

SECTION 26 90 00

STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 01 01 "Basic Electrical Requirements".
- C. Section 26 05 26 "Grounding and Bonding for Electrical Systems".
- D. Section 26 05 29 "Hangers and Supports for Electrical Systems".
- E. Section 26 05 33 "Raceways and Boxes for Electrical Systems".
- F. Section 26 05 44 "Sleeves and Seals for Electrical Raceways and Cabling".

0.2 SUMMARY

- A. All work under this specification section to be performed by a qualified telecommunications contractor as defined in this section. This includes, but is not limited to, cabling installation, cabling termination, equipment installation, system component labeling, owner coordination, etc. All work performed by a contractor who does not meet the contractor qualifications as defined in this section will be replaced at no expense to the owner.
- B. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling at the building. Backbone and horizontal cabling comprised of copper and fiber cabling, and support systems are covered under this document.
- C. The Horizontal (workstation) Cabling System shall consist of 4-pair Unshielded Twisted Pair (UTP) Copper Cables to each work area outlet as shown on the plans. The cables shall be installed from the Work Area Outlet to the Telecommunications Room location as called for, and routed to the appropriate rack serving that area and terminated as specified in this document.
- 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 or as required for a fully functional system as intended.
- 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. Any/all work called for in this document or the attachment shall be included in the bid price as if called for in both this document and any/all attachments. The successful contractor shall meet or exceed all requirements for the cable system described in this document
- F. Section Includes:

1. Patch cords.
2. Telecommunications outlet assemblies.
3. Horizontal (workstation) cabling and terminations.
4. Cable identification.
5. Cable connecting hardware.
6. Cross-connects.
7. Patch panels.
8. Telecommunications equipment racks, cabinets and enclosures.
9. Optical fiber panels/enclosures, patch panels and terminations.
10. Backbone cabling.
11. Telecommunications mounting elements.
12. Backboards.
13. Copper cable protection units.
14. Grounding.
15. Fire-stopping.

G. Related Requirements:

1. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association (latest edition of applicable sections), all local codes, requirements of authority having jurisdiction, and present manufacturing standards.
2. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
3. All modular jacks, patch cords, patch panels and CAT6A cable performance shall be verified (not just tested) by a third party to be category 6A component and channel compliant.
4. Regulatory References:
 - a. NFPA 70/NEC (latest edition): National Electrical Code.
 - b. ANSI J-STD-607 (latest edition): Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
 - c. TIA/EIA-606 (latest revision): Administration Standard for Telecommunications Infrastructure.
 - d. UL 969 (latest revision): Marking and Labeling Systems.
 - e. NECA 1 (latest edition): Standard Practice of Good Workmanship in Electrical Construction.
 - f. BICSI TDMM (latest edition): Telecommunications Distribution Methods Manual.
 - g. TIA/EIA-569 (latest edition): Commercial Building Standard for Telecommunications Pathways and Spaces.
 - h. TIA/EIA-568 (latest edition): Cabling Standard.
 - i. All other regulatory references noted in this document.
5. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
6. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

H. All cable shall be plenum rated.

- I. Allowances to be included with this bid:
 - 1. See architectural for allowances

0.3 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations and setup necessary to complete the installation of this structured cabling system in compliance with the specifications, drawings and applicable codes/regulatory references. The Telecommunications contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish and install a complete telecommunications wiring infrastructure.
 - 2. Furnish, install, and terminate ALL UTP (both ends) and Optical Fiber cable (all pairs, both ends) and Coaxial cable (both ends).
 - 3. Furnish and install all work area patch cords, wall plates, jacks, cables, patch panels and equipment room patch cords.
 - 4. Furnish and install all required cabinets and/or racks and/or enclosures as required or as indicated.
 - 5. Perform link or channel testing (100% of horizontal and/or backbone links/channels) and certification of all components.
 - 6. Furnish test results of all cabling to the owner in electronic (searchable PDF file) and paper format, listed by each closet, then by workstation ID with the close-out documents.
 - 7. Adhere and comply with all requirements of connectivity and cabling manufacturer Certification programs.
 - 8. Provide owner training and documentation.
 - 9. Coordinate with the owner and the engineer for the required telecom room and equipment identification, conduit routes and identifications, cable identification (at the rack and at the work area). Provide and install labeling for all cables using the labeling method detailed on the drawings.
 - 10. Furnish any other material required to form a complete system.

0.4 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local Area Network.
- C. CLAN: Campus Local Area Network.
- D. RCDD: Registered Communications Distribution Designer.
- E. EF: Entrance facility.
- F. ER: Equipment Room.
- G. CMDF: Campus Main Distribution Frame(s).
- H. MDF: Facility Main Distribution Frame. May include the Entrance Facility equipment and/or the Equipment Room equipment.

- I. IDF: Intermediate Distribution Frame.
- J. EMI: Electromagnetic Interference.
- K. Cross-connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- L. IDC: Insulation Displacement Connector.
- M. UTP: Unshielded Twisted Pair.
- N. Outlet/connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- O. WAP: Wireless Access Point

0.5 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
 - 1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 2. Bridged taps and splices shall not be installed in the horizontal cabling.
 - 3. Splitters shall not be installed as part of the optical fiber or copper cabling system (including coaxial cable).
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of up to 20 feet of patch cord to the workstation equipment or in the horizontal cross-connect.

0.6 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, entrance facilities, MDF, IDF and CMDF (where applicable) in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms, entrance facilities or MDF. Bridged taps and splitters shall not be used as part of backbone cabling.
- C. Performance requirements
 - 1. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

0.7 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications department and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.
- C. Coordinate cable pathway routes with electrical contractor and all other trades.

