

**SECTION 16140****WIRING DEVICES****1 GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Wiring devices for electrical systems; complete, ready for operation, including all necessary parts, accessories, connections and equipment. Refer to individual system sections for special wiring device specifications. Types of wiring devices in this section include the following:
  - a) Switches
  - b) Key Switches
  - c) Switches, Motor Starting
  - d) Convenience Receptacles
  - e) Ground Fault Circuit Interrupting (GFCI) Receptacles
  - f) Power Outlet Receptacles
  - g) Wall Plates
  - h) Telephone, Data and Television Outlets
  - i) Dimmers
  - j) Photocells
  - k) Time Clocks
  - l) Electric Service Reel Drops
  - m) Occupancy Sensors

**B. Related Sections:**

1. Section 16050 - Basic Electrical Materials and Methods
2. Section 16130 - Boxes

**1.2 QUALITY ASSURANCE**

- A. The wiring devices and associated accessories included in this specification section shall be manufactured and installed in accordance with the latest editions and applicable sections of the following codes and standards:
  1. National Fire Protection Association (NFPA) 70, National Electrical Code (NEC)
  2. National Electrical Manufacturers Association (NEMA)
  3. American National Standards Institute (ANSI)
  4. Underwriters Laboratory (UL) listed and labeled.

**1.3 SUBMITTALS**

- A. Submit product data sheets to Engineer in accordance with requirements of section 16050 and General Conditions of Contract for equipment included in this specification.

**1.4 OPERATION AND MAINTENANCE DATA**

- A. Submit to Engineer the operation and maintenance information in accordance with the requirements of section 16050 and General Conditions of Contract for equipment included in this specification.

**2 PRODUCTS****2.1 MANUFACTURERS****A. Acceptable Manufacturers:**

1. Switches, Key Switches, Motor Starting Switches, Convenience Receptacles, GFCI Receptacles, Power Outlet Receptacles and Wall Plates:
  - a) Hubbell
  - b) Leviton
  - c) Pass & Seymour/Legrand
  - d) Cooper
2. Telephone and Data Outlets: See specification section 16745.
3. Photocells:
  - a) Tork
  - b) Intermatic
  - c) Fisher Pierce OLC
4. Time Clocks:
  - a) Tork
  - b) Sangamo
  - c) Intermatic
  - d) Paragon
5. Electric Service Cable Reel Drops:
  - a) McGill
  - b) Hubbell
  - c) Thomas & Betts
6. Occupancy Sensors
  - a) Watt Stopper/Legrand
  - b) Leviton
  - c) Hubbell
  - d) Novitas/Cooper

**2.2 COMMERCIAL GRADE SWITCHES**

- A. Provide commercial grade toggle switches of single pole, double pole, 3-way, 4-way, illuminated and pilot lighted types as indicated per the contract documents and as

required by the application. Switches shall be rated not less than 20 amperes at 120/277 volts AC. Switches shall feature silver-alloy contacts with quiet-action mechanism, and combination terminal and mounting screws (Phillips-head, slotted). Switches shall be designed for back and side wiring and shall accept #14, #12 and #10 AWG solid or stranded wire. Molded parts of switches shall be constructed from impact-resistant thermoplastic nylon. Verify color selections with Architect.

1. Commercial grade switches shall feature:
  - a) Heavy-gauge plated steel mounting strap with ground contact.
  - b) One-piece brass alloy contact arm.
2. Designer-style switches shall:
  - a) Generally comply with the above specified requirements for commercial grade switches.
  - b) Be shaped as a smooth-faced, rounded-edge rectangle.
  - c) Be a concave, architectural-style rocker with no visible seam.
3. Key switches shall:
  - a) Generally comply with the above specified requirements for commercial grade switches.
  - b) Feature a 302 stainless steel plate. Key-operated switches shall be furnished with two keys per switch and all switches shall be keyed identically.

### 2.3 SWITCHES, MOTOR STARTING

- A. For use in starting fractional horsepower motors, furnish and install a thermal circuit breaker specifically designed for this purpose unless furnished as a part of the equipment. In general, these shall be of the surface or flush type as required, mounted adjacent to the motor locations. These switches shall be used for the power requirements above stated. Each starter shall be provided with the heater element required for the motor to be controlled. Switches shall be quick-make and quick-break, trip free under overload conditions and shall indicate whether on or off or tripped. Heater elements shall be readily removable and interchangeable. Verify color selections with Architect.

### 2.4 COMMERCIAL GRADE CONVENIENCE RECEPTACLES

- A. Provide commercial grade convenience receptacles in single- and duplex-outlet configurations of the styles and types indicated per the contract documents and as required by the application. Receptacles shall be rated at not less than 20 amperes at 125 volts AC (NEMA 5-20R). Receptacles shall feature triple-wipe power contacts constructed of brass. Receptacles shall be designed for back and side wiring with provisions for split circuit wiring via break off tabs. Receptacles shall accept #14, #12 and #10 AWG solid or stranded wire. Back wiring clamps shall be v-shaped and serrated for three-point contact with wires. Receptacles shall feature a plated steel mounting strap with ground contact and self-grounding clip. Molded parts of receptacles shall be constructed from impact-resistant thermoplastic nylon. Verify color selections with Architect. Provide the following convenience receptacles:
  1. Generally comply with the above specified requirements for commercial grade convenience receptacles.
- B. Designer style receptacles shall:
  1. Generally comply with the above specified requirements for commercial grade convenience receptacles.

2. Be shaped as a smooth-faced, rounded-edge rectangle.
- C. Ground Fault Circuit Interrupting (GFCI) receptacles shall:
1. Generally comply with the above specified requirements for commercial grade convenience receptacles.
  2. Comply with UL 943 requirements.
  3. Comply with UL Class A requirements.
  4. Feature trip threshold that shall meet or exceed UL requirements for trip time.
  5. Feature trip test and reset buttons.
  6. Feature a trip indicator light.
  7. Feature lockout protection. If critical components are damaged and ground fault protection is lost, power to receptacle is disconnected.

