

## **271519-TC**

### **Horizontal Cabling for Telecommunications Systems**

#### **Related Documents**

The following related sections of the OT standards shall also be applicable to this section.

OT Engineer shall approve all product cut sheets prior to purchasing and installation by contractor. Reference S9 Approved Products.

- S1 Approved Product Request
- S1 Change Request
- S1 Request for Variance
- S1 Resource Allocation Permit
- S2 Introduction
- S3 SOP and Policy
- S4 275116-TC CORE Passenger Communications Paging System
- S4 275118-TC Emergency Communications and Evacuation Paging System
- S5 270000X Telecommunications Systems (Boiler Plate)
- S5 MAA Radio System
- S7 270000-TC Common Work
- S7 270100-TC Systems Cabling
- S7 270101-TC COMCAST Standard
- S7 270526-TC Grounding and Bonding
- S7 270528-TC Hangers and Support
- S7 270553-TC Identification
- S7 270555-TC OT Facility Warning Standard
- S7 271116-TC Cabinets Racks Frame Enclosures
- S7 271119-TC Termination Blocks and Patch Panels
- S7 271313-TC Cable Splicing and Termination
- S7 271323-TC Optical Fiber Splicing and Terminations
- SS7 271525- TC Tenant and Airlines Extended DEMARC
- S7 271543-TC Faceplates and Connectors
- S7 271600-TC Telecommunications Station Equipment
- S7 271601-TC Courtesy Phone Backboard
- S8 E911 PS ALI Standard
- S9 Approved Products

## **Part 1 - General**

### **1.1 Work Included**

- A. Provide all labor, materials, tools and equipment required for the complete installation of work called for in the Construction Documents

### **1.2 Scope of Work**

- A. This document describes the products and execution requirements relating to furnishing and installing Horizontal Cabling. Data Communications Horizontal Cabling is covered under this document.
- B. The Communication Equipment Room shall support a minimum of (4) 4-pair Unshielded Twisted Pair (UTP) Copper Cables to each work area outlet unless otherwise noted for specific locations. The cables shall be installed from the Work Area Outlet to the Telecommunications Room (TR) located on the same floor, and routed to the appropriate rack serving that area and terminated as specified in this document.
- C. This section includes minimum requirements for the following:
  - Copper UTP Cable
  - Fiber Cable
- D. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the telecommunications contractor as detailed in this document.
- E. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

### 1.3 Regulatory References

- A. The following industry standards are the basis for the structured cabling system described in this document.

#### TIA/EIA

TIA/EIA-568-B Cabling	Commercial Building Telecommunications Standard
TIA/EIA-569-A Pathways	Commercial Building Standard for Telecom and Spaces
TIA/EIA-606 Telecommunications	Administration Standard for the Infrastructure of Commercial Buildings
TIA/EIA-607	Commercial Building Grounding/Bonding Requirements

#### NFPA

NFPA-70	National Electric Code (NEC)-1999
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#### ISO/IEC

ISO/IEC 11801	Generic Cabling for Customer Premises
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- B. The most recent versions of all documents shall apply to this project. If there is a conflict between applicable documents, the order above shall dictate the order of precedence in resolving the issue unless an enforceable local or national code is in effect.

## Part 2 - Products

### 2.1 Copper UTP Cable

Recommended design shall include:

- Minimum 2 Four-pair 100 ohm 24 AWG, UTP cable—Category 6 for voice
- Minimum 2 Four-pair 100 ohm, 24/23 AWG, UTP cable—Category 6 for data
- Maximum cable length is 90 meters
- All cable shall meet or exceed the following specifications

The Copper Cable shall be used for the horizontal cabling subsystem. These requirements are for cables of unshielded 24 AWG bare copper

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conductors, insulated with thermoplastic, twisted into pairs and enclosed in a thermoplastic jacket. The finished cable shall meet or exceed the following requirements of ANSI/EIA/TIA-568-B.

All cable shall conform to the requirements for communications circuits defined by the National Electrical Code (Article 800). Cable listed to NEC Article 800-51(a) will be used for "Plenum" installations and carry labeling of CMP. Cable listed to NEC Article 800-51(b) shall be installed in vertical runs penetrating more than one floor and carry the labeling of CMR.

These specifications are for cable that will meet or exceed the requirements of ANSI/TIA/EIA Category 6 Cabling.

All cable shall conform to the requirements for communications circuits defined by the National Electrical Code (Article 800). Cable listed to NEC Article 800-51(a) will be used for "Plenum" installations and carry labeling of CMP. Cable listed to NEC Article 800-51(b) shall be installed in vertical runs penetrating more than one floor and carry the labeling of CMR.