0.8 SUBMITTALS

- A. Contractor shall provide 4 hard copies and an electronic copy (searchable PDF file) of all submittal data required including Product Data, Shop drawings, Informational submittals and samples. Submittals will not be reviewed until complete Structured Cabling submittal package is received.
- B. The Structured Cabling contractor shall check all suppliers' submittals regarding measurements, capacity, performance and details to satisfy him/herself that they conform to the intent of the contract drawings and specifications. Submittals package shall bear the stamp of approval of the Structured Cabling contractor as evidence that the submittals have been checked by him/her. Submittals will not be reviewed without the Structured Cabling contractor's stamp.
- C. See Section 26 01 01 for additional submittal requirements.
- D. Product Data: For each type of product including but not limited to: Patch cords, jacks, face plates, cables, patch panels, racks/cabinets
 - 1. Work shall NOT proceed without the engineer's approval of the submitted items.
 - 2. For all cable types used include:
 - a. Performance characteristics.
 - b. Nominal outside diameter.
 - c. Minimum bending radius.
 - d. Maximum pulling tension.
 - 3. For all racks/cabinets and associated accessories include:
 - a. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - b. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- E. Shop Drawings:
 - 1. Submit a typical outlet assembly and labeling configuration.
 - 2. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - b. Patch panels (copper and fiber)
 - c. Patch cords and jumpers.
 - d. Work area outlet.
 - e. Active network equipment.

3. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
4. Cable pathway layout, showing raceway route and type (cable tray, J-hooks, conduit, sleeves and pull-boxes) to scale, with relationship between the pathway and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays and J-hook pathway.
 - c. Vertical elevation of pathway above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray/J-hooks and support elements.
 - e. Load calculations to show dead and live loads as not exceeding manufacturer's rating for conduit support elements.
5. Detail equipment assemblies and indicate dimensions, weights, loads, recommended clearances, method of field assembly, components, and location and size of each field connection.
6. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
7. Grounding: Submit a scale drawing of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
8. Contractor shall include in the submittal package 1-1/2" scale equipment rack elevations (front) for all equipment racks/cabinets. Elevations must include and identify (by manufacturer and model# where applicable) the following:
 - a. Individual equipment rack identification
 - b. All rack-mounted equipment
 - c. All rack-mounted cable management
 - d. All rack-mounted Power Distribution Units
 - e. All rack-mounted ground bars
 - f. All blank filler plates
 - g. All rack mounted Uninterruptible Power Supplies (UPS)
9. Contractor shall include in the submittal package 1/2" scale drawings of each telecom room. Drawings must include and identify (by manufacturer and model# where applicable) the following:
 - a. All equipment rack(s) and clearances.
 - b. All backboard(s).
 - c. All cable tray/cable runway.
 - d. Wall mounted ground bar.
 - e. All raceway penetrations.
 - f. All riser conduits.
 - g. All punch-down blocks.
 - h. All floor or wall-mounted Uninterruptible Power Supplies (UPS).
 - i. Receptacle locations.
 - j. All fire-stopping material/fittings
 - k. All other equipment indicated on drawings or existing (where applicable).

10. Contractor shall include in the submittal package 1/2" scale interior elevations of all walls in each Comm room. Elevations must include and identify (by manufacturer and model# where applicable) the following:
 - a. All backboards.
 - b. All wall mounted equipment.
 - c. All raceway penetrations.
 - d. All riser conduits.
 - e. All wall mounted cable management (D-rings).
 - f. All backbone cabling.
 - g. All receptacles.
 - h. All punch-down blocks.
 - i. Wall mounted ground bar(s).
 - j. All fire-stopping material/fittings.

11. **Substitutions: Any proposed substitution must be submitted a minimum of 10 days prior to the bid. Any proposed substitution must be fully demonstrated to owner's IT department prior to the bid and must be shown to FULLY meet or exceed all relative specifications and performance criteria of the specified product. Any product or component that has not been demonstrated to the full satisfaction of the owner's IT department or has not been deemed acceptable by the owner's IT department prior to the bid will not be accepted. The Owner and architect/engineer reserves the right to reject and deny any substitution that it may, in its sole discretion, deem unequal, and the findings in this regard shall be accepted by the bidder as final and binding**

F. INFORMATIONAL SUBMITTALS

1. The following informational submittal information must be provided with the submittal package:
 - a. Qualification Data: For all telecommunications contractor's personnel on site, qualified layout technicians, installation supervisor, Installers, telecommunications contractor's field quality inspector and RCDD. Personnel qualification data shall include all BICSI certifications as well as all current cabling/connectivity manufacturer's certifications.
 - 1) Contractor shall submit names of all personnel to be performing work related to this project
 - 2) Contractor shall submit a copy of the current cabling/connectivity manufacturer's certification documents for all contractor personnel to be involved with this project.
 - 3) Contractor shall submit a copy of all BICSI certification documents for all contractor personnel to be involved with this project.
 - b. Seismic Qualification Certificates: For equipment frames from manufacturer.
 - 1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.

- 3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Contractor must submit the following information regarding the 3 projects of similar size and scope (see "Quality Assurance"):
 - 1) Project name.
 - 2) Project location.
 - 3) Project owner. Include contact information (name, address, telephone and e-mail) for owners IT department or responsible party as it relates to structured cabling.
 - 4) Approximate value of project structured cabling.
 - 5) Approximate drop count.
 - 6) Contact information (including name, address, telephone and e-mail) of electrical or general contractor directly responsible for the structured cabling subcontractor.
- G. Samples: jacks, jack assemblies, icons, cable (1 foot section), patch cable (3 foot length) and faceplate. Provide one of each type and size of each product submitted.

0.9 CLOSEOUT SUBMITTALS

- A. System Labeling Schedules: Electronic copy of labeling schedules in searchable PDF file format.
- B. All testing records.
- C. All as-built drawings.
- D. All warranty materials.
- E. Other records as called for within this specification.

0.10 MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Patch cables: Ten of each length used.
 2. Jacks: Ten of each type used.
 3. Faceplates: Ten of each type/port capacity used.
 4. 4 pair UTP Cable: One 500ft reel of each type used.
 5. Patch-Panel units: Two of each type used.
 6. Power distribution units: Two of each type used.

