SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Multimode optical-fiber cabling.
   2. UTP cabling.
   3. RS-485 cabling.
   4. Low-voltage control cabling.
   5. Control-circuit conductors.
   6. Identification products.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Source quality-control reports.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PERFORMANCE REQUIREMENTS

A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
   1. Flame Travel Distance: 60 inches or less.
   2. Peak Optical Smoke Density: 0.5 or less.
   3. Average Optical Smoke Density: 0.15 or less.

B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
2.3 BACKBOARDS

A. Description: Plywood, [fire-retardant treated,] 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

B. Painting: Paint plywood on all sides and edges with [flat] [eggshell] [black] <Insert color> [latex] [alkyd] paint. Comply with requirements in Section 099123 "Interior Painting."

2.4 OPTICAL-FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Belden Inc.
   2. CommScope, Inc.
   3. Corning Incorporated.
   4. Emerson Connectivity Solutions.
   5. General Cable Technologies Corporation.
   6. Mohawk; a division of Belden Inc.
   7. Nexans; Berk-Tek Products.
   8. Siemon Company (The).
   9. Superior Essex Inc.
   10. SYSTIMAX Solutions; a CommScope, Inc. brand.
   11. 3M.
   12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

C. Description: Multimode, [50/125] [62.5/125]-micrometer,[24]-fiber, nonconductive, tight-buffer, optical-fiber cable.
   1. Comply with ICEA S-83-596 for mechanical properties.
   2. Comply with TIA-568-C.3 for performance specifications.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
      a. Plenum Rated, Nonconductive: [Type OFNP, complying with NFPA 262] [Type OFNP in listed plenum communications raceway] installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
      b. Riser Rated, Nonconductive: [Type OFNR or Type OFNP complying with UL 1666] [Type OFNP or Type OFNR in listed riser or plenum communications raceway].
      c. General Purpose, Nonconductive: [Type OFNG or Type OFNP] [Type OFNG, Type OFNP, or Type OFNR in listed communications raceway].
      d. Plenum Rated, Conductive: [Type OFCP complying with NFPA 262] [Type OFCP in listed plenum communications raceway].
e. Riser Rated, Conductive: [Type OFCR or Type OFCP complying with UL 1666] [and ICEA S-103-701] [Type OFCP or Type OFCR in listed riser or plenum communications raceway].

f. General Purpose, Conductive: [Type OFCG or Type OFCP] [Type OFCG or Type OFCP in listed communications raceway].

5. Conductive cable shall be [steel] [aluminum]- armored type.

6. Maximum Attenuation: \[3.5\] <Insert number> dB/km at 850 nm; \[1.5\] <Insert number> dB/km at 1300 nm.

7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

D. Jacket:
1. Jacket Color: [Aqua for 50/125] [Orange for 62.5/125]-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.5 OPTICAL-FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. ADC
3. Belden Inc.
5. Dynacom Inc.
7. Molex Premise Networks; a division of Molex, Inc.
8. Panduit Corp.
9. Siemens.

B. Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Cable Connecting Hardware:
2. Quick-connect, simplex and duplex, [Type SC] [Type ST] connectors. Insertion loss of not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.
2.6 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. ADC.
   2. Alpha Wire Company; a division of Belden Inc.
   3. Belden Inc.
   4. CommScope, Inc.
   5. Draka Cableteq USA.
   7. Mohawk; a division of Belden Inc.
   8. Nexans; Berk-Tek Products.
   9. Siemon Company (The).
   10. Superior Essex Inc.
   11. SYSTIMAX Solutions; a CommScope, Inc. brand.
   12. 3M.
   13. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, four-pair UTP[, 24-pair UTP, formed into four-pair binder groups with no overall jacket,][, 25-pair UTP covered with a thermoplastic jacket].
   1. Comply with ICEA S-90-661 for mechanical properties of Category 5e cables.
   2. Comply with ICEA S-102-700 for mechanical properties of Category 6 cables.
   3. Comply with TIA-568-C.1 for performance specifications.
   4. Comply with TIA-568-C.2, [Category 5e] [Category 6] [Category 6A].
   5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with [NEMA WC 66,] [UL 444] [and] NFPA 70 for the following types:
      a. Communications, Plenum Rated: [Type CMP complying with UL 1685.]
         [Type CM or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."]
      b. Communications, Riser Rated: [Type CMP, or Type CMR in listed plenum or riser communications raceway.] [Type CMP or Type CMR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."]
      c. Communications, General Purpose: [Type CM] [Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70].

