

## Section 27 15 00 – COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
1. Horizontal twisted pair cabling.
  2. Telecommunication testing.

#### 1.2 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
1. Federal Communications Commission (FCC) Regulations: FCC Part 15; Radio Frequency Devices & Radiation Limits. FCC Part 68; Connection of Terminal Equipment to the Telephone Network.
  2. Electronics Industries Alliance (EIA): EIA; Testing Standards.
  3. American National Standards Institute, Inc. (ANSI) / Telecommunications Industry Association (TIA) / Electronics Industries Alliance (EIA):

ANSI/TIA/EIA-568-C; Commercial Building Telecommunications Cabling Standards, including the following:

- Part 1: General Requirements.
- Part 2: Balanced Twisted-Pair Cabling Components.
- Part 2, Addendum 1: Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cable.
- TIA SP 3-4426 (12/28/06 or latest version): Transmission Performance Specifications for 4-Pair 100 Ohm Augmented Category 6 Cable (to be published as TIA-568-C.2-10).

ANSI/TIA/EIA-569-A; Commercial Building Standard for Telecommunications Pathways and Spaces, including the following:

- TIA/EIA-569-A-1: Perimeter Pathway Addendum.
- TIA/EIA-569-A-2: Furniture Pathway Fill Addendum.
- TIA/EIA-569-A-3: Access Floors.
- TIA/EIA-569-A-4: Poke-Thru Devices.
- TIA/EIA-569-A-6: Multi-Tenant Pathway and Spaces.
- TIA/EIA-569-A-7: Cable Trays and Wireways. ANSI/TIA/EIA-

598-B; Optical Fiber Cable Color Coding.

ANSI/TIA/EIA-606-A; Administration Standard for Commercial Telecommunications Infrastructure.

ANSI/J-STD-607-A; Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

ANSI/TIA/EIA-758; Customer-Owner Outside Plant Telecommunications Cabling Standard (TIA/EIA-758-1: Addendum No. 1).

TIA TSB-155; Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBase-T

4. Building Industry Consulting Service International, Inc. (BICSI):
  - BICSI (TDMM); Telecommunication Distribution Methods Manual.
  - BICSI; Customer-Owner Outside Plant Design Manual.
  - BICSI (WDRM); Wireless Design Reference Manual
  - BICSI (NDRM); Network Design Reference Manual.
5. Insulated Cable Engineers Association (ICEA):
  - ICEA S-80-576-2002; Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems.
  - ICEA S-83-596-1994; Fiber Optic Premises Distribution Cable.
  - ICEA S-87-640-1999; Fiber Optic Outside Plant Communications Cable.
  - ICEA S-90-661-2002; Category 3, 5 & 5e Individually Unshielded Twisted Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems.
  - ICEA S-104-696-2001; Standard for Indoor-Outdoor Optical Cable.
6. Underwriters Laboratories, Inc. (UL):
  - UL 444; Communication Cables.
  - UL 497; Protectors for Paired-Conductor Communication Circuits.
  - UL 1651; Optical Fiber Cable. UL 1690; Data-Processing Cable.
  - UL 1963; Communications-Circuit Accessories.
  - UL 2024A; Optical Fiber Cable Routing Assemblies.

### 1.3 DEFINITIONS

- A. Above finish floor (AFF) - Standard mounting height (e.g., 18 inch AFF) for a device using the center line of the device as the measurement point.
- B. Administration - The methodology defining the documentation requirements of a cabling system and its containment, the labeling of functional elements and the process by which moves, additions, and changes are recorded.
- C. ANSI/TIA/EIA - Associations involved in developing telecommunications industry standards.
- D. Attenuation - The decrease in magnitude of transmission signal strength between points, expressed in dB as the ratio of output to input signal level.
- E. Attenuation-to-crosstalk ratio (ACR) - The ratio obtained by subtracting insertion loss (attenuation [dB]) from near-end crosstalk (dB). ACR is normally stated at a given frequency.
- F. Auditory assistance device - An intentional radiator used to provide auditory assistance to a handicapped person or persons. Such a device may be used for