0.11 QUALITY ASSURANCE

- A. Installer Qualifications: The successful telecommunications contractor shall be a company specializing in communication cabling installation and shall have been in business for a minimum of 5 years under the same name and with the same board of directors/management. Contractor must have successfully completed a minimum of 3 projects of similar size and scope within the last 5 years. At least 30 percent of the copper installation and termination crew must be certified by BICSI and the cable/connectivity manufacturer with a Technicians Level of

Training. At least 10 percent of the optical fiber installation and termination crew must be certified by BICSI and the cable/connectivity manufacturer in optical fiber installation and termination practices. The contractor must have an RCDD on staff in responsible charge of the project. Provide all contact information for the RCDD as this will be the point of contact for the project.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of a BICSI certified Commercial Installer, Level 2, who shall be present at all times when work of this Section is performed at Project site.
 3. Contractor's field quality inspector shall be the RCDD who is in responsible charge of the project or the on-site installation supervisor. Contractor's field quality inspector shall provide bi-weekly on-site inspection reports to the engineer documenting this discipline's project progress. These reports shall be submitted to INS@aamu.edu. Report shall include work that has been completed, work that is in progress, work remaining and estimated date of completion for each phase of work for the project. Report shall include photographs of completed work and work in progress. Report shall include telecommunications contractor's personnel on-site for the duration of time included in the report. The report shall also include work by other trades to be utilized for the completion of the work specified in this section.
 4. Structured cabling contractor shall have, on site for final inspection, the RCDD who is in responsible charge of the project or the on-site installation supervisor. If one of the requested personnel is not present at the final inspection, the structured cabling contractor will be charged for time (\$125.00/hour) and mileage (\$0.56/mile) for the EE Group, Inc. representative for the missed inspection. This charge must be paid prior to any subsequent visits to the site.
 5. Testing supervisor shall be currently certified by BICSI as an RCDD and shall be on-site to supervise all testing.
- B. The cabling/connectivity manufacturer shall extend a manufacturer's warranty for all products installed, this project, to the end user once the telecommunications contractor fulfills all requirements under this specification. See section 3 of this document for full warranty requirements.
- C. 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.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.
- 0.12 DELIVERY, STORAGE, AND HANDLING
- A. Delivery and receipt of products shall be at the site.
 - B. Cable shall be stored according to manufacturer's recommendations at a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable shall be moved to a heated (50 degrees F. minimum) location. If necessary, cable shall be stored off site at the contractor's expense.

- C. If the telecommunications contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner.
- D. Test all cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in closeout submittals.
 - 3. Test each pair of UTP cable for open and short circuits.

0.13 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install ANY cables or connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

0.14 DRAWINGS

- A. It shall be understood that the details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the telecommunications contractor in bidding the job. The telecommunications contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications and provide a fully functional system as intended.
- B. The telecommunications contractor shall verify all dimensions at the site and be responsible for their accuracy.
- C. Prior to submitting the bid, the telecommunications contractor shall call the attention of the Engineer to any materials or apparatus the telecommunications contractor believes to be inadequate and to any necessary items of work omitted.

PART 2 - **PRODUCTS**

0.1 PRODUCTS

- A. Due to the nature and type of communications all products, including but not limited to faceplates, jacks, patch panels, racks, punch-down blocks, and patch cords, for the purpose of this document, shall be manufactured by Panduit. All copper and optical fiber cable products shall be manufactured by Panduit.

0.2 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Work area cables shall each be terminated at their designated work area location in the connector types specified on drawings/described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate.
- B. The Telecommunications Outlet Assembly shall accommodate a minimum of two (2) modular jacks plus any additional accommodations for specific locations as noted in the plans for optical fiber and/or additional copper cables as necessary

- C. A blank filler will be installed when extra ports are not used.
- D. A dust cap shall be provided on all modular jacks with the circuit number on the identifier strip.
- E. Multiple jacks that are identified in close proximity on the drawings (but not separated by a physical barrier) may be combined in a single assembly. The telecommunications contractor shall be responsible for determining the optimum compliant configuration based on the products proposed.
- F. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the telecommunications contractor shall submit the proposed configuration for each outlet assembly for review by the owner.
- G. The modular jack shall incorporate printed label strip on the dust cap module for identifying the outlet. Printed labels shall be permanent and compliant with ANSI/TIA/EIA-606-A standard specifications. Labels shall be printed using standard connectivity manufacturer's label program or using a printer such as a Brady hand held printer. Hand printed labels shall NOT be accepted.
- H. Workstation Outlets shall be as specified on drawings with connector and faceplate.
 - 1. Jacks shall:
 - a. Be Panduit# CJ6X88TGGR
 - b. Follow TIA 568B termination
 - 2. Faceplate shall:
 - a. Be as manufactured by connectivity manufacturer.
 - b. Be UL listed and CSA certified.
 - c. Be available in single-gang or dual-gang.
 - d. Shall provide easy access for adds, moves, and changes by front removal of jack modules.
 - e. Possess recessed designation windows to facilitate labeling and identification.
 - f. Shall include a clear plastic cover to protect labels in the designation window.
 - g. Have mounting screws located under recessed designation windows.
 - h. Comply with ANSI/TIA/EIA-606-A work area labeling standard.
 - i. Allow for the UTP modules to be inverted in place for termination purposes.
 - j. Be manufactured by an ISO 9001 registered company.
 - k. Be compliant with the above requirements along with the following when incorporating optical fiber:
 - l. Be a low profile assembly,
 - m. Incorporate a mechanism for storage of cable and fiber slack needed for termination,
 - n. Position the fiber optic couplings to face downward or at a downward angle to prevent contamination.
 - o. Incorporate a shroud that protects the fiber optical couplings from impact damage.
 - p. Be stainless steel as specified on drawings and complying with requirements in section 26 05 33 "Raceways and Boxes for electrical Systems".

- q. For use with snap-in jacks accommodating any combination of UTP, optical fiber and coaxial work area cords.
- r. Flush mounting jacks.
- s. Shall have window for snap-in, clear-label covers and machine-printed paper inserts.

0.3 UTP CABLE

- A. Subject to compliance with requirements, provide product indicated on drawing.
- B. Performance:
 - 1. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.1 when tested according to test procedures of this standard.
 - 2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
 - 3. 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.
 - 4. Grounding: Comply with J-STD-607-A.
- C. Description: 100-ohm, four-pair UTP, covered with a thermoplastic jacket shall:
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-C for performance specifications.
 - 3. Comply with TIA/EIA-568-C, Category 6A for cables as specified on drawings
 - 4. Be listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: CMP.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - 5. Be plenum rated and meet applicable requirements of ANSI/ICEA S-80-576 in all locations.
 - 6. Shall meet guaranteed Published Channel Performance – ANSI/TIA-568-C.2 Category 6A/ISO 11801 Edition 2.1 Class EA – 10G UTP
 - a. Guaranteed Channel Performance – 100m
 - b. The Category 6A/Class EA cabling channel solution shall be an end-to-end UTP cabling solution guaranteed to support 10GBASE-T to 100 m.
 - c. The UTP channel shall exhibit superior Alien Crosstalk performance, improved Insertion Loss performance and guaranteed channel performance up to 500 MHz. The channel Alien Crosstalk performance shall be guaranteed for installed UTP channels with up to 4 connectors and up to 100 meters in length or 2 connectors and as short as 5 meters (3meter permanent link).

- d. The channel performance (including Alien Crosstalk performance) shall be guaranteed for the worst-case six-around-one channel configuration, where the entire 90m permanent link length is in a structured (combed) bundle.
- e. Channel PSANEXT shall be guaranteed to be 2dB over the TIA/EIA & ISO/IEC Class EA limit from 1 to 500 MHz.
- f. Channel PSAACR-F shall be guaranteed to be 10 dB over the TIA/EIA & the ISO/IEC Class EA limit from 1 to 500 MHz.
- g. Channel Insertion Loss margin shall be guaranteed to be 3% over the TIA/EIA & ISO/IEC Class EA limit from 1 to 500 MHz.
- h. Channel NEXT margin shall be guaranteed to be 3.5 dB over TIA/EIA & 2.5 dB over ISO/IEC Class EA limit from 1 to 500 MHz.
- i. Channel PSNEXT margin shall be guaranteed to be 5.0 dB over TIA/EIA & 4.0dB over ISO/IEC Class EA limit from 1 to 500 MHz.
- j. Channel PSACR-F margin shall be guaranteed to be 10.0 dB over TIA/EIA & ISO Class EA limit from 1 to 500 MHz.
- k. Channel Return Loss margin shall be guaranteed to be 3.0 dB over TIA/EIA & ISO Class EA limit from 1 to 500 MHz.
- l. The manufacturer shall provide Design and Installation guidelines to ensure that the minimum guaranteed performance margins are met.
- m. The cable shall consist of an outer jacket, tape consisting of discontinuation metallic elements, foam barrier, and 4-twisted pairs divided by a center cross web.
- n. The cable is a round design with a nominal outside diameter of 0.300 inches.
- o. The cable, cordage, and connecting hardware shall be UTP components that do not include internal or external shields, or drain wires.
- p. The guaranteed performance specifications for 4-connection channels shall meet the following table:

<i>Electrical Parameter</i>	<i>Guaranteed Channel Margins to ANSI/TIA-568-C.2 (1 – 500MHz)</i>	<i>Guaranteed Channel Margins to ISO/IEC 11801 Edition 2.1 “Class EA” (1 – 500 MHz)</i>
Insertion Loss	3 %	3%
NEXT	3.5 dB	2.5 dB
PSNEXT	5 dB	4 dB
PSACR-F	10 dB	10 dB

0.4 UTP CABLE HARDWARE

- A. Subject to compliance with requirements, provide product indicated on drawing.
- B. 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.
- C. Connecting Blocks: 110-style IDC for Category 6A. Provide blocks for the number of cables terminated on the block, plus 50 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

- D. Number of Terminals per Field: One for each conductor in assigned cables.
- 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.
 1. 48 port patch panels that accept Category 6A modular jacks with IDC connector terminations on rear
 2. The patch panel shall have electrical performance guaranteed to meet or exceed TIA/EIA 568-C.2 Category 6A and ISO/IEC 11801 Edition 2.1 Class EA component and channel specifications.
 3. The panel shall have vertical and horizontal cord organizers available as to improve patch cord management.
 4. The panel shall be available in flat 24-port 1RU and 48-port 1RU and 2RU configurations.
 5. Each modular jack in the panel shall come with universal A/B labeling and IDC termination that ensures 22 to 26 AWG cable conductors are fully terminated by utilizing a termination cap design and terminates to the modular jack through a smooth forward motion without impact on critical internal components for maximum reliability.
 6. Each modular jack shall be 100% performance tested, capable of being re-terminated up to 10 times and identified with the performance level and with an individual serial number for traceability.
 7. The panel shall have a black powder finish over high-strength steel.
 8. The panel shall have a labeling option to comply with TIA/EIA-606-A.
 9. The panel shall be equipped with a removable rear mounted cable management bar and front and rear labels.
 10. The panel shall be UL listed, UL-C certified and ACA approved.
 11. The panel shall support network line speeds in excess of 1 and 10 gigabit per second and be backward compatible with Category 6, 5e, 5 and 3 cords and cables.
 12. The Category 6A punchdown patch panels shall meet or exceed the Category 6A/Class E_A standards requirements in ISO/IEC 11801, TIA/EIA-568-C and shall be UL Listed.
 13. 48 port patch panels with front patch cord retainer & rear cable retainer:
 14. The Category 6A modular jack panels shall meet or exceed Category 6A standards requirements in ANSI/TIA-568-C.2 and Class E_A in Amendment 1 to ISO/IEC11801 Edition 2.1 shall be UL Listed.
 15. The modular jack panel shall utilize universal A/B wiring.
 16. The jack panels shall be 19-inch rack mountable.
 17. Jacks and Jack Assemblies: eight-position modular receptacle units with integral IDC-type terminals
 18. **Category 6A Requirements**