2.7 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. ADC.
   3. Belden Inc.
   4. Dynacom Inc.
   5. Hubbell Incorporated.
   6. Leviton Commercial Networks Division.
   7. Molex Premise Networks; a division of Molex, Inc.
   8. Panduit Corp.
   9. Siemon Company (The).
  10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

C. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

D. Connecting Blocks: [110-style IDC for Category 5e] [110-style IDC for Category 6]. Provide blocks for the number of cables terminated on the block, plus [25] <Insert number> percent spare. Integral with connector bodies, including plugs and jacks where indicated.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

F. Jacks and Jack Assemblies: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.

G. Patch Cords: Factory-made, four-pair cables in [36-inch] [48-inch] lengths; terminated with eight-position modular plug at each end.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

H. Workstation Outlets: [Two] [Four] -port-connector assemblies mounted in [single] [or] [multigang] faceplate.

I. Faceplates:
   1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
   2. For use with snap-in jacks accommodating any combination of UTP, optical-fiber, and coaxial work area cords.
      a. Flush-mounted jacks, positioning the cord at a 45-degree angle.

J. Legend:
   1. Factory labeled by silk-screening or engraving.
2.8 TWIN-AXIAL DATA HIGHWAY CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Paired, <insert number> pairs, [No. 20] [No. 22] [No. 24] AWG, stranded [(7x28)] [(7x30)] [(7x32)] tinned-copper conductors.
   2. Plastic insulation.
   3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
   5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.

2.9 RS-485 CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Paired, [one pair] [two pairs], No. 22 AWG, stranded (7x30) tinned-copper conductors.
   2. Fluorinated ethylene propylene insulation.
   3. Unshielded.
   4. Fluorinated ethylene propylene jacket.

2.10 LOW-VOLTAGE CONTROL CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
   1. [One ][Multi-]pair, twisted, [No. 16 AWG, stranded (19x29)] [No. 18 AWG, stranded (19x30)] tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with NFPA 262.

2.11 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, [Type THHN-2-THWN-2] [Type XHHW-2],
   in raceway, complying with [UL 44] [UL 83].

B. Class 2 Control Circuits: Stranded copper, [Type THHN-2-THWN-2, in raceway] [Type XHHW-2, in raceway], complying with [UL 44] [UL 83].

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, [Type THHN-2-THWN-2, in raceway] [Type XHHW-2, in raceway] [Type TW or Type TF, in raceway],
   complying with [UL 44] [UL 83].

D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
   1. Smoke control signaling and control circuits.
2. <Insert list of critical circuits that require CI cable>.

2.12 SOURCE QUALITY CONTROL

A. Factory test UTP cables according to TIA-568-C.2.
B. Factory test optical-fiber cables according to TIA-568-C.3.
C. Cable will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.
   1. Test optical-fiber cable to determine the continuity of the strand end to end. Use [optical-fiber flashlight] [optical loss test set] [optical-fiber flashlight or optical loss test set] <Insert test>.
   2. Test each pair of UTP cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
   1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
   2. Outlet boxes for optical-fiber cables shall be no smaller than 4 inches square by [1-1/2 inches] [2-1/8 inches] deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
   3. Flexible metal conduit shall not be used.

B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:
   1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
   2. Install cable trays to route cables if conduits cannot be located in these positions.
   3. Secure conduits to backboard if entering the room from overhead.
   5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. General Requirements for Cabling:
   2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems."
   3. Terminate all conductors and optical fibers; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and patch panels.
   4. Cables may not be spliced.
   5. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems."
   7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   10. Support: Do not allow cables to lie on removable ceiling tiles.
   11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.

C. UTP Cable Installation:
   2. Install termination hardware as specified in Section 271500 "Communications Horizontal Cabling" unless otherwise indicated.
   3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Optical-Fiber Cable Installation:
   2. Terminate cable on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than [30 inches] <Insert dimension> apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:
   1. Install plenum-rated cable only.
   2. Install cabling after the flooring system has been installed in raised floor areas.
   3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil.

G. Separation from EMI Sources:
   1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.

3.4 REMOVAL OF CONDUCTORS AND CABLES
A. Remove abandoned conductors and cables. Abandoned are those installed that are not terminated at equipment and are not identified for future use with a tag.

3.5 CONTROL-CIRCUIT CONDUCTORS
A. Minimum Conductor Sizes:
   1. Class 1 remote-control and signal circuits; No 14 AWG.
   2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING
A. Comply with requirements in Section 078413 "Penetration Firestopping."
B. Comply with TIA-569-B, Annex A, "Firestopping."
C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING
A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION
A. Comply with identification requirements in Section 260553 "Identification for Electrical Systems."
B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections[ with the assistance of a factory-authorized service representative]:

1. Visually inspect UTP and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross-connection.
   a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical-Fiber Cable Tests:
   a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   b. Link End-to-End Attenuation Tests:
      1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      2) Attenuation test results for links shall be less than 2.0 dB.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling is considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION