SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections, 600V and below.

1.2 REFERENCES

A. NECA (National Electrical Contractors Association) - Standard of Installation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Product Data: Submit for building wire, marked to indicate selected products and where each product is to be used.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Closeout and turnover procedures.
B. Project Record Documents: Record actual locations of components and approximate routes of conductors.
C. Test Reports: Indicate procedures and values obtained.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Materials: Materials shall be new and shall be delivered to the job site in the original packaging.
B. Wire and Cable: All wire and cable shall be delivered to the job site in unbroken packages.
1.7 COORDINATION

A. Section 01 33 00 - Administrative Requirements: Coordination and project conditions.

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

C. Wire and cable routing indicated is approximate unless dimensioned.

1.8 SYSTEM DESCRIPTION

A. General:

1. All cable installations shall be performed to manufacturer's recommendations and as noted below.
2. All wire and cable shall be new and bear the UL label.
3. All wire shall be copper.

B. Product Requirements: Use products as follows:

1. Use stranded conductors for feeders and branch circuits.
2. Use stranded conductors for control circuits. Exception: wire used in fire alarm circuits shall be solid copper per NEC 760-16.
3. Minimum conductor sizes:
   a. Use conductor not smaller than 12 AWG for power and lighting circuits.
   b. Use conductor not smaller than 14 AWG for signal and control circuits over 100 volts (V).
   c. Low voltage (50 V or less): #14 AWG or specified cables.
   d. Fire alarm: Refer to Fire Alarm System specification section.

C. Wiring Methods: Use wiring methods indicated and as follows:

1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway or type MC cable with type THHN/THWN insulated conductors.
2. Exposed Dry Interior Locations: Use only building wire, Type XHHW or THHN/THWN insulation, in raceway.
3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway or type MC cable with type THHN/THWN insulated conductors.
4. Wet or Damp Interior Locations: Use only building wire, Type XHHW or THWN or THWN2 insulation, in raceway.
5. Exterior Locations Above Grade: Use only building wire, Type XHHW, THWN or THWN2 insulation, in raceway.
6. Underground Locations: Use only building wire, Type XHHW, THWN or THWN2 insulation, in raceway.
7. Encased in Concrete: Use only building wire type XHHW or THWN insulation, in raceway or type MC cable suitable for concrete encasement.
1.9 FIELD MEASUREMENTS

A. Verify field measurements are as indicated.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Product Description: Single conductor insulated wire, type THHN/THWN or XHHW UL listed for the application.

B. Conductor: Copper.

C. Insulation Voltage Rating: As required per NEC.

2.2 WIRING CONNECTORS

A. Split Bolt Connectors:

1. High strength copper alloy connector with spacer. Spacer separates dissimilar conductors and provides long contact length to prevent high pressure point contacts. Burndy type KSU or equal.

B. Solderless Pressure Connectors:

1. Polyvinylchloride insulated tin plated, ring or fork tongue type with 105 degree C, 600V max insulation color coded for the wire size used.

C. Spring Wire Connectors:

1. Insulated, 105 degree C, electrical spring connector incorporating a non-restricted, zinc-coated steel spring with an insulating outer jacket.

D. Compression Connectors:

1. Heavy duty, 600V high-conductivity seamless electrolytic wrought copper electro-tin plated to prevent corrosion. Color coded to match compression die sets to provide correct location and quantity of crimps. Die embossment to indicate die used.

2.3 SPlicing AND INSULATING TAPE (600 V AND BELOW)

A. General purpose electrical tape shall be suitable for temperatures from minus 18°C to 105°C and shall be black, ultraviolet-proof, self-extinguishing, seven (7) mil thick vinyl. Provide 3M Super 33+, or equivalent.

B. In wet/damp locations, provide 3M Super 88.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 33 00 - Administrative Requirements: Coordination and project conditions.
B. Verify that interior of building has been protected from weather.
C. Verify that mechanical work likely to damage wire and cable has been completed.
D. Verify that raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab below-grade or in-slab raceway before installing wire.