<i>Electrical Parameter</i>	<i>Guaranteed Channel Margins to ANSI/TIA/EIA-568-C.2 (1 – 500MHz)</i>	<i>Guaranteed Channel Margins to ISO/IEC 11801 Edition 2.1 “Class E_A” (1 – 500 MHz)</i>
Insertion Loss	3 %	3%
NEXT	3.5 dB	3 dB
PSNEXT	5 dB	4 dB
ACR-F	10 dB	10 dB
PSACR-F	10 dB	10 dB
Return Loss	3 dB	3 dB
PSANEXT	2 dB	2 dB
PSAACR-F	10 dB	10 dB

- F. Copper Patch Cords:

1. Patch Cords shall be:
 - a. Panduit TX6A™ 10Gig™ Patch Cords shall be constructed with Category 6A 23-AWG stranded cable featuring MaTriX Technology. Patch Cords shall be factory terminated with modular plugs featuring a one-piece, tangle-free latch design and black strain-relief boots to support easy moves, adds and changes. Panduit A™ 10Gig™ Patch Cords have incorporated MaTriX Technology and a barrier tape into the patch cable design to help suppress alien crosstalk and improve internal electrical performance. Patch cords shall be wired to be compatible with both T568A and T568B wiring schemes. The patch cords shall come in standard lengths of one to twenty feet (one-foot increments) and twenty-five to fifty feet (five-foot increments). The patch cords are available in eight standard colors of White, Blue, Yellow, Green, Black, Red, Violet, and Orange.
 - b. The patch cords shall be ETL verified ANSI/TIA-568-C.2 Category 6A and IEC/ISO 11801 Class EA channel performance. Each patch cord shall be 100% performance tested at the factory in a channel test to the ANSI/TIA-568-C.2 and IEC/ISO standards. The Panduit TX6A™ 10Gig™ Patch Cords must be installed as part of a complete Panduit TX6A™ 10Gig™ UTP Copper Cabling System in order to achieve 10GBASE-T certified performance.
2. Work Area Patch cords: Factory-made, four-pair, category 6A cables in 7 foot, 10 foot and 15 foot lengths; terminated with eight-position modular plug at each end.
 - a. Contractor shall provide one each patch cord for each Data and Voice cable terminated in a work area outlet. Patch cord shall be provided in the following lengths:
 - 1) 60% of patch cords provided shall be 7 foot in length.
 - 2) 30% of patch cords provided shall be 10 foot in length.
 - 3) 10% of patch cords provided shall be 15 foot in length.
3. Cross-connect copper Patch Cords: Factory-made, four-pair, category 6A cables in 1 foot, 2 foot, or 3 foot lengths as required; terminated with eight-position modular plug at each end.
 - a. Contractor shall provide one each patch cord for each Data and Voice cable terminated in telecom room. Cables shall be furnished in lengths as required to facilitate a neat and flexible installation. Minimum cable length shall be 1 Foot.
4. Cross-connect fiber patch cords: factory made, single pair, multimode, 50/125 micrometer, OM4 and single-mode, in lengths as required, terminated with type LC, connectors as required. Verify connector type with owner prior to ordering.

0.5 COPPER CABLE PROTECTION UNITS

- A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #4 AWG copper bonding conductor between the protector ground lug and the structured cabling ground point. Protector modules shall be housed in connector with cover and splice chamber and shall contain punch-down blocks of same style as specified elsewhere. Enclosure shall be consistent with the environment in which it is installed.
 1. Copper cable protection modules for Digital voice, Data and Security cabling shall be Circa# 4B1FS-240 or equal.

2. Copper cable protection modules for P.O.T.S, Fire Alarm System and paging cabling shall be Circa# 4B1E or equal.

0.6 OPTICAL FIBER CABLE

- A. Subject to compliance with requirements, provide product indicated on drawing.
- B. Optical fiber cable characteristics
 1. OSP fiber cable shall be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
 2. Shall be suitable for use in environment where it is being installed (risers, plenums and horizontal applications).
 3. OSP fiber shall be loose tube with dry water blocking elements.
 4. Premise fiber shall be tight buffered.
 5. Shall be available with a fiber strand count range from 6 to 288.
 6. Shall have a 3.0 mm sub-unit diameter.
 7. Shall have and be marked with an UL-OFNP or UL-OFNR Flame Rating as required for environment where it is installed.
 8. Shall be independently verified to comply with Bellcore GR-409 and GR20
 9. Shall be independently verified to comply with ICEA S-83-596 & ANSI/ICEA S-87-640
 10. Strength members shall be FGE/Aramid yarn.
 11. Suitable for underground or above ground conduits.
 12. Fibers shall be color coded in accordance with EIA/TIA 598 with an overall aqua jacket for indoor multimode cable, yellow jacket for Single mode cable and black for OSP fiber cable.
 13. Shall have a ripcord for overall jacket.
 14. Suitable for operation between -40° to +75° C
 15. OSP fiber cable shall be UV resistant
 16. Shall be constructed with dielectric yarns, dielectric central strength member or dielectric outer strength members
 17. Shall be protected by interlocking armor where specified
 18. All fiber routed in conduit or above ceiling spaces shall be protected by Maxcell, 2", 3-cell, Teflon innerduct
- C. Jacket:
 1. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
 2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
- D. Single mode optical fiber cable shall:
 1. comply with ANSI/TIA 568-C.3, TIA 492CAAB, UL444 sunlight resistant, and listed OFNP (NFPA 262)
 2. have a maximum attenuation of 0.7dB/km at 1310nm and 1550nm
 3. support Gigabit Ethernet up to 10km at 1310nm and 70km at 1550nm
 4. support 10G Ethernet up to 25km at 1310 and 40km at 1550km

0.7 OPTICAL FIBER CABLE HARDWARE

- A. Subject to compliance with requirements, provide product indicated on drawing.
- B. Optical Fiber Cabinets/Enclosures.