- auricular training in an educational institution, for auditory assistance at places of public gatherings, such as a church, theater, or auditorium, and for auditory assistance to handicapped individuals, only, in other locations.
- G. Backboard - Backboard generally refers to the 3/4" A-C grade plywood sheeting, lining the walls of the telecommunications room. Plywood shall be void-free, with two coats of fire retardant paint matching the painted interior walls covering both sides.
- H. Backbone - A facility (e.g., pathway, cable, or conductors) between any of the following spaces: telecommunications rooms, common telecommunications rooms, floor-serving terminals, entrance facilities, equipment rooms, and common equipment rooms.
- I. Basic link test configuration - Horizontal cable of up to 90m (295 ft.) plus up to 2m (6.5 ft.) of test equipment cord from the main unit of the tester to the local connection, and up to 2m (6.5 ft.) of test equipment cord from the remote connection to the remote unit of the tester. Maximum length is 94 m (308 ft.).
- J. Bonding Conductor (BC) - A conductor used specifically for the purpose of bonding.
- K. Cable Labeling System –
1. The scheme employed when identifying cable or its associated hardware.
  2. Scheme adapted for labeling cables to identify them based on ANSI/TIA/ EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure. See administration.
- L. Cable Runway - Hardware designed and manufactured for horizontal pathway distribution of cable and inside wiring inside the MC, IC, or TR rooms.
- M. CAT - Category used when identifying the performance characteristics of twisted pair cabling.
- N. Ceiling Distribution System - A distribution system that utilizes the space between a suspended or false ceiling and the structural surface above.
- O. Closed-Circuit Television (CCTV) - A private television system, typically used for security purposes, in which the signal is transmitted to a limited number of receivers.
- P. Communications plenum cable (CMP) - Type CMP communications plenum cable shall be listed as being suitable for use in ducts, plenums, and other spaces used for environmental air and shall also be listed as having adequate fire-resistant and low smoke-producing characteristics. (NEC)Cables must pass required test for fire and smoke characteristics of wires and cables, NFPA 262 or UL 910.
- Q. Communications Riser Cable (CMR) - Type CMR communications riser cable shall be listed as being suitable for use in a vertical run in a shaft or from floor to floor and shall also be listed as having fire-resistant characteristics capable of preventing the carrying of fire from floor to floor. (NEC) Cables must pass requirements for flame propagation.
- R. Electromagnetic Interference (EMI) - Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment or signal transmissions.
- S. Entrance Conduit - Conduit that connects the campus underground infrastructure with the building's Telecommunications Room.
- T. Fire Retardant - Any substance added to delay the start or ignition of fire or slow the spread of the flame of any material.
- U. Fire stopping - The process of installing [specialty] listed fire-rated materials into penetrations of fire-rated barriers to reestablish the fire-resistance rating of the

- barrier.
- V. Fire stopping Location. A penetration through a fire-rated wall with a sleeve.
  - W. Firestop System - A specific installation consisting of the material(s) (firestop penetration seals) that fill the opening in the wall or floor assembly, and around and between any items that penetrate the wall or floor (e.g., cables, cable trays, conduit, ducts, pipes), and any termination devices (e.g., electrical outlet boxes) along with their means of support.
  - X. Grounding Conductor - A conductor used to connect the grounding electrode to the buildings main grounding busbar.
  - Y. Grounding System - A system of hardware and wiring that provides an electrical path from a specified location to an earth ground point.
  - Z. Horizontal Cabling - The part of the cabling system that extends from the work area telecommunications outlet to the horizontal cross-connect in the telecommunications room.
  - AA. Hybrid Cable - An assembly of two or more cables, of the same or different types or categories, covered by one overall sheath.
  - BB. Infrastructure (Telecommunications) - A collection of those telecommunications components, excluding equipment, that together provide the basic support for the distribution of all information within a building or campus.
  - CC. Intermediate Cross-connect (IC) - the connection point between a backbone cable that extends from the main cross-connect and the backbone cable from the horizontal cross-connect.
  - DD. Loose Tube - A type of optical fiber cable construction where one or more fibers are laid loosely in a tube. Also called loose tube fiber.
  - EE. Main Cross-connect (MC) - The cross-connect normally located in the Telecommunications Equipment Room for cross-connection and interconnection of entrance cables, first-level backbone cables, and equipment cables.
  - FF. Metropolitan Area Network (MAN) - A data communications network that covers an area larger than a campus area and smaller than a wide area network. Typically interconnects two or more LANs and usually covers an entire metropolitan area.
  - GG. MPOE - Minimum Point of Entry, Utility Partnerships/Alternate Carrier, usually located within the Telecommunications Room.
  - HH. Multimode Fiber (MMF) - An optical fiber that carries many paths of light or an optical waveguide that allows many bound modes to propagate.
  - II. Single-mode Fiber (SMF) - An optical fiber, usually step-index grade, which supports only one mode of light propagation. This does not necessarily imply single wavelength operation. The light source is normally a laser.
  - JJ. Strand (STR) - A single unit of optical fiber within a cable (e.g., a 12-strand fiber cable has 12 individual optical fibers within the cable sheath).
  - KK. Telecommunications Entrance Facility - Utility Partnerships/Alternate Carrier Minimum Point of Entry that is usually located within the Main Cross-connect Room (MC).
  - LL. Telecommunications Equipment Room (TER) - A centralized space that provides space and maintains a suitable operating environment for the termination of backbone and campus cabling and house centralized communications and/ or computer equipment (such as Core

Switches and Servers). *Note:* An equipment room is considered distinct from a telecommunications closet because of the nature or complexity of the equipment housed by the equipment room.

