

SECTION 16123

BUILDING WIRE AND CABLE

1. PART 1 GENERAL

1.5 SECTION INCLUDES

- A. Building Wire and Cable.
- B. Wiring Connectors and Connections.
- C. Fiber Optic Cable.

1.6 RELATED SECTIONS

- A. Section 16111 - Conduit.
- B. Section 16130 - Boxes.
- C. Section 16195 – Electrical Identification.

1.7 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.8 QUALIFICATIONS

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

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.10 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on plans.
- B. Conductor sizes are based on copper unless indicated as aluminum or "AL."
- C. Wire and cable routing shown on plans 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.

1.11 COORDINATION

- A. Coordinate Work under provisions of Section 01039 – Coordination and Meetings.
- B. Determine required separation between cable and other Work.
- C. Determine cable routing to avoid interference with other Work.

2. PART 2 PRODUCTS

2.5 BUILDING WIRE AND CABLE

- A. Conductor: Copper.
- B. Insulation Voltage Rating: 600 Volts.
- C. Insulation: ANSI/NFPA 70, Type THHN/THWN.

2.6 WIRING CONNECTORS

- A. Split Bolt Connectors.
- B. Solderless Pressure Connectors.
- C. Spring Wire Connectors.
- D. Compression Connectors.

2.7 FIBER OPTIC CABLE

- A. General: All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification. Optical fiber splices are not allowed.
- B. All fibers shall have been subjected to a minimum tensile proof test by the fiber manufacturer equivalent to 100 kpsi.
- C. All fibers in each cable shall be guaranteed to meet the stated specifications.
  - 1. Performance
    - a. Installed fiber must meet or exceed the following performance specifications.
      - 1. Wavelength: 850nm, maximum attenuation: 3dB/Km, minimum bandwidth: 200Mhz\*Km.
      - 2. Wavelength: 1300nm, maximum attenuation: 0.9 dB/Km, minimum bandwidth: 500Mhz\*Km.
  - 2. Cable Construction
    - a. Installed cable must be manufactured to meet or exceed the following specifications:
      - 1. Outside plant cable shall be used for all applications where cable is to be run in underground conduits. Outside plant cable shall meet the following specifications:
        - a. Gel filled buffer tube, 250 ?, acrylate.
        - b. EIA/TIA-598 color coding for fiber optic cable.
        - c. Flooded core.

- d. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load).
  - e. Capable of a minimum crush resistance of 850 lb./in.
3. Acceptable manufacturers:
- a. Corning.
  - b. Berk-Tech fiber.
  - c. Comscope.
  - d. Superior Exects.
  - e. Substitutions permitted under provisions of Section 01600 – Basic Electric Requirements.
4. All fiber strand counts shall be large enough to provide double the current necessary compactly with minimum of 6 strands.

### 3. PART 3 EXECUTION

#### 3.5 EXAMINATION

- A. Verify that interior of building or cabinet has been protected from weather.
- B. Verify that mechanical Work likely to damage wire and cable has been completed.

#### 3.6 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

#### 3.7 WIRING METHODS

- A. Use conduit methods as described in Section 16111 - Conduit.
- B. Use wiring methods indicated on plans.

#### 3.8 INSTALLATION

- A. Install products in accordance with manufacturer's 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 than 14 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, branch circuits longer than 200 feet.
- H. Pull all 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. Use suitable cable fittings and connectors.