1. Rack Mount Optical Fiber Enclosure shall:
 - a. Be equipped with either a swing out mechanism or a sliding drawer to access fibers.
 - b. Be capable of terminating tight-buffered or loose tube optical fiber cable.
 - c. Provide for bend radius control throughout the panel as well as storage space for slack cabling.
 - d. Meet or exceed the performance criteria per ANSI/TIA-568-C.3.
 - e. Be equipped with optical fiber adapter panels.
 - 1) The optical fiber adapter panels shall accommodate either multi-mode or single-mode terminated optical fiber.
 - 2) The optical fiber adapter panels shall be compatible with LC connectors.
- C. Laser optimized adapters and connectors shall be Aqua for 50/125-micrometer, OM4 cable, cable in color and equipped with zirconia ceramic sleeves.
- D. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
- E. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Patch Cords: Factory-made, dual-fiber cables in various lengths as defined elsewhere in these specifications.
- G. Cable Connecting Hardware:
 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB. Verify connector type with owner prior to ordering
 3. Type SFF connectors may be used in termination racks, panels, and equipment packages if coordinated with owner prior to installation.

0.8 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 2. Lacing bars, spools, J-hooks, and D-rings.
 3. Straps and other devices.
- C. Cable Trays:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cablofil Inc.

- b. Cooper B-Line, Inc.
 - c. WBT
2. Cable Tray Material: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inches thick.
- a. Where cable tray is indicated on plans, the following types shall be utilized in these specific areas:
 - 1) Basket Cable Trays (CT): 8 inches wide and 4 inches deep. Wire mesh spacing shall not exceed 2 by 4 inches. Tray shall be powder-coated black and shall be center hung with mounting hardware as required.
 - 2) In all telecom/MDF/IDF rooms, ladder Cable Trays: Nominally 24 inches wide, and a rung spacing of 8 inches.
- D. Conduit and Boxes: Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems".
- 1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep.

0.9 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated (both sides, two coats), 3/4 by 48 by 96 inches sheets (long side mounted vertical) to cover area indicated on drawings.

0.10 EQUIPMENT FRAMES

- A. Subject to compliance with requirements, provide product indicated on drawing.
- B. General Frame Requirements:
 - 1. Equipment racks/cabinets shall provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Horizontal Wire management shall also be mounted above and below each patch panel and/or piece of equipment on the rack at a ratio of 1 rack unit of horizontal cable management per each rack unit of patching or equipment or 1 rack unit of horizontal cable management per 24 ports of patching or active network equipment (whichever is greater). The rack shall include mounting brackets for cable tray ladder rack/cable runway to mount to the top of the rack. Velcro cable ties shall be provided inside the rack channels to support the horizontal cable. Rack shall be black in color to match the patch panels and cable management. Contractor shall provide complete dimensioned rack assembly details showing all components including part numbers as called for in as built drawings submittals section of this document.
 - 2. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 3. Module Dimension: Width compatible with EIA 310-D standard, 19-inch panel mounting.
 - 4. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks shall:

1. Be modular type steel construction. vertical and horizontal cable management sections, grounding lug and PDU.
2. Have Baked-polyester powder coat finish.
3. Provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA/EIA-568-B.
4. Have top cable trough with waterfall and built in patch/horizontal cable distribution separator.
5. Have EIA hole pattern on front and rear.
6. Provide floor and ceiling access for cable management and distribution.
7. Provide pre-drilled base for floor attachment of rack.
8. Be available in standard color of black.
9. Be manufactured by an ISO 9001 registered company.
10. Be furnished with manufacturer's grounding kit.
11. Use blank panels where required

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

0.11 POWER DISTRIBUTION UNITS

A. Power Distribution Units shall:

1. Comply with UL 1363.
2. Be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Be rack mounted.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Be provided in each rack/cabinet as required to provide one 5-20R outlet for each 24 cables terminated at the rack.
7. Shall NOT have on/off switch.
8. Have integral amp/current meter.
9. Have integral surge suppression with a minimum rating of 26 kA.
10. Surge suppression protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

B. Horizontal Power Distribution Unit

1. The horizontal power distribution unit shall be equipped with a minimum of ten (10) 3-prong, NEMA 5-20R, 120 VAC outlets, and 7' cord.
2. The horizontal power distribution unit shall be equipped with surge protection with a 20 Amp current limit.
3. The horizontal power distribution unit shall be equipped with a bracket that enables it to be mounted on a 19" rack, cabinet or wall mount bracket without modification.

C. Vertical Power Distribution Unit

1. The vertical power distribution unit shall be equipped with a minimum of ten (10) 3-prong, NEMA 5-20R, 120 VAC outlets, 10' cord.
2. The vertical power distribution unit shall be equipped with surge protection with a 20 Amp current limit.
3. The vertical power distribution unit shall be equipped with a bracket that enables it to be mounted on a 19" rack, cabinet or wall mount bracket without modification.

0.12 GROUNDING

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB) furnished and installed by the electrical contractor. This backbone shall be used to ground all telecommunications cable shields (where applicable), equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor.
- B. Each distribution frame location (backboard location) shall be equipped with a telecommunications ground bus bar (TGB). Each TGB shall be connected to the building electrical entrance grounding facility with #3/0 AWG in 1" C. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, cabinets, enclosures, cable sheaths, metallic strength members, splice cases, cable trays, sleeves, conduits, etc. entering or residing in the EF, ER, MDF or IDF shall be grounded to the respective TGB using conductors as shown on the plans or called for elsewhere in the specifications. Telecommunications grounding conductors shall be a minimum of #3/0 AWG.
- D. All cable tray sections shall be connected to building ground.
- E. All metallic components of fire-stop fittings and conduits shall be connected to system ground.
- F. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this specification.
- G. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- H. Telecommunications Main Bus Bar:
 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- I. Comply with J-STD-607-A.