MM. Telecommunications Main Grounding Busbar (TMGB) - A grounding busbar, located in the MC, connected to the main building ground electrode by a continuous 2/0 - #4 AWG wire (Wire size is dependant on the distance between the busbar and the building main).

NN. Telecommunications Room (TR) – A room dedicated to housing a group of telecommunications connectors (e.g., patch panel or punch-down block) that allows equipment and backbone cabling to be cross connected with patch cords or jumpers.

OO. Underwriters Laboratories (UL) - A United States-based independent testing laboratory that sets safety tests and standards.

PP. Uninterruptible Power Supply (UPS) - A device that is inserted between a primary power source (e.g., a commercial utility) and the primary power input of equipment to be protected (e.g., a computer system) to eliminate the effects of transient variances or temporary voltages. Retain acronyms, abbreviations, and terms that remain after this Section has been edited.

#### **1.4 SYSTEM DESCRIPTION**

A. Provide a complete telecommunication cabling system installation as specified herein and as shown on the Drawings. In general, system shall include, but not be limited to, the following:

1. Horizontal twisted pair cabling:

a. Horizontal twisted pair cables shall route between the TR and workstation outlets, and shall consist of Category 6, and small diameter Category 6A, 4-pair, UTP, riser rated copper cables.

b. Horizontal twisted pair cable will support communication devices such as but not limited to the following:

- 1) Wireless Access Points (small diameter Category 6A)
- 2) Projectors (small diameter Category 6A)
- 3) IP intercom/paging network interface box (Category 6)
- 4) Workstations, VoIP phones, printers, etc. (Category 6)

c. Horizontal twisted pair cables shall terminate on back of rack mounted, Category 6, and Category 6A, 48-port, 19" wide patch panels with modular 8-pin connector front for interface.

d. Wire management shall be provided above and below, 1 RU, for each 48-port patch panel.

e. Copper jack standard is Category 6, or Category 6A, RJ-45 modular connectors at patch panels and workstation outlets.

2. Patch cords:

a. UTP patch cords shall match the physical and performance criteria of the specified horizontal twisted pair cable and be terminated at each end with 8-postion modular plugs.

b. Patch cords shall be furnished in varying lengths as required.

c. Patch cord quantities shall match the following:

- 1) Two patch cords for each category 6/6A data cable installed. This includes one standard line cord at the work station and one patch cord at the equipment room.

3. Wireless Access Point Outlets

a. WAP telecommunication outlets shall consist of the following, unless otherwise noted on the Drawings:

- 1) One horizontal small diameter Category 6A twisted pair cable(s) per outlet.
- 2) Single -gang cover plate with 2-ports when wall mounted.
- 3) Gang box mounted above tile with faceplate below tile when installed at accessible ceiling.
- 4) RJ-45 connector modular jacks for twisted pair terminations.
- 5) Blanks as required.

B. Refer to Drawings for complete documentation of above requirements and all additional requirements.

**1.5 SUBMITTALS**

A. Submit in accordance with the requirements Basic Communications Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
2. Describe system operation, equipment, dimensions and indicate features of each component.
3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
4. Shop Drawings prepare in AutoCAD Release 2012 or later, to include the following:
  - a. Building floor plans showing location of all outlets, raceways, conduits and cable routing to each device at same scale as construction documents. Base site / floor plan drawings will be provided.
5. Use industry standard symbols.
6. Complete bill of materials listing all components.
7. Warranty.

B. Installer's qualifications: Furnish satisfactory proof of required experience specified herein for system installer.

1. The installing contractor shall be certified by the manufacturer for the product installed to provide a manufacturer's product and application warranty.
2. Technicians shall be certified by the manufacturer of the system components installed per the manufacturer's requirements to provide a certified structured cabling system.

C. Record Drawings:

1. Furnish Record Drawings. These Drawings shall include but not be limited to the following:
  - a. Plot plans and building floor plans, showing point-to-point wiring location of all devices.

- b. Block Diagram/Riser Diagram showing the system components and all conduit and wire type/sizes between each.

#### **1.6 OPERATION AND MAINTENANCE MANUAL**

A. Supply operation and maintenance manuals, to include the following:

1. Pictorial parts list and part numbers.
2. Schematic wiring diagrams.
3. Telephone numbers for the authorized parts and service distributor.
4. Final testing reports.

