

**SECTION 28 05 13**

**CONDUCTORS AND CABLES FOR ELECTRONIC SECURITY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section covers security conductors and cables.
- B. Cable for the interfacing of power and grounding provisions with work provided under these Sections is covered under these Sections.

**1.2 RELATED SECTIONS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Additional related specification sections include:
  - 1. Section 28 05 00, Common Work Results for Electronic Security.
  - 2. Section 28 05 28, Pathways for Electronic Security.
  - 3. Section 28 08 00, Commissioning of Electronic Security.
  - 4. Section 28 10 00, Access Control.
  - 5. Section 28 20 00, Video Surveillance
  - 6. Section 28 31 00, Intrusion Detection

**1.3 ACTION SUBMITTALS**

- A. See Section 28 05 00, Common Work Results for Electronic Security for additional requirements.
- B. Product Data: For each type of product.
- C. Shop Drawings:
  - 1. Cabling administration drawings and printouts.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Source quality-control reports.
- B. Field quality-control reports.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operations and Maintenance Documentation Package: As defined in Section 28 05 00, Common Work Results for Electronic Security.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Installation Supervision: Installation shall be under the direct supervision of a Technician, who shall be always present when Work of this Section is performed at Project site.

**PART 2 - PRODUCTS****2.1 CABLES, CONNECTORS AND MISCELLANEOUS EQUIPMENT**

## A. General:

1. Cable construction, insulation, and jacket shall comply with the requirements for the application for which it is used. Provide type CM or CMG for general use; type CMP for plenum use; and CMR for riser use.
2. Cables and conductors installed in enclosures or raceways underground or in slabs on grade shall be UL listed for use in wet locations.
3. Provide all labor, equipment, materials, and supervision to install, calibrate, adjust, document, and test the total system as required herein and on the drawings.

## B. Power and Grounding Cables:

1. Except as otherwise specified herein, or indicated on the Drawings, grounding conductors shall be insulated. Insulation shall be rated 600 V. Conductors shall be continuous from connector to connector with no splices. Grounding connectors shall be solid bronze, compression type, designed for use intended.
2. Power wiring for the extension of power circuits shall be #12 AWG THWN/THHN or XHHN, 600 V, rated at 194°F.

## C. Alarm Cabling:

1. Two unshielded twisted pair, #22 AWG or larger cable (sized for voltage drop) for cabling between addressable alarm or sensor devices.
2. Unshielded 4-conductor, #20 AWG or larger cable (sized for voltage drop) for cabling to motion detection devices.
3. Unshielded 2-conductor, #20 AWG or larger cable (sized for voltage drop) for cabling to door contacts.
4. Manufacturer: Alpha, Belden, CommScope, West Penn, or Windy City Wire.

## D. RS-232 Cables:

1. Two twisted pairs, #22 AWG, stranded (7x30) tinned copper conductors, each pair individually shielded with aluminum foil-polyester tape to provide 100% shield coverage.
2. Pairs shall be cabled on common axis with #24 AWG, stranded (7x32) tinned copper drain wire.
3. Flame resistance: nonplenum-rated cable shall comply with UL 1581-2001(R2017). Plenum-rated cable shall comply with NFPA 262-2019.

## E. RS-485 Cables:

1. Two unshielded twisted pairs, #22 AWG, stranded (7x30) tinned copper conductors with overall 100% foil shield.
2. Flame resistance: nonplenum-rated cable shall comply with UL 1581-2001(R2017). Plenum-rated cable shall comply with NFPA 262-2019.

## F. Control Cables:

1. Multiconductor, color-coded type, #22 AWG or larger conductors (sized for voltage drop), stranded tinned copper for energy limited control circuits. Multiconductor, color-coded type, #14 AWG or larger conductors (sized for voltage drop), stranded tinned copper for other control circuits.
  2. Flame resistance: nonplenum-rated cable shall comply with UL 1581-2001(R2017). Plenum-rated cable shall comply with NFPA 262-2019.
- G. Access Control Composite Cable:
1. OSDP V2 compliant cable with four separately jacketed cables for Lock Power, Card Reader, Door Contacts, REX under one yellow plenum rated jacket.
    - a) Lock Power: #18 AWG 4-Conductor – stranded bare copper, PVC insulation with a Plenum jacket.
    - b) Card Reader: #22 AWG 2-Pairs – unshielded stranded bare copper, with overall aluminum shield, PVC insulation with a Plenum jacket.
    - c) Door Contacts: #22 AWG 2-Conductor - stranded bare copper, PVC insulation with a Plenum jacket.
    - d) REX/PIR: #22 AWG 2-Conductor - stranded bare copper, PVC insulation with a Plenum jacket.
    - e) Manufacturer: Belden, West Penn, or Windy City Wire.

## 2.2 PATCH PANELS, CONNECTORS AND MISCELLANEOUS EQUIPMENT

- A. Fiber Optic Cabinets:
1. Fiber optic cabinets shall provide cross connect, interconnect, and splicing capabilities and contain troughs for supporting and routing of the fiber cables and jumpers.
  2. Fiber optic cabinets shall consist of a modular enclosure with retainer rings in the slack storage section to limit the bending radius of fibers.
  3. Fiber optic cabinets shall have a window section to insert connector panels for mounting connectorized fibers.
  4. Fiber optic cabinets shall provide terminating capability to accommodate closet terminations and spare requirements.
- B. Patch Cords and Connectors Administration:
1. Fiber Optic Connectors:
    - a) Connectors for fiber patch panel and patch cord connectors shall be LC.
    - b) Fiber optic connectors to multimode fiber shall utilize a field installable epoxy, polish method or hot melt.
    - c) Fiber optic connectors to single-mode fiber shall utilize fusion splices to factory pigtailed.
  2. Fiber Optic Patch Cords:
    - a) Factory assembled and tested to requirements of cable specified herein.
    - b) Minimum bend radius: 1".
    - c) Operating temperature: -4°F to 158°F.

## PART 3 - EXECUTION

### 3.1 CONDUCTORS AND CABLES

## A. General:

1. Cables and conductors installed in enclosures or raceways underground or in slabs on grade shall be UL listed for use in wet locations.
2. Install plenum rated cables where cables are not installed in conduits or enclosed wireways.
3. As a general practice, power cables, and high-level signal cables shall be run on the left side of an equipment rack as viewed from the rear. Other cables shall be run on the right side of an equipment rack, as viewed from the rear.
4. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer.
5. Unused cables shall be dressed at each end in heat-shrink tubing and marked as unused.
6. Heat-shrink tubing shall be used to insulate and dress the ends of outdoor wires and cables, including a separate tube for the ground or drain wire.
7. No cables shall be wired with a polarity reversal between connectors, at either end. Special care shall be taken when wiring to ensure that constant polarity is maintained.
8. Remove abandoned cable and dispose of it.

## B. Fiber Optic Cables:

1. Fiber optic cable shall be used where indicated on the Drawings or where cable lengths between active devices exceed 1000' or in instances where equipment is installed at lightning strike prone locations, such as roofs and exterior light or camera poles.
2. Fiber optic cables shall be visually inspected, and continuity testing shall be performed on each fiber of each cable reel on-site prior to installation to ensure no damage occurred during shipment.
3. The control center end of each fiber optic cable shall be terminated in a fiber enclosure using field-installable LC compatible connectors and fan-out tubing. The field end of each cable shall be terminated directly to the end equipment using the field installable connector type compatible with the end equipment and fan-out tubing. Patch cord jumpers shall be preconnectorized at one end with LC compatible connectors and at the other end with the connector type compatible with the end equipment. Jumpers shall be used to connect the cables terminated at the patch panel in the control center to the end equipment.
4. Each device utilizing fiber optics shall have a dedicated 6 fiber cable.
5. The connector loss for field-installed connectors shall not exceed 0.5 dB for LC compatible connectors.
6. Fiber optic cables shall be installed and terminated in accordance with the manufacturer's recommended procedures.

**3.2 PATCH PANELS, CONNECTORS, AND MISCELLANEOUS EQUIPMENT**

## A. General:

1. Cables shall not be spliced.
2. Terminal blocks, boards, strips, and connectors shall be provided for cables which interface with racks, cabinets, consoles, enclosures, and equipment modules.

## B. Receptacles and Connectors:

1. Unless otherwise specified herein, female type receptacles shall be used for floor, wall, and panel mountings. Male type connectors shall be used for cable mountings.
2. Provide strain relief on connectors.

3. Provide faceplates for receptacles as indicated on the Drawings.
4. Receptacles shall be insulated from the mounting panel, outlet box, or wireway. Unless otherwise specified herein, this shall be accomplished by using insulated-from-panel type receptacles.
5. Provide blank coverplates for boxes intended for future use, unless otherwise indicated on the Drawings.
6. Insulate cables from receptacle faceplates.

### 3.3 IDENTIFICATION

- A. Identification shall consist of upper-case letters.
- B. Cables, regardless of length, shall be marked with preprinted, wrap-around number or letter cable markers at both ends. Markers shall be permanently affixed with heat-shrink tubing. There shall be no unmarked cables at any place in the system. Marking codes used on cables shall be indicated on the record drawings.

### 3.4 FIELD QUALITY CONTROL:

- A. Tests and Inspections:
  - B. General:
    1. Applies to fiber optic cables.
    2. Testing shall be accomplished using an Agilent Technologies, Fluke Networks, or Ideal Industries test instrument supporting an extended frequency range to 250 MHz.
    3. Test 100% of the cabling links.
    4. The tester shall support the following requirements:
    5. Input the test results into the test instrument manufacturer's reporting software. Tabulate and analyze results to ensure cabling system meets requirements specified herein.
    6. Document failed strands. Replace cable, then retest. Repeat procedure until cable passes requirements.
    7. Upon completion provide a PDF copy of the test reports for review and approval.
    8. A representative of the Owner shall be invited to witness the field testing. The representative shall be notified of the start date of the testing phase at least 5 business days before testing commences.
  - C. Optical Fiber Testing:
    1. Each fiber optic cabling link in the installation shall be tested in accordance with ANSI/TIA 568.1D-2016.
    2. Each fiber optic cabling link shall be tested bi-directionally.
    3. The test equipment for multimode fiber cabling shall meet the requirements of TIA 526-14-C-2015. Test equipment for single-mode fiber cabling shall meet the requirements of TIA 526-7-2015.
    4. A pass or fail condition shall not be valid if the test equipment has not been set-up and configured according to the manufacturer's instructions and requirements. The test equipment's reference values shall be within the manufacturer's recommended values.
    5. Fiber optic launch cables, patch cables, and adapters shall be of high quality and shall not show excessive wear resulting from repetitive coiling and storing of the test equipment interface adapters. The fiber optic launch cables, patch cables, test cords, and adapters shall be of the same manufacturer as the test equipment or the manufacturer

providing the channel warranty. The test cords for OLTS testing shall be between 36" and 180" in length. The test cords for OTDR testing shall be approximately 500 m for single mode and 80 m for multimode for the launch cable and at least 82' for the receive cable.

6. The pass or fail condition for the link-under-test shall be determined by the results of the required individual tests. A pass or fail result for each parameter shall be determined by comparing the measured values with the test limit specified herein for that parameter. Results indicated as marginal pass as defined by the test equipment manufacturer shall be deemed as failures.

D. Optical Loss Testing:

1. The insertion loss shall be calculated by the following formulae defined in ANSI/TIA 568.1D-2016 using the following values:
2. Insertion loss = Cable attenuation + Connector attenuation + Splice attenuation.
  - a) Cable attenuation (dB) = Attenuation coefficient (dB/km) x Length (km).
  - b) Connector attenuation (dB) = Number of connector pairs x Connector loss (dB).
  - c) Maximum allowable connector loss = 0.5 dB.
  - d) Splice attenuation (dB) = Number of splices (S) x Splice loss (dB).
  - e) Maximum allowable splice loss = 0.15 dB.
3. The above specified link test attenuation limits are based on the use of the One Reference Jumper Method described in TIA 526-14-C-2015, Method B and TIA 526-7-2015, Method A-1.
4. Link attenuation shall not include any active devices or passive devices other than cable, connectors, and splices.
5. Cable test results with negative loss values shall be deemed invalid. Fiber terminations shall be cleaned, evaluated, and retested until the results contain no negative loss values at no additional cost to the Owner. Verify that the cable test results are valid.
6. Multimode horizontal links: acceptable insertion loss for a multimode horizontal fiber optic cabling system is based on the maximum 295' distance. Horizontal fiber optic cabling link segments shall be tested at 850 nm and 1300 nm in accordance with TIA 526-14-C-2015, Method B, One Reference Jumper. Horizontal links may be tested using a fixed upper limit for attenuation of 2.0 dB. This value includes the loss of two connector pairs, one pair at the communications outlet/connector and one pair at the horizontal cross-connect, plus 295' of fiber optic cable.
7. Multimode backbone links shall be tested bidirectionally at both 850 nm and 1300 nm in accordance with TIA 526-14-C-2015.
8. Link attenuation shall be based upon the use of a light source categorized by an Encircled Flux (EF) per Annex E of TIA 526-14-C-2015 utilizing one reference jumper per Annex A.
9. Links designed to be used with network applications that use laser light sources (underfilled launch conditions) shall be tested with test equipment based on laser light sources.
10. For Gigabit Ethernet compliant certification (IEEE 802.3-2015/ COR1 2017 application), use test equipment which uses a vertical cavity surface emitting laser at 850 nm (compliant with 1000BASE-SX) and an FP laser at 1320 nm (compliant with 1000BASE-LX).
11. Single-mode backbone links shall be tested bidirectionally at both 1310 nm and 1550 nm in accordance with TIA 526-7-2015, Method A.1, One Reference Jumper. Single-

mode links shall be certified with test tools using laser light sources at 1310 nm and 1550 nm.

E. Tests and Inspection Reports:

1. Cable test reports.

**END OF SECTION 28 05 13**