0.13 FIRE-STOP

- A. Fire-stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Fire-stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
- B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire-stopped.
- C. All through penetrations shall be fire-stopped with Wiremold flamestopper (or equal) adjustable fire-stop fitting with integrated intumescent barrier.
- D. Fire-stop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed. A drawing showing the proposed fire-stop system, stamped/embossed by the PE shall be provided to the Owner's Technical Representative prior to installing the fire-stop system(s).

0.14 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 26 05 53 "Identification for electrical Systems"

0.15 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

0.16 SOURCE QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified, third party testing agency to evaluate all cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

PART 3 - *EXECUTION*

0.1 WORK AREA OUTLETS

- A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.1 document, manufacturer's recommendations and best industry practices.
- C. Pair untwist at the termination shall not exceed one-half inch.
- D. Bend radius of the horizontal cable shall not be less than 4 times the outside diameter of the cable
- E. The cable jacket shall be maintained to within one inch of the termination point.
- F. Data jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).
- G. Voice jacks shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).
- H. All installation shall comply with manufacturer's recommendations.

0.2 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.
- B. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider. Coordinate with owner for the provision of any/all telecommunications utility service connections where owner request/approval is required by the serving utility. Contractor shall notify owner in writing of any/all required telecommunications utility service that requires owner coordination a minimum of five (5) weeks prior to scheduled project completion date. Contractor shall endeavor to assist owner with telecommunications utility coordination as required to expedite the provision of said utility service prior to the project completion date.

0.3 INSTALLATION OF EQUIPMENT ROOM FITTINGS

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 - D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment as directed by owner's IT department.
 - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room. Contractor shall coordinate with owner's IT, Security, ETV and maintenance departments and facilitate inter-department coordination for acceptable configuration of shared space in telecom rooms.
 - E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
 - F. Racks/cabinets shall be securely attached to the concrete floor using a minimum 3/8" hardware or as required by local codes.
 - G. Racks/cabinets shall be placed with a minimum of 36 inch clearance from the walls or other equipment on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall or equipment behind and in front of the row of racks and from the wall or equipment at each end of the row.
 - H. All racks/cabinets shall be grounded to the telecommunications ground bus bar in accordance with other sections of this document.
 - I. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
 - J. The contractor shall install 24" ladder cable tray from wall to each rack/cabinet.
- 0.4 INSTALLATION OF PATHWAYS
- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
 - B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified elsewhere in this document. Drawings indicate general arrangement of pathways and fittings.
 - C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
 - D. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems" for installation of conduits and wireways.

- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits a minimum of 6 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

0.5 WIRING METHODS

- A. Wiring Method: Install cables in raceways, cable trays and J-hooks except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical systems"
- B. Conceal conductors and cables in accessible ceilings, walls and floor
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures:
 - 1. Bundle, lace, and train cables within enclosures.
 - 2. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 3. Provide and use lacing bars and distribution spools.
 - 4. Install conductors parallel with or at right angles to sides and back of enclosure.

0.6 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. No cables shall be painted either intentionally or inadvertently. Cables must be protected during painting to avoid accidental painting or overspray. Any cable that are painted shall be replaced at no cost to the owner. Paint can degrade the cable insulation and may void the warranty.
- C. General Requirements for Cabling installation:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Cable shall be installed in accordance with manufacturer's recommendations, best industry practices and these specifications.
 - 3. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

4. Cable raceways shall not be filled greater than the ANSI/TIA/EIA-569-A maximum fill for the particular raceway type or 40% (whichever is less).
5. Comply with BICSI ITSIM "Cable Termination Practices."
6. Install 110-style IDC termination hardware as required for copper cables unless otherwise indicated.
7. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
8. Cables may not be spliced. 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.
9. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
11. 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. Any cabling found to be damaged during installation shall be removed and replaced at no cost to owner.
12. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
13. In the communications equipment room, install a 10-foot long service loop on each end of cable.
14. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
15. MUTOA shall not be used as a cross-connect point.
16. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors and may only be used where specifically called for in the contract documents.
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to work station equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
17. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
18. 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.
19. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
20. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 36 inch intervals. At NO point shall cable(s) rest on acoustic ceiling grids, ceiling panels, electrical conduits, fire alarm system conduits, structural elements, mechanical piping or ductwork.
21. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance
22. 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.

23. 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. See the plans for approximate support locations and requirements.
24. 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.
25. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. 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.
26. 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.
27. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.
28. Backbone cabling
 - a. Backbone cables shall be installed separately from horizontal distribution cables.
 - b. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits.
 - c. Where backbone cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit.
 - d. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
 - e. All backbone cables shall be securely fastened to the sidewall of the telecom room.
 - f. Backbone cables spanning more than two floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
 - g. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
 - h. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

D. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

E. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
3. Verify termination type with owner prior to ordering.

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 36 inches apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

G. UTP cable hardware installation

1. 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 practices.
2. Pair untwist at the termination shall not exceed one-half inch.
3. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
4. 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.
5. The cable jacket shall be maintained as close as possible to the termination point.
 - a. 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

H. Optical Fiber hardware installation

1. Adapter Plates/fiber patch panels:

I. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

0.7 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces. This includes the shield for coaxial cable.

0.8 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems"
 1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 50 feet and at every cable pathway transition.
 3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

- a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 5. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.