#### **1.7 QUALITY ASSURANCE**

A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.

B. Only products and applications listed in this section may be used on the Project unless otherwise submitted.

C. Manufacturer qualifications: Manufacturer must have a minimum 5 continuous years of experience in design and manufacturing of the materials and equipment specified herein.

D. Installer's qualifications:

1. Installer must have a minimum 5 continuous years of experience in satisfactory completion for Projects similar in scope and cost. Provide backup information on 5 such Projects.
2. Installer shall possess a current, active and valid C7 or C10 California State Contractors License.
3. The installer shall be the Manufacturer's certified reseller/installer of the telecommunication equipment/cable system provided. The certification shall have been completed 60 days prior to project bid date. Provide evidence of this certification.

#### **1.8 PRODUCT DELIVERY, STORAGE AND HANDLING**

A. Delivery: Telecommunication system components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipping shall be replaced and returned to Manufacturer at no cost to Owner.

B. Storage: Store in clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic.

C. Handling: Handle in accordance with Manufacturer's written instructions. Damaged materials shall not be installed. Replace damaged materials and return to Distributor / Manufacturer.

#### **1.9 WARRANTY**

A. Materials offered under this Section shall be covered by a 20 year product and application warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall be provided from the component manufacturer and shall name the owner on the warranty certificate. Warranty shall begin upon acceptance by the Owner.

- B. Contractor shall provide required drawings, test results, application and any other items required by the manufacturer to produce the required warranty.

### **1.10 MAINTENANCE**

A. Maintenance services:

1. Distributor of the major system components shall maintain a replacement parts department and provide testing equipment when needed. A complete parts department shall be located close enough to supply replacement parts within a 4 hour period.
2. Service must be rendered within 4 hours of system failure notification.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

A. Furnish products by the following Manufacturers; All components shall be from the same manufacturer system and offer minimum 20 year manufacturer system warranty.

1. Fiber Optic Cable, terminations, and patch cord cable:
  - a. PanGen Structured Cabling Solutions;
  - b. Commscope Systemax
  - c. TE Connectivity / AMP-NetConnect
  - d. BerkTek Leviton
2. Horizontal twisted pair and modular patch cord cable:
  - a. PanGen Structured Cabling Solutions;
  - b. Commscope Systemax
  - c. TE Connectivity / AMP-NetConnect
  - d. BerkTek Leviton
3. Horizontal twisted pair modular patch cord terminations and modular patch panels:
  - a. PanGen Structured Cabling Solutions;
  - b. Commscope Systemax
  - c. TE Connectivity / AMP-NetConnect
  - d. BerkTek Leviton
4. Test equipment:
  - a. Corning Cable Systems
  - b. Fluke Networks.
  - c. Agilent Technologies WireScope 350 Test Set.
  - d. Laser Precision.
  - e. Tektronix.

### **2.2 HORIZONTAL TWISTED PAIR CABLING**

A. Horizontal cables:

1. Application:



- a. Suitable for indoor installations, exposed within equipment rooms, above suspended ceilings and below raised floors in cable trays, hangers or on deck, or within walls. If space is used as an air plenum, cable shall either be plenum rated or installed in EMT conduit.
- b. Each cable run shall be continuous single cable, homogenous in nature, without splices.
- c. Cables shall meet CAT6 performance criteria for Category 6 cables, and CAT6A performance criteria for small diameter Category 6A cables.
- d. Cables shall be CMR or CMP rated as required for rating of space.

2. Conductors:

- a. Insulated conductors: Eight #23 AWG, solid copper wire insulated with FEP for plenum applications or thermoplastic polyethylene or high-density polyolefin for non-plenum rated applications.
- b. Twisted pairs: Two insulated conductors twisted together to form a pair and four such paired cables to form a unit with individually color-coded pairs to conform to industry standards (ANSI/ICEA Publication S-80-576-1994 and EIA-230).

3. Cable sheath:

- a. Outer jacket: Seamless outer jacket, flame-retardant PVC, applied to and completely covering the internal components (twisted pairs).
- b. Flame rating: CMP according to NEC Article 800, tested to NFPA 262 and UL Listed as such.

4. Electrical performance: Meet or exceed TIA/EIA-568-C.2 Enhanced and ISO 11801 Class E specifications for CAT6e / CAT6A UTP cabling.

5. Manufacturer:

- a. PanGen, General Cable
  - 1) GenSpeed 6000 CAT6 -CMR (Blue)
  - 2) GenSpeed 10MTP CAT6A - CMR (Orange)
- b. CommScope Systimax
  - 1) GigaSPEED XL CAT6 -CMR (Blue)
  - 2) GigaSPEED X10 D 91B series CAT6A - CMR (Orange)
- c. BerkTek Leviton
  - 1) LANmark CX CAT6 - CMR (Blue)
  - 2) LANmark XTP CAT6A - CMR (Orange)

B. Modular patch cords:

- 1. Application: Suitable for indoor installations within equipment rooms or workstation environments.
- 2. Cords assembled from a single, continuous length of cordage, homogenous in nature and terminated at both ends via 8-position modular plugs. Splices are not permitted anywhere.
- 3. Cordage:
  - a. Insulated conductors: Eight #23 AWG, solid copper wire insulated with thermoplastic polyethylene or high-density polyolefin for non-plenum rated applications.

- b. Twisted pairs: Two insulated conductors twisted together to form a pair and four such paired cables to form a unit with individually color-coded pairs to conform to industry standards (ANSI/ICEA Publication S-80-576-1994 and EIA-230).
- 4. Cable sheath:
  - a. Outer jacket: Seamless outer jacket, flame-retardant PVC, applied to and completely covering the internal components (twisted pairs).
  - b. Flame rating: CM according to NEC Article 800, tested to UL listed as such.
- 5. Electrical performance: Meet or exceed TIA/EIA-568-C.2 Enhanced and ISO 11801 Class E specifications for CAT6 UTP cabling.
- 6. Manufacturer:
  - a. Panduit
  - b. Part #:
    - 1) Work Station Cords 10' for 70% of total, 20' for 30% of total. Blue
    - 2) Patch Panel Cords 1'.

### **2.3 COPPER DISTRIBUTION PATCH PANELS**

- A. Application: To terminate horizontal distribution cable for data and telephone systems. The patch panels shall match the category of the horizontal cable and be from the same cable manufacturer or matched to the cable manufacturer for maximum warranty as required by the manufacturer.
  - 1. Copper patch panels shall be 19" rack mountable 48 ports per rack mounting unit and shall be no more than two rack mounting units in height.
  - 2. All copper patch panels shall use modular RJ45 jacks.
  - 3. There shall be port identifier label space on the front and shall also include a port identifying number.
  - 4. Manufacturer:
    - a. PanGen Structured Cabling Solutions;
    - b. Commscope Systemax
    - d. BerkTek Leviton

### **2.4 MODULAR CONNECTORS:**

- A. Modular connectors shall be 8-position jacks, compliant to TIA/EIA-568-C.2 Addendum 10, and shall be compatible with the specified cable within this Section, both electrically and physically
- B. Modular connectors shall be T568B wired.
- C. Manufacturer:
  - 1. PanGen Structured Cabling Solutions;
  - 2. Commscope Systemax
  - 3. BerkTek Leviton
- A. Labels:
  - 1. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer or hand-held printer.
  - 2. Labels for horizontal cables:
    - a. Panduit: Wrap around smoke rated labels.
    - b. Fit the horizontal cables specified herein by fully wrapping around the cable jacket.
    - c. Machine printed.

- d. Size: 2" x .05" printable area, minimum.
- e. Color: White.
- B. Miscellaneous components:
  - 1. Velcro cable ties:
    - a. Width: 0.75".
    - b. Color: Velcro cable ties the same color as the cable to which it is applied.
  - 2. Plenum cable ties:
    - a. Suitable for use in plenums or air handling spaces.
    - b. Color: Maroon or other distinctive non-white color.

## 2.6 J-HOOKS

- A. Wide base J-hooks or cable slings mounted above ceiling for cable distribution when outside of conduit and cable tray. Size to not exceed 40% fill.
  - 1. B-Line
  - 2. Caddy Fasteners
  - 3. Mono Systems

## 2.7 CABLE TESTING EQUIPMENT

- A. Twisted pair cabling:
  - 1. Horizontal cable tester:
    - a. Equipment shall meet TIA/EIA-568C.2 Addendum 1 requirements for Level III accuracy, as applicable for cable type specified herein.
    - b. Test standards: ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 100Base-Y, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5.
    - c. Areas of test measurement (minimum):
      - 1) Wire Map.
      - 2) Length.
      - 3) Insertion Loss.
      - 4) The following at both master unit and remote unit:
        - a) Near End Crosstalk (NEXT) loss.
        - b) Power Sum NEXT (PSNEXT) loss.
        - c) Equal Level Far End Crosstalk (ELFEXT).
        - d) Power Sum ELFEXT.
        - e) Return Loss (RL).
        - f) Attenuation-to-Crosstalk Ratio (ACR).
        - g) Power Sum ACR (PSACR).
        - h) Propagation Delay and Delay Skew.
        - i) Characteristic Impedance.
        - j) DC Loop Resistance.

## 2.8 SURFACE MOUNTED RACEWAYS

- A. Panduit or District approved equal. Provide all parts and accessories for a complete system.
  - 1. Raceway shall be LDP210
  - 2. Outlet box shall be 2 gang extra deep divided box
  - 3. Fittings – for use with LDP210; end fitting, entrance end fitting

## 2.9 FIBER OPTIC CABLE

- A. Fiber Optic Cables
  - 1. Manufacturer:
    - a. PanGen, General Cable
      - 1) NextGEN OS2, 6 strand armored - riser
    - b. CommScope Systimax
      - 1) TerraSPEED OS2, 6 strand armored - riser
    - c. BerkTek Leviton
      - 1) Enterprise OS2, 6 strand armored - riser
- B. Fiber Optic Patch Panels
  - 1. Provide panel for maintenance and cross connecting of fiber optic cables.
  - 2. Panel shall be constructed of 0.125-inch minimum aluminum and shall have connectors which interface the inside plant fiber optic jumper cable with the outside plant fiber optic cable.
  - 3. Panels shall be equipped with engraved laminated plastic nameplates above each connector.
  - 4. Rack-mounted fiber patch panels shall be equipped to terminate or splice the incoming inter-building fiber and any required backbone or interconnect cables.
  - 5. Each cable must be properly dressed.
  - 6. These units will terminate the fiber optic cables, provide a place for jumper cables and will provide room to terminate additional optics.
  - 7. Panel shall provide capacity for minimum of 12 fiber optic strands. Larger capacity patch panels shall be determined at site walk.
  - 8. Panel shall be 100% populated with type SC couplers and adapter plates. All connectors and couplers will be type SC.
  - 9. The fiber optic patch panel connections shall provide 0.4 dB or less insertion loss.
  - 10. All patch panels shall be grounded.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of the telecommunication cabling system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.
- B. Verify that pathways and supporting devices are properly and completely installed prior to cable installation.
- C. Verify dimensions of pathways to include length, i.e. “true tape” conduit runs.
- D. Prior to installation, verify that equipment rooms are ready to accept cables and

terminations.

### 3.2 INSTALLATION

A. Horizontal management panels: NOT USED No horizontal wire managers required

1. Provide fasteners and parts required to complete the installation.
2. Accessories: Provide all accessories as required for a complete installation. Include one bag of rack mounting screws, as come packaged with rack product. Attach the screws directly to the rack, which shall constitute turn-over to the Owner.

B. Horizontal twisted pair cabling:

1. Horizontal cable installation and routing:

- a. Cable runs shall have continuous sheath continuity, homogenous in nature with no splicing.
- b. No cabling shall exceed a cable length of 295' (90m) from the termination point at the equipment room to the termination at the workstation outlet, including service slack, when measured using test equipment.
- c. Place cables within the designated pathways, such as cable tray or basket tray, cable runway, cable hangers, etc. Do not fasten, support or attach cables to other building infrastructures (i.e. ducts, pipes, conduits, etc.), other systems (i.e. ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays and non-approved pathway systems.
- d. Place and suspend cables during installation and termination in a manner to protect them from physical damage or interference. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.
- e. Route cables at 90° angles, allowing for bending radius.
- f. Do not exceed pulling tension of 25 lbs.
- g. Do not use cable-pulling compounds.
- h. Do not exceed a minimum bend radius of 6 times the cable diameter during and after installation.
- i. Route cables beneath other building infrastructures (i.e. ducts, pipes, conduits, etc.) in above ceiling applications. Do not route cables over building infrastructures. The installation shall result in easy accessibility to the cables in the future.
- j. Place cables 6" minimum away from power sources to reduce interference from EMI.
- k. Do not set 360° service loops in place for slack storage. Instead, set slack as forward-and-back or as figure eights.
- l. Place a pull string along with cables where run in conduits and spare capacity in conduit remains. Tie off ends of the pull string to prevent the string from falling onto the conduit.
- m. When exiting the primary pathway, such as cable or basket tray, to the workstation outlets, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

2. Cable routing and dressing within equipment rooms:

- a. Within equipment rooms, only use Velcro type straps.
- b. Place cables within the overhead cable support system. When routing vertically on walls, fasten the cables onto vertical supports every 24" on center.

- c. Provide 12" minimum sheath cable slack, length not to exceed permanent link maximum length requirement. Place the slack in the overhead cable support system.
- d. At the rack bay, route and neatly dress cables from the overhead cable support system into the back of the vertical management sections. Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination. Fasten the cables to the cable support bar at the back of the patch panel using approved ties.