## 2.5 INDUSTRIAL GRADE CONVENIENCE RECEPTACLES

- A. Provide convenience receptacles in single- and duplex-outlet configurations of the grades, styles and types indicated per the contract documents and as required by the application. Receptacles shall be rated at not less than 20 amperes at 125 volts AC (NEMA 5-20R). Receptacles shall feature triple-wipe power contacts constructed of brass. Receptacles shall be designed for back and side wiring with provisions for split circuit wiring via break off tabs. Receptacles shall accept #14, #12 and #10 AWG solid or stranded wire. Back wiring clamps shall be v-shaped and serrated for three-point contact with wires. Receptacles shall feature a one-piece brass mounting strap with integral ground contact and self-grounding clip. Molded parts of receptacles shall be constructed from impact-resistant thermoplastic nylon. Verify color selections with Architect. Provide the following convenience receptacles:
- B. Ground Fault Circuit Interrupting (GFCI) receptacles shall:
1. Generally comply with the above specified requirements for industrial grade convenience receptacles.
  2. Comply with UL 943 requirements.
  3. Comply with UL Class A requirements.
  4. Feature trip threshold that shall meet or exceed UL requirements for trip time.
  5. Feature trip test and reset buttons.
  6. Feature a trip indicator light.
  7. Feature lockout protection. If critical components are damaged and ground fault protection is lost, power to receptacle is disconnected.

## 2.6 POWER OUTLET RECEPTACLES

- A. Provide power outlet receptacles of the flush mounted, single-outlet, three or four wire variety as required by the service indicated on the drawings. The power outlet receptacles shall have a capacity of 20, 30, 50 or 60 amperes at rated voltage indicated and of sufficient capacity to accommodate the load to be connected. The receptacles shall feature heavy-gauge, double-wipe copper alloy power contacts. The receptacles shall accept up to #4 AWG conductors. Molded parts of receptacle shall be constructed from arc-resistant thermoplastic. Each receptacle shall be provided with a stainless steel plate and the associated plug to fit receptacle. Grounding type plugs shall be provided where required by the NEC or applicable codes. Verify color selections with Architect.

**2.7 WALL PLATES**

- A. General: Furnish and install wall plates with beveled edges for all local control switches, convenience receptacles, miscellaneous wiring devices and blank outlets. Where more than one device occurs at one point, gang plates shall be used. Plates and mounting screws shall match the color of the devices to which they are to be attached. Verify color selections with Architect.
- B. Materials and Finishes:
1. Thermoplastic: High impact thermoplastic, nylon material.
  2. Stainless Steel: Type 302 stainless steel.
  3. Weatherproof While-In-Use Covers:
    - a) Body, cover and plates shall be made of polycarbonate. Shall be non-conductive and non-corrosive.
    - b) Gasket shall be pre-applied. Constructed of closed-cell foam, neoprene blend regular density and UL rated HBF.
    - c) Shall provide a water channel, which keeps water moving outside while cord flap keeps the inside dry.
    - d) Shall be able to mount vertically or horizontally.
    - e) Must conform to NEMA 3R.

**2.8 TELECOMMUNICATIONS DEVICES**

- A. Furnish and install a flush two-gang box with single-gang extension ring for each outlet, unless otherwise noted.
- B. Provide a minimum 3/4" sized EMT conduit from outlet box into accessible ceiling cavity, unless otherwise noted.
- C. Provide the quantity of jacks and associated wall plates indicated on the drawings, unless otherwise noted. Verify color selections with Architect.
- D. Provide blank wall plates for empty outlet boxes, and equip empty conduits with nylon pull lines.
- E. All cabling, terminations, station devices, etc., shall be furnished and installed under the electrical contract.

**2.9 CCTV CAMERAS AND SPEAKERS**

- A. Furnish and install a flush two-gang box with single-gang extension ring for each outlet, unless otherwise noted.
- B. Provide a minimum 3/4" sized EMT conduit from outlet box into accessible ceiling cavity, unless otherwise noted.
- C. Provide blank wall plates for empty outlet boxes, and equip empty conduits with nylon pull lines.
- D. All cabling, terminations, station devices, etc., shall be furnished and installed by the associated Contractors. Not the Electrical Contractor.

**2.10 PHOTOCELLS**

- A. Furnish and install quantity of photocells shown on the drawings and required for the application. The photocell shall be constructed of cadmium sulfide and be furnished complete with weatherproof housing, mounting base, brackets and adapters. Provide photocells at rated voltage indicated on the contract documents and of sufficient capacity to accommodate the load to be connected. The unit shall be suitable for outdoor installation at temperature ranges of -40°F to 140°F. Mounting shall be via locking type prongs through 11/16" - 13/16" hole with ¼" threaded stem or flush in outdoor junction box with stainless steel plate and gasket. A built-in time delay shall be incorporated to prevent nuisance switching (response time shall be instant). The SPST normally closed switch shall provide fail "on" operation. Turn-on shall be at 1.5 FC. Turn-off shall be approximately 3 times turn-on.

**2.11 TIME CLOCKS**

- A. Furnish and install an astronomical dial time clock that includes a spring wound carryover and that maintains time control on schedule during power failure for not less than 12 hours. The time clock carryover shall automatically rewind upon power resumption. Provide the quantity of heavy duty, silver contacts indicated on the contract documents or required for the application. The time clocks shall be of the 24 hour dial type capable of automatically controlling lighting loads based on seasonal changes of sunset and sunrise times. Provide time clocks at rated voltage indicated on the contract documents and of sufficient capacity (amperage and wattage) to accommodate the load to be connected. Time clock shall provide for seven-day operation. A skipper dial shall be provided to allow for omitting operation on any selected day or days of the week. The time clock shall be installed in a NEMA 1 lockable steel enclosure with hinged cover.

**2.12 ELECTRIC SERVICE REEL DROPS**

- A. Provide at the locations as shown on the drawings, electric reel drop assemblies of rewind type. Units shall be of the totally enclosed take-up type having shock absorbing ball stop, and shall have a minimum 20' cords length with two duplex outlets on the end of the cord. All cord units shall be suitable for the services shown on the drawings and shall contain a grounding conductor. Cords shall be Type SO-Oil resistant type. Units shall be provided with suitable mounting accessories for the areas in which they are to be used.

**2.13 LINE VOLTAGE OCCUPANCY SENSORS**

- A. Ceiling mounted line voltage occupancy sensors shall be similar to above and also comply with the following:
1. Rated 0-800W (ballast/tungsten) 120VAC; 0-1200W (ballast) 277VAC.
  2. Basis of design is Watt Stopper model no. DT-355. Provide sensors with matching power packs and/or relays as required for intended usage.
- B. Contractor shall set occupancy sensor time delays to 15 minutes, as noted on the drawings, or as otherwise directed by the Owner/Architect.