- L. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- M. Clean conductor surfaces before installing lugs and connectors.
- N. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- O. Terminate aluminum conductors with tin-plated aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.
- P. Use suitable reducing connectors or mechanical connector adaptors for connecting 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. Fiber optic cable:
  - 1. Underground Inter-Building Cable
    - a. All fiber cable is to be protected with inner duct. After installation, inner ducts are to be permanently labeled as containing fiber optic cable.
    - b. All cable and inner duct are to be fully supported throughout its entire run. At no time shall more than 400 pounds of tension be placed on any fiber cable while it is being pulled through tray or conduit. It is preferred that all fiber cable be pulled with hand power only. If power winches or mechanical advantage devices are used to pull cable, a tension meter must be used to insure that maximum tension is not exceeded. Alternatively, a "mechanical fuse" rated at 350 pounds may be included in the linkage. Torsion shall be avoided by the use of a swivel at the cable end. While under tension, a minimum bend radius of 20 times the outside cable diameter will be maintained through the use of pulleys and sheaves where required. After pulling, no bend may have a radius, at rest, of less than 10 times the outside cable diameter.
  - 2. Labeling
    - a. Each cable and inner duct is to be permanently labeled at each end with a unique cable number. In addition, labels shall be affixed to the cable/inner duct at every transition of a vault, hand hole, riser closet, or major pull box. Labels will be in the form of "CCD-Location one-Location two- sequence number". For example, cable number 1 from Detention Area E Outlet Control Structure to Detention Area E Inlet Control Structure would be labeled as "CCD - Detention Area E Outlet Control Structure - Detention Area E Inlet Control Structure - 1.
    - b. Each fiber optic strand shall be labeled with a unique identifier at the ST coupler in the FIC. Connectors shall be labeled on the identifying sheets on the front of the FIC. Terminals shall be clearly labeled using the same method.

3. Termination Standards
  - a. The terminal ends of all fibers cable strands shall have connector installed in field. The connectors shall be mounted on bulkheads and installed in enclosures called Fiber Integration Centers (FIC). Terminate both ends of all fibers within a fiber cable with ST, epoxy and polish style connectors. Termination shall be in a wall mounted outlet assembly. The fiber optic outlet shall be a low profile assembly that accommodates a minimum of 4 optical fibers. It shall incorporate a mechanism for storage of cable and fiber slack needed for termination, be equipped with ST –type couplings, which face downward to prevent contamination and incorporate a shroud, which protects the optical couplings from impact damage.
4. Contractor shall supply compatible fiber optic patch cables of sufficient length and using the methods described above to connect devices to fiber optic network.

### 3.9 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 16195 – Electrical Identification.
- B. Identify each conductor with its circuit number or other designation indicated on plans.

### 3.10 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 01400 – Quality Control.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.
- E. Fiber optic cable:
  1. Before Installation
    - a. Each individual fiber in a cable be tested with an OTDR for length and transmission anomalies while on the reel before installation. Results are to be recorded and supplied to Engineer in the form of hard-copy printouts or photographs of screen traces. The Engineer, given a one-week notice, shall be present for these tests.
  2. After Installation and termination
    - a. All single mode and multi mode fiber strands shall be tested end-to-end for bi-directional attenuation, 850 nm/1300 nm for multimode and 1310 nm/1550 nm for singlemode fibers. Tests should be conducted in compliance with EIA/TIA-526-14 or OFSTP 14, Method B, according to the manufacturer's instructions for the test set being utilized.
  3. Tests
    - a. Tests must ensure that the measured link loss for each strand does not exceed the "worst case" allowable loss defined as the sum of the connector loss (based on the number of mated connector pairs at the EIA/TIA-568 B maximum allowable loss of 0.75 dB per mated pair) and the optical loss (based on the performance standard above, 2.1.1 and 2.2.1).

4. After the cable is in place it shall be tested in the following manner:
  - a. After termination, each fiber shall be tested with an ODTR for length, transmission anomalies, and end-to-end attenuation. Results are to be recorded and supplied to Engineer in the form of hard-copy printouts or photographs of screen traces. The Engineer, given a one-week notice, shall be present for these tests.
  - b. After termination and bulkhead mounting, each terminated fiber is to be tested for end-to-end loss with a power meter/light source. As above, results are to be recorded and supplied to Engineer.
  - c. In the event that, during testing, any of the above criteria are not met, the cable shall be replaced at the Contractor's own expense.
  - d. Should the Contractor or fiber optic cable supplier have any misgivings that the system as designed may not meet the above criteria, they shall inform the Engineer prior to Bid.

END OF SECTION