3. Termination in the equipment rooms:

- a. Provide termination apparatus and accessories required for a complete installation. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
- b. Properly relieve strain from the cables to and at termination points per manufacturer's instructions. Provide a strain relief bar at the back of the modular patch panels for proper strain relief.
- c. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and TIA/EIA-568-C standard installation practices. Terminate cable pairs onto the termination apparatus compliant to T568A wiring.
- d. Modular patch panels and horizontal management panels:
  - 1) Provide quantity of modular patch panels to support the terminations of cables served from respective MDF / IDF.
  - 2) Install and assemble modular patch panels according to the manufacturer's instructions.
  - 3) Terminate cables in sequential order using the link's identifier starting at the top left and completing a panel before moving to the next panel below.

4. Cable routing and dressing at workstations:

- a. Provide 18" cable slack at each workstation outlet, length not to exceed permanent link maximum length requirement. Place the slack within ceiling space neatly on a cable hanger or other approved cable support device.

5. Termination at the workstation outlets:

- a. Provide device components, connectors, and accessories required for a complete installation. Install and assemble connectors, jacks, adapters, termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
- b. Provide orange connectors for data links and green connectors for wireless data.
- c. Wall mounted standard devices:
  - 1) Install devices at heights indicated on drawings.
  - 2) Mount faceplates plumb, square and at the same level as adjacent power receptacles.
  - 3) Patch gaps around faceplates so that faceplate covers the entire wall opening.
- d. Partition furniture mounted devices:
  - 1) Coordinate installation of the faceplate adapters with the furniture contractor, including color.
  - 2) Mount faceplate adapters into the designated openings for horizontal cables.

- e. Terminate cables and twisted pairs in accordance with the manufacturer's latest installation requirements and TIA/EIA-568-B standard installation practices. Terminate cable pairs onto the connector compliant to T568A wiring.

6. Patching and cross connecting:

- a. In equipment rooms, provide one modular patch cord for each data connector in each workstation outlet. Install from the horizontal termination field to the network switches/equipment. Neatly dress patch cords within the horizontal and vertical cable management components.
- b. At work station, provide one modular patch cord for each cable jack installed in each workstation outlet.

### 3.3 LABELING

A. General requirements:

- 1. Labeling, label colors, and identifier assignments shall conform to EIA/EIA-606-A Administration Standards and as approved by the Owner.
- 2. Provide permanent and machine-generated labels. Hand written labels will not be accepted.
- 3. Modular patch panels:
  - a. Text color shall be black, #10 font size.
  - b. Label installation:
    - 1) Provide labels at each port.
    - 2) Install labels into label window.

B. Horizontal twisted pair labeling:

- 1. Cables:
  - a. Text color shall be black, #10 font size.
  - b. Label installation:
    - 1) Provide labels on both ends of cable.
    - 2) Install labels such that they are visible by technician from a normal stance. 3) Fully wrap label around the cable jacket (self-lamination). 4) Provide one label within 4" of the termination apparatus.
- 2. Modular patch panels:
  - a. Text color shall be black, #10 font size.
  - b. Label installation:
    - 1) Provide labels at each port.
    - 2) Install labels into label window.
- 3. Outlets:
  - a. Text color shall be black, #10 font size.
  - b. Label installation: 1) At faceplates, provide labels above and below jacks. 2) At surface boxes, provide labels on the top of the box.

### 3.4 FIELD QUALITY CONTROL AND TESTING

A. General:

- 1. Calibrate test sets and associated equipment per the manufacturer's instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each

day's testing to ensure proper operation.

2. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the Engineer's discretion, halt testing activity and clean testing equipment, test cords and related apparatus.
3. Permanently record test results electronically within test equipment at the time of testing.

B. Twisted pair testing:

1. Test for UTP cabling as follows:

TESTS FOR CATEGORY 6 CABLING TABLE				
Subsystem	Type	Test	Configuration	Notes
Horizontal	CAT6	Category 6	Permanent Link	Per TIA/EIA-568-C.2

2. Precautions:

- a. Adhere to the equipment manufacturer's instructions during all testing.
- b. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature, approximately 70°F.
- c. Fully charge power sources before each day's testing activity.

3. Horizontal twisted pair testing:

a. Test equipment set-up:

- 1) Set-up the tester to perform a full CAT6 test, as a Permanent Link configuration.
- 2) If the tester has the capability, set the cable type as product specific setting. If not, set as generic CAT6 cable.
- 3) Set the tester to save the full test results (all test points, graphs, etc.).
- 4) Save the test results with associated cable link identifier.
- 5) Calibrate the test set per the manufacturer's instructions.

b. Acceptable test results measurements:

1) Overall test results:

- a) Links which report a Fail, Fail or Pass for any of the individual tests shall result in an overall link fail. All individual test results must result in a Pass to achieve an overall Pass.
- b) Any reconfiguration of link components required as a result of a test Fail, must be re-tested for conformance.
- c) Remove and replace any cabling links failing to meet the criteria described in this Specification, at no cost to the Owner, with cables that prove to meet the minimum requirements.