**3 EXECUTION****3.1 INSTALLATION**

- A. Install in accordance with requirements of Section 16050 and manufacturer's recommendations.
- B. ALL Receptacles and power outlets shall be labeled in accordance w/ owner requirements including but not limited to panelboard name and circuit number (example....LP-24). Coordinate exact labeling requirements with owner prior to installation.
- B. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- C. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work.
- D. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the E.C. shall check with other contractors concerned, to determine exact field location of the above items. In addition, the E.C. shall check for exact direction of door swings so that local switches are properly located on the strike side.
- E. Install wiring devices only in electrical boxes that are clean and free from building materials, dirt and debris.
- F. Install wiring devices after wiring work is completed.
- G. Install wall plates after painting work is completed. Use galvanized steel wall plates in unfinished spaces unless otherwise noted.
- H. Where more than one wiring device occurs in any one location, arrange devices in gangs with common cover plate.
- I. In locations where several pieces of wall-mounted equipment such as wall switches and thermostats are in the same general area, all shall be installed and grouped in a neat, orderly fashion, all of the same horizontal or vertical center line, whichever the case may be. Variation from this direction shall be approved by the Architect. All receptacles and switches shall be mounted at a height as indicated on the contract drawings or as directed in specification section 16050.

**3.2 FIELD ADJUSTMENTS**

- A. Subsequent to the final connection of the wiring devices, energize circuits and demonstrate proper functioning.
- B. Perform any corrections and adjustments required at no additional cost to the owner. This shall include setting of time delays and adjusting sensitivity/coverage areas for occupancy sensors.

END OF SECTION

**SECTION 16745****DATA & VOICE COMMUNICATION CABLING****PART 1 GENERAL SPECIFICATIONS****1.1 SCOPE**

- A. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling at the new or remodeled buildings for HACC Midtown 1 (CCTA). Backbone and Horizontal cabling comprised of Copper and Fiber Cabling, and support systems are covered under this document.
- B. The Horizontal (workstation) Cabling System shall consist of a minimum of (2) 4-pair Unshielded Twisted Pair (UTP) Copper Cables to each work area outlet unless otherwise noted for specific locations. The cables shall be installed from the Work Area Outlet to the Telecommunications Room (TR) located on the same floor, and routed to the appropriate rack serving that area and terminated as specified in this document.
- C. 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.
- D. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.
- E. RELATED SECTIONS:
  - 1. SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS
  - 2. SECTION 16110 – RACEWAYS
  - 3. SECTION 16115 – CABLE TRAYS
  - 4. SECTION 16130 – BOXES
  - 5. SECTION 16140 – WIRING DEVICES
  - 6. SECTION 16190 – SUPPORTING DEVICES
  - 7. SECTION 16450 – GROUNDING

**1.2 REGULATORY REFERENCES:**

- A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the local Electrical Code and present manufacturing standards.
- B. 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.

- C. All materials shall be ETL Verified (not just tested) to be category 5e component and channel compliant.
- D. The cabling system described in this is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:
  - 1. ANSI/TIA/EIA - 568-B.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, August, 2001
  - 2. ANSI/TIA/EIA - 568-B.2, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components, December, 2001
  - 3. ANSI/TIA/EIA - 568-B.3, Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components, April, 2000
  - 4. ANSI/TIA/EIA – 569-A, Commercial Building Standard for Telecommunications Pathways and Spaces, February, 1998
  - 5. ANSI/TIA/EIA – 570-A, Residential Telecommunications Cabling Standard, October, 1999
  - 6. ANSI/TIA/EIA – 606-A, Administration Standard for Telecommunications Infrastructure of Commercial Buildings, February 2002
  - 7. ANSI/TIA/EIA – 607, Commercial Building Grounding and Bonding Requirements for Telecommunications, August, 1994
  - 8. ANSI/ TIA/EIA – 758, Customer-Owned Outside Plant Telecommunications Cabling Standard, April, 1999
  - 9. BICSI - TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM) – 9<sup>th</sup> Edition, 2000
  - 10. National Fire Protection Agency (NFPA – 70), National Electrical Code (NEC) - 2002
- E. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- F. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

### 1.3 APPROVED CONTRACTOR

- A. The Telecommunications contractor must be an approved Ortronics Certified Installer at a Plus tier (CIP, CIP-GOLD, CIP-PLATINUM, and multi-site/national contractors) and Berk-Tek Certified OASIS Integrator. A copy of certification documents must be submitted with the quote in order for such quote to be valid. The Telecommunications contractor is responsible for workmanship and installation practices in accordance with the Ortronics CI/CIP Program and Berk-Tek OASIS Program. Ortronics/Berk-Tek will extend a NetClear 25-year Static, Dynamic and Applications Warranty to the end user once the Telecommunications contractor fulfills all requirements under Ortronics CI/CIP and Berk-Tek OASIS Program. At least 30 percent of the copper installation and termination crew must be certified by BICSI, Berk-Tek, or Ortronics with a Technicians Level of Training. Also, at least 10 percent of the optical fiber installation and termination crew must be certified by Berk-Tek or Ortronics or other approved organizations in Optical Fiber installation and termination practices.

#### 1.4 APPROVED PRODUCTS

- A. Approved 4-pair UTP Cable : Berk-Tek LANmark-350 Enhanced Category 5e Cable (Plenum/Non-Plenum), Berk-Tek LANmark-350 Category 5e Cable (Plenum/Non-Plenum)
- B. Approved high pair count UTP Cable manufacturer: Berk-Tek
- C. Approved Optical Fiber Cable manufacturer: Berk-Tek
- D. Approved UTP connector product manufacturer: Ortronics
- E. Approved Fiber Optic cabinet product manufacturer: Ortronics
- F. Approved Fiber Optic connectors/splices/couplers: Ortronics
- G. Approved Rack and Cabinet manufacturer: Ortronics
- H. Approved Patch Panel manufacturer: Ortronics
- I. Approved UTP Patch Cord manufacture: Ortronics

#### 1.5 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. 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 and Optical Fiber cable
  - 3. Furnish and install all wall plates, jacks, patch panels, and patch cords.
  - 4. Furnish and install all required cabinets and/or racks as required and as indicated.
  - 5. Furnish any other material required to form a complete system.
  - 6. Perform link or channel testing (100% of horizontal and/or backbone links/channels) and certification of all components.
  - 7. Furnish test results of all cabling to the owner on disk and paper format, listed by each closet, then by workstation ID.
  - 8. Adhere and comply with all requirements of Ortronics CI/CIP and/or Berk-Tek OASIS programs.
  - 9. Provide owner training and documentation. (Testing documentation and As-built drawings)

#### 1.6 SUBMITTALS

- A. Under the provisions of this request for proposal, prior to the start of work the telecommunications contractor shall:

1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec.
  2. Submit proof from manufacturer of contractor's good standing in manufacturer's program.
  3. Submit appropriate cut sheets and samples for all products, hardware and cabling.
- B. Work shall not proceed without the Owner's approval of the submitted items.
- C. The telecommunications contractor shall receive approval from the Owners on all substitutions of material. No substituted materials shall be installed except by written approval from the Owner.