0.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections under the direction of RCDD:
1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 2. Visually confirm Category 5e, Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.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.
 5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. 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) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
6. UTP Performance Tests:
- a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
- a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the active network equipment is installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Perform tests and inspections.
- H. Tests and Inspections:
1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with

- color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.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/EIA-568-B.1. 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) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, one Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
 - I. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
 - J. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
 - K. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 - L. Prepare test and inspection reports. All testing shall be performed by equipment that has been maintained and calibrated as directed by testing equipment manufacturer. Include calibration history with test and inspection reports.
- 0.10 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceway and Cabling"

0.11 FIRESTOPPING

- A. All fire-stop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

0.12 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems"
- B. See drawings and details for owner approved labeling method for work area outlets, cabling and MDF/IDF rooms.
- C. All label printing will be machine generated by connectivity/cabling manufacturer software using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A.
- E. Labels shall be preprinted or computer-printed type.

0.13 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

0.14 TESTING AND ACCEPTANCE

- A. 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. 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, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
- B. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the connectivity/cabling manufacturer Certification Program Information Manual and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.
- C. Copper Channel Testing.

1. 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 III test unit for category 6 performance compliance as specified in ANSI/TIA/EIA-568-B.2-1.
2. 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.
3. 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.
4. Category 6 Performance
 - a. Follow the Standards requirements established in ANSI/TIA/EIA-568-B .1, B.2-1
 - b. A Level III test unit is required to verify category 6 performance.
 - c. The basic tests required are:
 - 1) Wire Map
 - 2) Length
 - 3) Attenuation
 - 4) NEXT (Near end crosstalk)
 - 5) Return Loss
 - 6) ELFEXT Loss
 - 7) Propagation Delay
 - 8) Delay skew
 - 9) PSNEXT (Power sum near-end crosstalk loss)
 - 10) PSELFEXT (Power sum equal level far-end crosstalk loss)

D. 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 EIA/TIA-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.
2. Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for Single mode) in both directions.
3. Test set-up and performance shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, Method B.
4. 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 LINK TEST IS REQUIRED.** The contractor can optionally install patch cords to 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.

5. Attenuation testing shall be performed with an approved hand held tester from an industry recognized test equipment manufacturer.

E. System Documentation

1. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets and one (1) searchable PDF document to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.
2. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result 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.
3. The Engineer may request that 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.

F. Test Results

1. Test documentation shall be provided (in searchable PDF format) 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 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.
2. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B including applicable TSB's and amendments. The appropriate Level III tester shall be used to verify Category 6 cabling systems.
3. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The telecommunications contractor must furnish this information in electronic form (flash drive or CD-ROM).
4. 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.

0.15 AS-BUILT DRAWINGS

- A. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. Construction documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.

- B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (PDF format) form.

0.16 WARRANTY

- A. Supplier will honor claims on this warranty for Life (which is defined as the usable life of the building and is referred to as the "Warranty Period" and shall be no less than 30 years).
- B. This warranty covers the copper and fiber optic permanent links of the network (as defined by ANSI/TIA/EIA-568-C.2 for CAT 5e, CAT.6, CAT 6A, ANSI/TIA/EIA-568-C.3 for Optical Fiber Cabling and Components): which includes the cable and connecting hardware.
- C. This warranty will be extended to include the entire channel.
- D. The network cabling infrastructure must be installed in accordance with TIA 568 Series Standards, and installed by Leviton Certified installers.
- E. Each permanent link or channel in the network must be field tested in accordance with the TIA 568 series industry standard in force at the time of purchase AND the installed permanent links and channels must have passed all applicable TIA and manufacturer performance requirements.
- F. Appropriate Warranty Application form must be properly completed and submitted to Supplier prior to initiating the installation. The Warranty Submittal Form must be submitted within 10 days of installation completion.
- G. Copies of all certification test reports must be submitted as part of the Warranty Submittal Form, and be kept on file by the registrant to be re-submitted when requested by Supplier. Data must be saved in raw data and summary formats. Submitting the data via online upload, e-mail or on disc are the preferred methods for providing test data.
- H. The Campus Warranty provides that at the time of delivery, Premises Voice-Grade Cable and Outside Plant Cable products, when installed as part of a campus network along with copper and/or fiber cables from specified manufacturer for 100% of the premises LAN installation, will be free from defects in design, material, and manufacture and conform to manufacturer specifications in force at the time of purchase for a period of no less than thirty (30) years from the delivery date (the "Campus Warranty").
- I. Transfer manufacturer's warranties to the owner in addition to the General System Guarantee. Submit these warranties on each item in list form with shop drawings. Detail specific parts within equipment that are subject to separate conditional warranty. Warranty proprietary equipment and systems involved in this contract during the guarantee period. Final payment shall not relieve you of these obligations.
- J. An Extended Product Warranty shall be provided which warrants functionality of all components used in the system for no less than thirty (30) years from the date of registration. The Extended Product Warranty shall warrant the installed horizontal and/or backbone copper, and both the horizontal and the backbone optical fiber portions of the cabling system.
- K. The manufacturer and contractor shall provide a warranty on the physical installation.
- L. All materials furnished shall meet the requirements of the connectivity/cabling manufacturer or solution partnership manufacturer's as required to provide the specified warranty period.

- M. All materials shall be installed per the connectivity/cabling manufacturer or solution partnership manufacturer's recommendations as required to provide the specified warranty period.

0.17 CONTINUING MAINTENANCE

- A. The contractor shall furnish an hourly rate with the proposal submittal, which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, adds, and changes to the system (MACs). MACs shall be performed by contractor that meets the qualifications outlined elsewhere in these Specifications.

0.18 FINAL ACCEPTANCE AND SYSTEM CERTIFICATION

- A. The contractor shall furnish an hourly rate with the proposal submittal, which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, adds, and changes to the system (MACs). MACs shall be performed by an connectivity/cabling manufacturer certified Integrator and shall be added to the warranty when registered with manufacturer. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation and successful performance of the cabling system for a two week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, the end user shall be provided with a numbered certificate, from connectivity/cabling manufacturer, registering the installation.

END OF SECTION