3.3 INSTALLATION

A. Route wire and cable as required to meet project conditions.
B. Install wire and cable in accordance with the NECA "Standard of Installation."
   1. All aspects of splicing and terminating shall be in accordance with cable manufacturer's published procedures.
   2. All splices in outlet boxes with connectors as specified herein shall be made up with separate tails of correct color. At least six (6) inches of tails within box after splice is made up shall be provided.
C. Neatly train wiring inside boxes, equipment, and panelboards.
D. Identify each conductor at each splice or termination with its circuit number or other designation indicated.
   1. All terminal strips shall have each individual terminal identified with machine printed label.
   2. All junction box cover plates shall be identified via felt-tip pen or decal label, denoting the panel and circuit numbers contained in the box.
   3. All receptacles and switches shall be decal labeled on the plate, denoting the panel and circuit number.
E. Signal Wiring:
   1. Wire used for alarm and control signal applications shall be identified at both ends and referenced to appropriate as-built drawings.
   2. Security alarm wiring shall be installed in accordance with NEC, it shall be Class A, or B, and where it is vulnerable to physical abuse, it shall be in metallic conduit. Consult with the Project Engineer for further details.
   3. Control wiring shall be numerically or otherwise coded in accordance with as-built control diagrams. See HVAC Controls and Instrumentation Facilities Design Guide.
F. Special Techniques--Building Wire in Raceway:
   1. Conductors shall not be installed in conduit until all work of any nature that may cause injury is completed. Care shall be taken in pulling conductors such that insulation is not damaged. UL approved pulling compounds shall be used as needed.
   2. All cables shall be installed and tested in accordance with manufacturer's requirements and warranty.

G. Special Techniques--Wiring Connections:
   1. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
   2. Insulate uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor or with pre-manufactured components such as heat-shrink or cold-shrink devices.

H. Connections to Circuit Breakers, Switches, and Terminal Strips; Stranded Copper Conductors:
   1. #12 through #8 AWG: Wire shall be terminated in locking tongue style, pressure type, compression lugs, unless clamp type connection for stranded conductor is provided with device.
   2. #6 AWG and larger: Wire shall be terminated in one-hole flat-tongue style, compression type lugs, or by connectors supplied by the manufacturer.

I. Joints in Wires in Dry Locations, Copper Conductors:
   1. #8 AWG and smaller: Wires shall be twisted and secured with twist-on, expandable spring type solderless connectors, or terminated on terminal strips.
   2. #6 AWG and larger: Wire shall be joined with split bolt connectors or compression sleeves. Joints shall be insulated with rubber tape and protected with half-lapped layers of vinyl plastic electrical tape. Insulation may also be provided by UL listed pre-manufactured components such as heat-shrink or cold-shrink devices.

J. Joints in Wires in Moist Locations, Copper Conductors:
   1. #8 AWG and smaller: Wire shall be securely joined as specified above, then encapsulated in epoxy (Scotchcast or approved equal) or wet location wire nuts.
   2. #6 AWG and larger shall be joined as specified above, and suitably water treated with 3M Scotchkote.

K. Grounding:
   1. Enclosures of equipment, raceways and fixtures shall be permanently and effectively grounded. A code-sized, copper, insulated green equipment ground
shall be provided for all branch circuit and feeder runs. Equipment ground shall
originate at panelboard ground bus and shall be bonded to all switch and
receptacle boxes and electrical equipment enclosures. Ground terminals on
receptacles shall be connected to the equipment grounding conductor by an
insulated copper conductor.

3.4 WIRE COLOR

A. General

1. For wire sizes 10 AWG and smaller - wire shall be colored as indicated below.
2. For wire sizes 8 AWG and larger - identify wire with colored tape at all
terminals, splices and boxes. Colors to be as indicated below.
3. Use black, white and red for single phase circuits at 120/240 volts, 1 phase 3-
wire.
4. For three phase, color code wires as follows:

<table>
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<tr>
<th>CONDUCTORS</th>
<th>120/208V</th>
<th>277/480V</th>
<th>120/240V 3-PHASE</th>
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<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
<td>Brown</td>
<td>Black</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
<td>Purple</td>
<td>Orange</td>
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<tr>
<td>Phase C</td>
<td>Blue</td>
<td>Yellow</td>
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<tr>
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<td>White</td>
<td>White or Gray</td>
<td>White</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>

5. Fire alarm wiring shall be color coded in accordance with Fire Alarm System
specification section.

B. Neutral Conductors: Where there are two or more neutrals in one conduit, each shall be
individually identified with the proper circuit.

C. Branch Circuit Conductors: Three or four wire home runs shall have each phase
uniquely color coded.

D. Feeder Circuit Conductors: Each phase shall be uniquely color coded.

E. Grounding Conductors: Green for 6 AWG and smaller. For 4 AWG and larger,
identify with green tape at both ends and all visible points including in all junction
boxes.

3.5 FIELD QUALITY CONTROL

A. Section 01 77 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.
C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

3.6 FIELD QUALITY CONTROL

A. Distribution Conductors 600 Volt Class, 100 Amps or Over: All 600 volt class conductors shall be tested to verify that no short circuits or accidental grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 1000 volts to provide a direct reading in resistance (Megger).

END OF SECTION