#### 1.7 QUALITY ASSURANCE

- A. The Ortronics CIP / Berk-Tek OASIS telecommunications contractor shall be a company specializing in communication cabling installation. At least 30 percent of the copper installation and termination crew must be certified by BICSI or Berk-Tek/Ortronics with a Technicians Level of Training. At least 10 percent of the optical fiber installation and termination crew must be certified by BICSI or Berk-Tek/Ortronics in optical fiber installation and termination practices.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- A. Delivery and receipt of products shall be at the site described in the Scope Section.
- B. Cable shall be stored according to manufacturer's recommendations as 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.

#### 1.9 DRAWINGS

- A. It shall be understood that the electrical 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.
- 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****2.1 EQUIVALENT PRODUCTS**

- A. Due to the nature and type of communications all products, including but not limited to faceplates, jacks, patch panels, racks, 110 blocks, and patch cords, for the purpose of this document, shall be manufactured by Ortronics. All copper and optical fiber cable products shall be manufactured by Berk-Tek. There will be no substitutions allowed.

**2.2 WORK AREA OUTLETS**

- A. Work area cables shall each be terminated at their designated work area location in the connector types 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:
1. A minimum of two (2) modular jacks
  2. Additional accommodations for specific locations as noted in the plans for optical fiber and/or additional copper cables as necessary
  3. A blank filler will be installed when extra ports are not used.
  4. A dust cap shall be provided on all modular jacks with the circuit number on the identifier strip.
  5. 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.
  6. 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.
  7. 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 Ortronics label program (LabelMo) or using a printer such as a Brady hand held printer. Hand printed labels shall not be accepted.
- C. Faceplates: The faceplates shall:
1. be Ortronics TracJack or Series II style as appropriate to fit the modular jack used
  2. be UL listed and CSA certified.
  3. be constructed of high impact, ABS plastic UL 94V-0 construction (except where noted otherwise).
  4. shall match the faceplate color used for other utilities in the building or match the color of the raceway if installed in surface raceway.
  5. be compliant with the above requirements along with the following when incorporating optical fiber:
    - a) be a low profile assembly,
    - b) incorporate a mechanism for storage of cable and fiber slack needed for termination,
    - c) position the fiber optic couplings to face downward or at a downward angle to prevent contamination and,
    - d) incorporate a shroud that protects the optical couplings from impact damage.
  6. be available as single-gang or dual-gang.
  7. shall provide easy access for adds, moves, and changes by front removal of jack modules.
  8. possess recessed designation windows to facilitate labeling and identification.
  9. shall include a clear plastic cover to protect labels in the designation window.

10. have mounting screws located under recessed designation windows.
11. comply with ANSI/TIA/EIA-606-A work area labeling standard.
12. allow for the UTP modules to be inverted in place for termination purposes.
13. be manufactured by an ISO 9001 registered company.

D. Voice / Data Jacks

1. Voice/Data jacks shall be 8-position modular jacks and shall be Category 5e or higher performance as defined by the references in this document including ANSI/TIA/EI-568-B.2. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.
2. The modular jack shall be one of the following for a NetClear<sup>GT</sup> Solution:

Part Number	Description
OR-TJ5E00	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Fog White
OR-TJ5E00-00	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Black
OR-TJ5E00-13	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Electric Ivory
OR-TJ5E00-22	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Red
OR-TJ5E00-23	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Orange
OR-TJ5E00-24	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Yellow
OR-TJ5E00-25	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Green
OR-TJ5E00-26	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Blue
OR-TJ5E00-27	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Purple
OR-TJ5E00-36	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Dk Blue
OR-TJ5E00-42	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Dk Red
OR-TJ5E00-43	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Dk Orange
OR-TJ5E00-44	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Dk Yellow
OR-TJ5E00-45	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Dk Green
OR-TJ5E00-68	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Wiremold Lt Gray
OR-TJ5E00-78	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Wiremold Gray
OR-TJ5E00-88	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Cloud White
OR-TJ5E00-99	Category 5e TracJack Clarity <sup>5E</sup> , 180°, Wiremold Ivory
OR-S215E00	Category 5e Series II, 1 unit Clarity <sup>5E</sup> , 180°, Fog White
OR-S215E00-00	Category 5e Series II, 1 unit Clarity <sup>5E</sup> , 180°, Black
OR-S215E00-99	Category 5e Series II, 1 unit Clarity <sup>5E</sup> , 180°, Wiremold Iv
OR-S225E00	Category 5e Series II, 2 units Clarity <sup>5E</sup> , 180°, Fog White
OR-S225E00-00	Category 5e Series II, 2 units Clarity <sup>5E</sup> , 180°, Black
OR-S225E00-99	Category 5e Series II, 1 unit Clarity <sup>5E</sup> , 180°, Wiremold Iv

3. Dust covers shall be used on each termination.

The voice cross connect shall be a passive connection between the horizontal termination blocks and the backbone termination blocks. The wall mount frames shall be field terminated kits including all blocks, connecting blocks, and designation strips. Management rings shall be mounted between vertical columns of blocks to provide management of cross-connect wire. Backbone and horizontal blocks shall use 4 or 5-pair connecting blocks on each 25-pair row. Blocks shall be oriented so that backbone terminations are located on the left and horizontal frames are located on the right of the termination field when facing the frame assembly.

- A. 110 Connecting Blocks shall
  - 1. be manufactured using fire retardant molded plastic.
  - 2. be used with 4 pair 110C connecting blocks for field termination.
  - 3. support termination of 22, 24, and 26 AWG solid conductor.
  - 4. be capable of accommodating a minimum of 200 repeated insertions without resulting in permanent deformation.
  - 5. have color-coded tips for installation identification.
  - 6. Termination hardware shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
  - 7. be labeled in compliance with ANSI/TIA/EIA-606-A labeling specifications using permanent labels and LabelMo software (or other labeling software/printer).
  - 8. be manufactured by an ISO 9001 registered company.
  
- B. 110 Wiring Blocks Shall:
  - 1. be Ortronics part number OR-30203506.
  - 2. be manufactured using fire retardant molded plastic.
  - 3. be available in 100 pair and 300 pair sizes.
  - 4. be rack mountable.
  - 5. be used with 4 pair 110C connecting blocks for field termination.
  - 6. support termination of 22, 24, and 26 AWG solid conductor.
  - 7. be capable of accommodating a minimum of 200 repeated insertions without resulting in permanent deformation.
  - 8. 110 wiring block and 110C connecting block shall have color-coded tips for installation identification.
  - 9. Termination hardware shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
  - 10. 110 wiring block and 110C connecting block shall be compliant with ANSI/TIA/EIA-606-A labeling specifications.
  - 11. be manufactured by an ISO 9001 registered company.
  