## 2.2 Fiber Cable

When using optical fiber cables, any length of horizontal cables, work area cables, patch cords, and equipment cables is acceptable so long as the total of the combined lengths does not exceed 100m (328 ft). When installing per TSB72, the maximum centralized cable length may not exceed 300m (984 ft.).

ANSI/TIA/EIA-568-B.3 Horizontal fiber cable distribution systems:

- The optical fiber cable shall consist of a minimum of two 62.5/125 $\mu$ m optical fibers enclosed by a protective sheath
- The cable will be capable of supporting applications using a bandwidth in excess of 1 GHz over the 85 m specified for horizontal cabling
- The optical fiber shall be multimode, graded-index with a nominal 62.5/125 $\mu$ m core/cladding diameter
- The mechanical and environmental specification for the optical fiber cable will be in accordance with ANSI/ICEA-S-83-596

### **62.5/125µm optical fiber**

<u>Wavelength (nm)</u>	<u>Maximum Attenuation (dB/km)</u>	<u>Minimum Information Transmission Capacity (MHz•km)</u>
850	3.5	500
1300	1.5	500

## **Part 3 - Execution**

### **3.1 Horizontal Distribution Cable Installation**

Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

Cable raceways shall not be filled greater than the TIA/EIA-569-A maximum fill for the particular raceway type or 40%.

Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

The cable's minimum bend radius and maximum pulling tension shall not be exceeded.

If a J-hook or trapeze system, with approval from OT is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

Horizontal distribution cables shall be bundled in groups of no more than 48 cables. Cable bundle quantities in excess of 24 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does

not obscure any valves, fire alarm conduit, boxes, or other control devices.

Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.

Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

### **3.2 Horizontal Cross Connect Installation**

Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B standard, manufacturer's recommendations and best industry practices.

Pair untwist at the termination shall not exceed 0.5 inch.

Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

Cables shall be neatly bundled not more than 48 cables per and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

The cable jacket shall be maintained as close as possible to the termination point.

Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the

bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

### **3.3 Optical Fiber Termination Hardware**

Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

Each cable shall be individually attached to the respective fiber enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

Each fiber cable shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.

A maximum of 12 strands of fiber shall be spliced in each tray

All spare strands shall be installed into spare splice trays.

### **3.4 Copper Termination Hardware**

Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's recommendations and best industry practice.

Pair untwist at the termination shall not exceed 3.18mm 0.5 inch.

Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.

Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support Velcro ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

### 3.5 Testing and Acceptance

#### A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B, TSB-67 and TSB-155. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards.

#### B. Copper Link Testing

All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a level IV test unit for category 6 or category 6 performance compliance, respectively.

Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.



A level IV or a better test unit is required to verify category 6 performance and must be updated to include the requirements of TSB-155.

The four basic tests required in TSB-67 are:

- Wire Map
- Length
- Attenuation
- NEXT (Near end crosstalk)

Four additional tests are required per TSB-95:

- Return Loss
- ELFEXT Loss
- Propagation Delay
- Delay skew

Two additional tests are required:

- PSNEXT (Power sum near-end crosstalk loss)
- PSELFEXT (Power sum equal level far-end crosstalk loss)

### C. Fiber Testing

1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in an RFP. Testing shall consist of an end-to-end power meter test performed per TIA/EIA-455-53A. The system loss measurements shall be provided at 850 and/or 1300 nanometers for multimode fibers and 1310 and/or 1550 nanometers for single mode fibers. These tests also include continuity checking of each fiber.

For horizontal cabling system using multimode optical fiber, attenuation shall be measured in one direction at either 850 nanometer (nm) or 1300 nm using an LED light source and power meter.

Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for singlemode) in both directions.

Test set-up and performance shall be conducted in accordance with ANSI/TIA/EIA-526-14 Standard, Method B.

Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. **ONLY BASIC LINK TEST IS REQUIRED.** The contractor can optionally install patch cords to

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complete the circuit and then test the entire channel. The test method shall be the same used for the test described above. The values for calculating loss shall be those defined in the ANSI/TIA/EIA Standard.

Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

### **3.6 System Documentation**

- A. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.
- B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase. This is inclusive of all test results and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the Engineer, the telecommunications contractor shall provide copies of the original test results.
- C. MAA/OT may do a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.
- D. Test Results documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version

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and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

- E. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B including applicable TSB's and amendments. The appropriate level IV tester shall be used to verify Category 6 cabling systems.
  
- F. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the telecommunications contractor may furnish this information in electronic form (compact disc). These discs shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable from Microsoft Word or Microsoft Excel.
  
- G. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

- H. The **As-Built** drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner. Numbering, icons, pathways and other drawing conventions are to be assigned their own individual AutoCAD layer.
  
- I. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form. In addition, for all cable runs that pass in or thru a manhole or hand hole, the contractor will provide digital photos of the attached label and entrance in and out of the duct system.