2) Wire map: Provide continuous pairs and terminate all of the cabling links correctly at both ends, no exceptions taken.

3) Length: Ninety-four meters (308 feet) is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.

4) Insertion loss: The acceptable insertion loss measurements for any



horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-C.2.

- 5) Worst pair-to-pair near end crosstalk (NEXT) loss: The acceptable worst pair-to-pair NEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-C.2.
- 6) Power sum NEXT loss: The acceptable power sum PS-NEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-C.2.
- 7) Worst pair-to-pair ELFEXT and FEXT loss: The acceptable worst pair-to-pair ELFEXT and FEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-C.2.
- 8) Power sum ELFEXT and FEXT loss: The acceptable PS-ELFEXT and PS-FEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-C.2.
- 9) Return loss: The acceptable return loss measurements for any horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-C.2.
- 10) Propagation delay and delay skew: The acceptable propagation delay and delay skew measurements for any horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-C.2.

C. Record documents:

1. Permanently record all test results.
2. Export test results' numerical values to a single Microsoft Excel spreadsheet.
3. Submit test results in a format acceptable to the Owner, Owner's Representative and the Engineer before system acceptance.
4. Cable, fiber and pair identifiers of the test reports shall match the identifiers as labeled in the field, i.e. use the same ID on the cable/termination label as what appears on the test report.
5. Measurements shall carry a precision through one significant decimal place, minimum.
6. Use feet for the units for measurements shown on the print of the test measurements.
7. Print report such that fiber strands of a given cabling link have matching axis scales. The "X" and the "Y" axis shall be the same from report-to-report.
8. The trace of the printed test report shall show the launch cord.
  9. For each fiber optic cable test, report shall contain the following information:
    - a. Project name and address.
    - b. Test company's and Operator's name.
    - c. Date measurements were taken.
    - d. Test equipment type to include model and serial numbers.
    - e. Cable identification number, fiber/strand number and fiber type (i.e. multimode, etc.).
    - f. Measurement direction.
    - g. Set-up parameters (i.e. wavelength, pulse width, refractive index, event threshold, etc.)
    - h. Length of fiber.
    - i. Overall link loss.

- j. Passive link insertion loss testing: 1) Wavelength. 2) Loss measurement.
- k. Pass/Fail
- 10. For each cabling link, include either a schematic graphic or a brief narrative accurately describing the test set-up. The description shall include test/launch cord (with length), expected events (connectors, slices, etc.) with expected distances, etc. This information will eliminate many questions the Engineer will have while reviewing the reports.
- 11. For each twisted pair horizontal cable test, report shall contain the following information:
  - a. Project name and address.
  - b. Test company's and Operator's name.
  - c. Date measurements were taken.
  - d. Test equipment type to include model and serial numbers.
  - e. Cable identification number and pair number.
  - f. Measurement results.
  - g. Pass/Fail

### **3.5 INSPECTION AND ADJUSTMENTS**

- A. Contractor shall inspect all installed Work in conjunction with the General Contractor and develop a "punch list" for all items needing correction. Provide punch list to the Engineer prior to their final walk of Project.
- B. Punch list work and the required remediation shall be performed prior to system final acceptance.
- C. Replace or repair work completed by others that was defaced or destroyed during the installation of the telecommunication cabling system by this contractor.
- D. Make changes to adjust the system to optimum operation for final use. Contractor is responsible for making changes to the system such that any defects in workmanship are correct and all cables and the associated termination hardware passes the minimum test requirements.

### **3.6 CLEANING**

- A. Remove all unused, excess and left over products, to include debris, spills, and installation equipment.
- B. Leave finished work and adjacent surfaces in neat, clean conditions with no evidence of damage.
- C. Legally dispose of debris.
- D. Clean installed products in accordance with manufacturer's instructions prior to final punch list.

### **3.7 TRAINING**

- A. At the completion of all Work, a period of not less than 16 hours shall be allocated by the Contractor for instruction and training for the Owner Representative. The Cabling Contractor will need to describe how the cable from each cover-plate is separated between different patch panels, how cross-connects are made and other basic cable plant management skills.
- B. Contractor shall schedule training with a minimum of 7 days advance notice.

**END OF SECTION 27 15 00**