- C. 110 Cross-Connect System Backboard Channels Shall
  - 1. be available in 300 and 900 pair sizes.
  - 2. allow the mounting of 110 100-pair blocks without legs.
  - 3. include bottom trough and grounding bar.
  - 4. be wall mountable.
  - 5. be of cold roll steel construction.
  - 6. be manufactured by an ISO 9001 registered company.

- D. 110 Wall Mount Vertical Trough Shall
  - 1. be available in single channel or dual channel configurations.
  - 2. in dual channel configuration shall be used to provide separation for different wiring media.
  - 3. be available in 300 pair and 900 pair sizes.
  - 4. be wall mountable.
  - 5. be used with wall mountable backboard channels. Acceptable configurations include a 300 pair and a 900 pair.
  - 6. be of cold roll steel construction.
  - 7. be manufactured by an ISO 9001 registered company.

2.4 MODULAR PATCH PANELS

- A. The modular patch panel shall be one of the following for a NetClear<sup>GT</sup> Solution:

Part Number	Description
OR-PHD5E6U24	24 port, Clarity <sup>5E</sup> , high density, 6 port modules
OR-PHD5E6U48	48 port, Clarity <sup>5E</sup> , high density, 6 port modules
OR-PHD5E6U96	96 port, Clarity <sup>5E</sup> , high density, 6 port modules
OR-PSD5E6U12	12 port, Clarity <sup>5E</sup> , standard density, 6 port modules
OR-PSD5E6U24	24 port, Clarity <sup>5E</sup> , standard density, 6 port modules
OR-PSD5E6U48	48 port, Clarity <sup>5E</sup> , standard density, 6 port modules
OR-PSD5E6U96	96 port, Clarity <sup>5E</sup> , standard density, 6 port modules
OR-PHD5E8U24	24 port, Clarity <sup>5E</sup> , high density, 8 port modules
OR-PHD5E8U48	48 port, Clarity <sup>5E</sup> , high density, 8 port modules
OR-PHD5E8U96	96 port, Clarity <sup>5E</sup> , high density, 8 port modules

2.5 RACKS

All racks and wire management shall be Ortronics specific. The equipment rack 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. Wire management shall also be mounted above each patch panel and/or piece of equipment on the rack. The rack shall include mounting brackets for cable tray ladder rack 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.

**A. Free-Standing Rack**

Free-standing rack shall:

1. 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.
2. have top cable trough with waterfall and built in patch/horizontal cable distribution separator.
3. have EIA hole pattern on front and rear.
4. be available with a 6.5" (165 mm) channel depth.
5. be available with hook and loop straps for securing bulk cables inside the vertical U-channels.
6. assemble as 19" (483 mm) or 23" (584 mm) with no additional hardware.
7. be available with three styles of vertical patch cord management: interbay with latches, cable management rings, or fingerduct with covers.
8. provide floor and ceiling access for cable management and distribution.
9. provide pre-drilled base for floor attachment of rack.
10. be available in standard color of black.
11. be manufactured by an ISO 9001 registered company.

**B. Wall Mounted Rack**

Wall mount rack shall:

1. 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.
2. have top cable trough to route patch and distribution cables between racks.
3. have EIA hole pattern on front and rear.
4. Rack height shall be specified as 7 ft / 2.13 m (44 rack units) or 4.0 ft/1.22 m (22 rack units).
5. be available with a 6.5" (165 mm) or 14" (356 mm) channel depth.
6. be available with hook and loop straps for securing cables inside the vertical U-channels.
7. be available with vertical cable management rings for cord routing organization and strain relief.
8. be available with vertical U-channels to protect and conceal distribution cables.
9. provide floor and ceiling access for cable management and distribution.
10. have wall mount braces with locator posts for easy wall mounting.
11. have side access points that allow for access to manage/install distribution cables in the vertical channels.
12. be available in standard color of black.
13. be manufactured by an ISO 9001 registered company.

2.6 HORIZONTAL DISTRIBUTION CABLE

All horizontal data station cable and voice cable shall terminate on modular patch panels (copper or fiber), 110 cross-connecting blocks (copper), or patch/splice cabinets (fiber) in their respective Telecommunications Room or Equipment Room as specified on the drawings.

A. 100 Ohm Enhanced Category 5e Unshielded TWISTED PAIR (UTP) CABLE

1. Physical Characteristics:

- a) **(For Plenum)** Shall be plenum rated and meet applicable requirements of ANSI/ICEA S-80-576. All 4 pairs must be insulated with F.E.P. No 2x2 or 3x1 construction will be allowed.
- b) The diameter of the insulated conductor shall be .020 in. nominal.
- c) Shall consist of (4) 24 AWG twisted pairs.
- d) Shall be suitable for the environment in which they are to be installed.
- e) The color coding of pairs shall be:

Pair 1	Pair 2	Pair 3	Pair 4
W-BL; BL	W-O; O	W-G; G	W-BR; BR

- f) The overall diameter of the cable shall be 0.165 inches.
- g) The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 400 N minimum.
- h) Cable shall withstand a bend radius of 2 inch at -20 degrees Celsius without jacket or insulation cracking.
- i) Cable shall be third party verified to meet ANSI/TIA/EIA – 568-B.1, Category 5e Specifications
- j) Plenum rated cable shall be UL certified to conform to UL 910, CMP and shall be marked as such
- k) Riser rated cable shall be third party certified to conform to UL 1666, CMR, CMG, and IEC 332-1 and shall be marked as such.

2. Transmission Characteristics:

- a) DC resistance of any conductor shall not exceed 9.4 Ohms per 100m max. at 20°C. Measured in accordance with ASTM D 4566.
- b) The mutual capacitance of any pair at 1 kHz for 100m of cable shall not exceed 4.4 nF .
- c) The capacitance unbalance to ground at 1 kHz of any pair shall not exceed 330 pF per 100m.
- d) Structural return loss swept measurement for 100m or longer shall meet or exceed the following:

Frequency (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	155	200	300	350
Max. SRL(dB)	25.5	25.5	25.5	25.5	25.5	24.4	22.7	21.5	20.4	19.8	18.8	18.4

- e) The maximum attenuation of any pair shall be less than the following:

Frequency (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	155	200	300	350
Max. Attenuation (dB)	2.0	4.0	6.4	8.1	9.2	11.6	16.8	21.7	27.7	32.1	40.5	44.4

- f) The NEXT coupling loss between pairs in a cable shall be greater than or equal to the following:

Frequency (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	155	200	300	350
NEXT Loss Worst Pair (dB)	70.3	61.9	55.3	52.3	50.8	47.9	45.4	40.3	37.5	35.8	33.2	32.2

