Electrical Contractor unless specifically noted otherwise within the bidding documents.

2.4 WIRE LUBRICATING COMPOUND:

A. The cable pulling lubricant shall be compatible with all cable jackets. The lubricant shall be UL (or CSA) listed. The lubricant shall contain no waxes, greases, silicones, or polyalkylene glycol oils or waxes.

B. A 200-gram sample of the lubricant, when placed in a one-foot, split metal conduit and fully dried for 24 hours at 105 degrees C, shall not spread a flame more than three-inches beyond a point of ignition at a continued heat flux of 40 kW/m^2. Total time of test shall be one-half hour.

C. Approved Lubricant is:

Dyna Blue

Polywater J available from:

American Polywater Corporation

Equal by Quick Slip from Buchanan
CCR Wire Pulling Lube from CRC
Poly-X from American Colloid.

2.5 FIREPROOFING TAPE:

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arcproof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200 ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 7 mils thick, and 3/4-inch wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERALLY:

A. Install in accordance with the NEC, and as specified.

B. Unless noted otherwise on the Electrical drawings or herein, all feeders for all systems shall be routed within conduit, shall be of the same insulation type and shall be continuous between outlets and boxes (with no splices or taps into conduit). This shall include but not be limited to:

- Service Entrance feeders
- Exposed Feeders
- Feeders concealed in ceilings, walls, partitions and crawl spaces.
- Feeders below slabs-on-grade and underground.

C. Branch circuits concealed in ceilings, walls and partitions: Single conductors in raceways. Type AC and Type MC in locations limited to the following:

1. Type AC and Type MC are acceptable for the following applications:
   a. Install cables for lighting fixtures whips and for branch circuits above ceiling to the j-box located in the vicinity of devices and fixtures being

served. All MC cable shall be routed neatly throughout the ceiling. MC cable shall be allowed in the web of the metal stud.

b. Fixture whips shall be limited to 6' lengths. Each individual fixture whip must terminate from each fixture to a junction box.

c. Use only single-circuit cable (i.e. two wire plus ground). For devices in the same wall connected to different circuits, install separate single circuit cable for each circuit or use color code multi circuit MC to match circuit colors connected.

2. Type AC and Type MC are not acceptable for the following applications; instead provide single conducts in rigid raceway:

a. Homeruns to panelboards.

b. Branch circuits and feeders serving HVAC equipment, elevator equipment, and kitchen loads (other than receptacle branch circuit located in the kitchen).

c. Within mechanical, electrical or communication rooms.

d. Exposed branch circuits within areas that do not have ceilings (i.e. exposed to structure) or rooms with cloud ceilings that have exposed structure around the perimeter of the room.

C. Splices and taps in outlet boxes shall be twisted joints. U.L. approved pre-insulated spring pressure connectors shall be used for branch circuit connections. Connectors shall be installed so that all conductors are properly insulated.

D. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes. Do not splice cables in panelboards, switchboards, disconnects, etc.

E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

F. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, and tie all cables.

G. Seal cable and wire entering a building from underground between the wire and conduit, where the cable exits the conduit, with a non-hardening approved compound.

H. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.

2. Use ropes made of nonmetallic material for pulling feeders.

3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Engineer.

4. Pull multiple cables into a single conduit with a single continuous pull.

5. Always use wire lubricant per this specification.

3.2 SPLICE INSTALLATION:

A. Splices and terminations shall be mechanically and electrically secure.

B. Where the Engineer determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Owner.

3.3 CONTROL, COMMUNICATION, AND SIGNAL WIRING INSTALLATION:

A. Unless otherwise specified in other sections of these specifications, install wiring as described below. Wiring shall be connected to perform the functions shown and specified in other sections of this specification.

B. Except where otherwise required, install a separate power supply circuit for each system, or control equipment, or control power. Circuit to nearest 120 volt panel or nearest emergency panel if equipment controlled is connected to emergency system. Provide 20 Amp breakers in panels where none are designated. Verify all requirements with actual equipment supplied in field.

C. Install a breaker lock-on clip on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.

D. System voltages shall not exceed 120 volts and shall be lower voltages where shown on the drawings or required by the NEC.

E. Wire and cable identification:

1. Install a permanent wire marker on each wire at each termination, outlet box, junction box, panel, and device.

2. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

3. Wire markers shall retain their markings after cleaning.

3.4 FIELD TESTING:

A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.

B. Test shall be performed by meggar and conductors shall test free from short-circuits and grounds.

C. Test conductors phase-to-phase and phase-to-ground.

D. Meggar motors after installation but before start-up and test free from grounds.

E. The Contractor shall furnish the instruments, materials, and labor for these tests.

END OF SECTION 16120