- g) PSNEXT loss @ 20 degrees Celsius  $\pm$  3 degrees (68 degrees F  $\pm$  5.5 degrees) between pairs in a cable for a length of 100m (328ft) shall meet or exceed the following:

Frequency (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	155	200	300	350
PSNEXT Loss Worst Pair (dB)	68.3	59.9	53.3	50.3	48.8	45.9	41.4	38.3	35.5	33.8	31.2	30.2

- h) The ELFEXT loss @ 20 degrees Celsius  $\pm$  3 degrees (68 degrees F  $\pm$  5.5 degrees) between pairs in a cable for a length of 100m (328ft) shall meet or exceed the following:

Frequency (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	155	200
ELFEXT Loss Worst Pair (dB)	66.8	54.7	46.8	42.7	40.7	36.9	30.8	26.8	23.0	20.7

- i) The PSELFEXT loss @ 20 degrees Celsius  $\pm$  3 degrees (68 degrees F  $\pm$  5.5 degrees) between pairs in a cable for a length of 100m (328ft) shall meet or exceed the following.

Frequency (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	155	200
PSELFEXT Loss Worst Pair (dB)	63.8	52.7	44.8	40.7	38.7	34.9	28.8	24.8	20.0	17.7

- j) The return loss @ 20 degrees Celsius  $\pm$  3 degrees (68 degrees F  $\pm$  5.5 degrees) between pairs in a cable for a length of 100m (328ft) shall meet or exceed the following

Frequency (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	155	200	300	350
Return Loss Worst Pair (dB)	20.0	23.3	25.5	25.5	25.5	24.4	22.7	21.5	20.4	19.8	18.8	18.4

## 3. Design Make:

## a) Berk-Tek LANmark-350, Enhanced Cat 5e (CMP Plenum-PVC Alloy)

Color	Box	Reel
White	10032072	10032071
Blue	10032065	10032064
Gray	10032079	10032078
Yellow	10032060	10032059
Green	10032086	10032085
Pink	10032068	10032069
Red	10032076	10032075
Black	10034514	10032102
Violet	10032088	10032087
Orange	10032082	10032081

## b) Berk-Tek LANmark-350, Enhanced Cat 5e (CMR Riser -PVC)

Color	Box	Reel
White	10032434	10032433
Blue	10032426	10032425
Gray	10032447	10032446
Yellow	10032419	10032418
Green	10032428	10032427
Pink	10034195	10032441
Red	10032491	10032490
Black	10032480	10033697
Violet	10032440	10033568
Orange	10032465	10032464

## 2.7 BACKBONE CABLE

## A. Indoor/Outdoor Optical Fiber Non-Conductive Plenum (OFNP) Loose Tube With Laser Enhanced 62.5/125 Optical Fibers

1. Each Multimode Fiber shall be:
  - a) Graded-index optical fiber wave-guide with nominal 62.5/125 $\mu$ m-core/cladding diameter.
  - b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
  - c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
  - d) Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455—204.
  - e) The measurements shall be performed at 23 degrees C +/- 5 degrees.
  - f) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.0
  - g) Bandwidth 200 MHz-km @ 850nm.
  - h) Bandwidth 500 MHz-km @ 1300nm.
  - i) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 500m/1000m for 850nm and 1300nm respectively
2. Physical Characteristics:
  - a) Shall be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
  - b) Shall be suitable for use in risers, plenums and horizontal applications.

- c) Shall have a dry water blocking system for cable core and buffer tubes.
- d) Shall be available with a fiber strand count range from 6 to 144.
- e) Shall have a 3.0 mm sub-unit diameter.
- f) Shall have and be marked with an UL-OFNP and OFN FT6 Flame Rating.
- g) Shall comply with the requirements of ICEA S-83-596 & ANSI/ICEA S-87-640.
- h) Strength members shall be dielectric and may be either fiberglass or aramid yarn.
- i) Suitable for underground or aboveground conduits.
- j) Loose Tube fibers shall be color coded in accordance with EIA / TIA 598 with an overall blue jacket.
- k) Shall have a ripcord for overall jacket.
- l) Suitable for operation between -40° to +75° C
- m) Shall be UV resistant
- n) Shall be of an all dielectric design

3. Design Make:

- a) Berk-Tek Adventum optical fiber cable with GIGAlite 62.5/125 micron fiber
  - Part # LTP006-GB3510/25 (6-fiber, GIGAlite optical fiber)
  - Part # LTP008-GB3510/25 (8-fiber, GIGAlite optical fiber)
  - Part # LTP012-GB3510/25 (12-fiber, GIGAlite optical fiber)
  - Part # LTP12B018-GB3510/25 (18-fiber, GIGAlite optical fiber)
  - Part # LTP12B 024-GB3510/25 (24-fiber, GIGAlite optical fiber)
  - Part # LTP12B 036-GB3510/25 (36-fiber, GIGAlite optical fiber)
  - Part # LTP12B 048-GB3510/25 (48-fiber, GIGAlite optical fiber)
  - Part # LTP12B 060-GB3510/25 (60-fiber, GIGAlite optical fiber)
  - Part # LTP12B 072-GB3510/25 (72-fiber, GIGAlite optical fiber)
  - Part # LTP12B096-GB3510/25 (96 fiber, GIGAlite optical fiber)
  - Part # LTP12B144-GB3510/25(144 fiber, GIGAlite optical fiber)

B. Indoor/Outdoor Optical Fiber Non-Conductive Plenum (OFNP) Loose Tube With Laser Enhanced 50/125 Optical Fibers

1. Each Multimode Fiber shall be:

- a) Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
- b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
- c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
- d) Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455—204.
- e) The measurements shall be performed at 23 degrees C +/- 5 degrees.
- f) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
- g) Bandwidth 500 MHz-km @ 850nm.
- h) Bandwidth 500 MHz-km @ 1300nm.
- i) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 600m/2000m for 850nm and 1300nm respectively

2. Physical Characteristics:

- a) Shall be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
- b) Shall be suitable for use in risers, plenums and horizontal applications.
- c) Shall have a dry water blocking system for cable core and buffer tubes.
- d) Shall be available with a fiber strand count range from 6 to 72.
- e) Shall have a 3.0 mm sub-unit diameter.
- f) Shall have and be marked with an UL-OFNP and OFN FT6 Flame Rating.
- g) Shall comply with the requirements of ICEA S-83-596 & ANSI/ICEA S-87-640.
- h) Strength members shall be dielectric and may be either fiberglass or aramid yarn.
- i) Suitable for underground or aboveground conduits.

- j) Loose Tube fibers shall be color coded in accordance with EIA / TIA 598 with an overall dark blue jacket.
- k) Shall have a ripcord for overall jacket.
- l) Suitable for operation between -40° to +75° C
- m) Shall be UV resistant
- n) Shall be of an all dielectric design
- o) Shall have a maximum installation tension of 300 lbs for cables without dielectric strength member and 600 lbs for cables with dielectric strength members.

3. Design Make:

- a) Berk-Tek Adventum optical fiber cable with GIGAlite 50/125 micron fiber
  - Part # LTP006-LB3515/55 (6-fiber, GIGAlite optical fiber)
  - Part # LTP008-LB3515/55 (8-fiber, GIGAlite optical fiber)
  - Part # LTP012-LB3515/55 (12-fiber, GIGAlite optical fiber)
  - Part # LTP12B018-LB3515/55 (18-fiber, GIGAlite optical fiber)
  - Part # LTP12B 024-LB3515/55 (24-fiber, GIGAlite optical fiber)
  - Part # LTP12B 036-LB3515/55 (36-fiber, GIGAlite optical fiber)
  - Part # LTP12B 048-LB3515/55 (48-fiber, GIGAlite optical fiber)
  - Part # LTP12B 060-LB3515/55 (60-fiber, GIGAlite optical fiber)
  - Part # LTP12B 072-LB3515/55 (72-fiber, GIGAlite optical fiber)
  - Part # LTP12B096 – LB3515/55 (96 fiber GIGAlite optical fiber)
  - Part # LTP12B144 – LB3515/55 (144 fiber GIGAlite optical fiber)

C. Indoor/Outdoor Optical Fiber Non-Conductive Plenum (OFNP) Loose Tube With 10 Gigabit Laser Optimized 50/125 Optical Fibers

1. Each Multimode Fiber shall be:

- a) Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
- b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
- c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
- d) Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455—204 for overfilled launch.
- e) The measurements shall be performed at 23 degrees C +/- 5 degrees.
- f) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
- g) Bandwidth: > 1500 MHz-km @ 850nm for overfilled launch,
- h) Bandwidth 500 MHz-km @ 1300nm.
- i) Bandwidth 2000 MHz-km characterized using FOTP 220
- j) Optical Fiber shall be laser optimized and guaranteed for 10 Gigabit Ethernet distances of 300m/300m for 850nm and 1300nm respectively
- j) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 1000m/550m for 850nm and 1300nm respectively

2. Physical Characteristics:

- a) Shall be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
- b) Shall be suitable for use in risers, plenums and horizontal applications.
- c) Shall have a dry water blocking system for cable core and buffer tubes.
- d) Shall be available with a fiber strand count range from 6 to 144.
- e) Shall have a 3.0 mm sub-unit diameter.
- f) Shall have and be marked with an UL-OFNP and OFN FT6 Flame Rating.
- g) Shall comply with the requirements of ICEA S-83-596 & ANSI/ICEA S-87-640.
- h) Strength members shall be dielectric and may be either fiberglass or aramid yarn.
- i) Suitable for underground or aboveground conduits.

- j) Loose Tube fibers shall be color coded in accordance with EIA / TIA 598 with an overall blue jacket.
- k) Shall have a ripcord for overall jacket.
- l) Suitable for operation between -40° to +75° C
- m) Shall be UV resistant
- n) Shall be of an all dielectric design

3. Physical Characteristics:

- a) Berk-Tek Adventum optical fiber cable with GIGAlite-10 laser optimized 50/125 micron fiber
  - Part # LTP006-EB3510/25 (6-fiber, GIGAlite-10 optical fiber)
  - Part # LTP008-EB3510/25 (8-fiber, GIGAlite-10 optical fiber)
  - Part # LTP012-EB3510/25 (12-fiber, GIGAlite-10 optical fiber)
  - Part # LTP12B018-EB3510/25 (18-fiber, GIGAlite-10 optical fiber)
  - Part # LTP12B 024-EB3510/25 (24-fiber, GIGAlite-10 optical fiber)
  - Part # LTP12B 036-EB3510/25 (36-fiber, GIGAlite-10 optical fiber)
  - Part # LTP12B 048-EB3510/25 (48-fiber, GIGAlite-10 optical fiber)
  - Part # LTP12B 060-EB3510/25 (60-fiber, GIGAlite-10 optical fiber)
  - Part # LTP12B 072-EB3510/25 (72-fiber, GIGAlite-10 optical fiber)
  - Part # LTP12B096-EB3510/25 (96 fiber, GIGAlite-10 optical fiber)
  - Part # LTP12B144-EB3510/25(144 fiber, GIGAlite-10 optical fiber)

D. Optical Fiber Non Conductive Riser (OFNR) Loose Tube with Laser Enhanced 62.5/125 optical fiber

1. Each Multimode Fiber shall be:

- a) Graded-index optical fiber wave-guide with nominal 62.5/125µm-core/cladding diameter.
- b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
- c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
- d) Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455—204.
- e) The measurements shall be performed at 23 degrees C +/- 5 degrees.
- f) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.0
- g) Bandwidth 200 MHz-km @ 850nm.
- h) Bandwidth 500 MHz-km @ 1300nm.
- i) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 500m/1000m for 850nm and 1300nm respectively

2. Physical Characteristics:

- a) Shall be suitable for use in both outdoor and indoor riser applications without the use of a transition at the building entrance.
- b) Shall be of a loose tube construction.
- c) Shall have a water blocking design of an all-dielectric construction.
- d) Shall be available with a fiber strand count range from 2 to144.
- e) Shall have a 3.0 mm sub-unit diameter.
- f) Shall have an UL-OFNR/FT4 Flame Rating.
- g) Shall have dry water-blocking system in cable core and buffer tubes.
- h) Suitable for underground or aboveground conduits.
- i) Loose tube fibers shall be color coded in accordance with EIA/TIA 598 with an overall black jacket.
- j) Shall be suitable for operation between -40° to +75° C.
- k) Shall have a maximum installation tension of 300 lbs for cables without dielectric strength member and 600 lbs for cables with dielectric strength members.
- l) Shall comply with requirements of ICEA S-83-596 & ANSI/ICEA S-87-640

## 3. Physical Characteristics:

- a) Berk-Tek Adventum Riser Series cable with GIGAlite 62.5/125 micron fiber:
  - Part # LTR002-GB3510/25 (2-fiber, GIGAlite optical fiber)
  - Part # LTR004-GB3510/25 (4-fiber, GIGAlite optical fiber)
  - Part # LTR006-GB3510/25 (6-fiber, GIGAlite optical fiber)
  - Part # LTR008-GB3510/25 (8-fiber, GIGAlite optical fiber)
  - Part # LTR012-GB3510/25 (12-fiber, GIGAlite optical fiber)
- b) Berk-Tek High Fiber Count Adventum Riser series with GIGAlite 62.5/125 micron fiber:
  - Part # LTR12B018-GB3510/25 (18-fiber, GIGAlite optical fiber)
  - Part # LTR12B024-GB3510/25 (24-fiber, GIGAlite optical fiber)
  - Part # LTR12B036-GB3510/25 (36-fiber, GIGAlite optical fiber)
  - Part # LTR12B048-GB3510/25 (48-fiber, GIGAlite optical fiber)
  - Part # LTR12B060-GB3510/25 (60-fiber, GIGAlite optical fiber)
  - Part # LTR12B072-GB3510/25 (72-fiber, GIGAlite optical fiber)
  - Part # LTR12B084-GB3510/25 (84-fiber, GIGAlite optical fiber)
  - Part # LTR12B096-GB3510/25 (96-fiber, GIGAlite optical fiber)
  - Part # LTR12B108-GB3510/25 (108-fiber, GIGAlite optical fiber)
  - Part # LTR12B120-GB3510/25 (120-fiber, GIGAlite optical fiber)
  - Part # LTR12B132-GB3510/25 (132-fiber, GIGAlite optical fiber)
  - Part # LTR12B144-GB3510/25 (144-fiber, GIGAlite optical fiber)

## E. Optical Fiber Non Conductive Riser (OFNR) Loose Tube with Laser Enhanced 50/125 optical fiber

## 1. Each Multimode Fiber shall be:

- a) Graded-index optical fiber wave-guide with nominal 50/125 $\mu$ m-core/cladding diameter.
- b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
- c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
- d) Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455—204.
- e) The measurements shall be performed at 23 degrees C +/- 5 degrees.
- f) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
- g) Bandwidth 500 MHz-km @ 850nm.
- h) Bandwidth 500 MHz-km @ 1300nm.
- i) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 600m/2000m for 850nm and 1300nm respectively

## 2. Physical Characteristics:

- a) Shall be suitable for use in both outdoor and indoor riser applications without the use of a transition at the building entrance.
- b) Shall be of a loose tube construction.
- c) Shall have a water blocking design of an all-dielectric construction.
- d) Shall be available with a fiber strand count range from 2 to144.
- e) Shall have a 3.0 mm sub-unit diameter.
- f) Shall have an UL-OFNR/FT4 Flame Rating.
- g) Shall have dry water-blocking system in cable core and buffer tubes.
- h) Suitable for underground or aboveground conduits.
- i) Loose tube fibers shall be color coded in accordance with EIA/TIA 598 with an overall black jacket.
- j) Shall be suitable for operation between -40° to +75° C.
- k) Shall have a maximum installation tension of 300 lbs for cables without dielectric strength member and 600 lbs for cables with dielectric strength members.

- l) Shall comply with requirements of ICEA S-83-596 & ANSI/ICEA S-87-640
3. Design Make:
- a) Berk-Tek Adventum Riser Series cable with GIGAlite 62.5/125 micron fiber:  
Part # LTR002-LB3510/25 (2-fiber, GIGAlite optical fiber)  
Part # LTR004-LB3510/25 (4-fiber, GIGAlite optical fiber)  
Part # LTR006-LB3510/25 (6-fiber, GIGAlite optical fiber)  
Part # LTR008-LB3510/25 (8-fiber, GIGAlite optical fiber)  
Part # LTR012-LB3510/25 (12-fiber, GIGAlite optical fiber)
- b) Berk-Tek High Fiber Count Adventum Riser series with GIGAlite 62.5/125 micron fiber:  
Part # LTR12B018-LB3510/25 (18-fiber, GIGAlite optical fiber)  
Part # LTR12B024-LB3510/25 (24-fiber, GIGAlite optical fiber)  
Part # LTR12B036-LB3510/25 (36-fiber, GIGAlite optical fiber)  
Part # LTR12B048-LB3510/25 (48-fiber, GIGAlite optical fiber)  
Part # LTR12B060-LB3510/25 (60-fiber, GIGAlite optical fiber)  
Part # LTR12B072-LB3510/25 (72-fiber, GIGAlite optical fiber)  
Part # LTR12B084-LB3510/25 (84-fiber, GIGAlite optical fiber)  
Part # LTR12B096-LB3510/25 (96-fiber, GIGAlite optical fiber)  
Part # LTR12B108-LB3510/25 (108-fiber, GIGAlite optical fiber)  
Part # LTR12B120-LB3510/25 (120-fiber, GIGAlite optical fiber)  
Part # LTR12B132-LB3510/25 (132-fiber, GIGAlite optical fiber)  
Part # LTR12B144-LB3510/25 (144-fiber, GIGAlite optical fiber)
- F. Optical Fiber Non Conductive Riser (OFNR) Loose Tube With 10 Gigabit Laser Optimized 50/125 Optical Fibers
1. Each Multimode Fiber shall be:
- a) Graded-index optical fiber wave-guide with nominal 50/125 $\mu$ m-core/cladding diameter.
- b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
- c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
- d) Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455—204 for overfilled launch.
- e) The measurements shall be performed at 23 degrees C +/- 5 degrees.
- f) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
- g) Bandwidth: > 1500 MHz-km @ 850nm for overfilled launch,
- h) Bandwidth 500 MHz-km @ 1300nm.
- i) Bandwidth 2000 MHz-km characterized using FOTP 220
- j) Optical Fiber shall be laser optimized and guaranteed for 10 Gigabit Ethernet distances of 300m/300m for 850nm and 1300nm respectively
- k) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 1000m/550m for 850nm and 1300nm respectively
2. Physical Characteristics:
- a) Shall be suitable for use in both outdoor and indoor riser applications without the use of a transition at the building entrance.
- b) Shall be of a loose tube construction.
- c) Shall have a water blocking design of an all-dielectric construction.
- d) Shall be available with a fiber strand count range from 2 to144.
- e) Shall have a 3.0 mm sub-unit diameter.
- f) Shall have an UL-OFNR/FT4 Flame Rating.
- g) Shall have dry water-blocking system in cable core and buffer tubes.
- h) Suitable for underground or aboveground conduits.

- i) Loose tube fibers shall be color coded in accordance with EIA/TIA 598 with an overall black jacket.
- j) Shall be suitable for operation between -40° to +75° C.
- k) Shall have a maximum installation tension of 300 lbs for cables without dielectric strength member and 600 lbs for cables with dielectric strength members.
- l) Shall comply with requirements of ICEA S-83-596 & ANSI/ICEA S-87-640

3. Design Make:

- a) Berk-Tek Adventum Riser Series cable with GIGAlite-10 laser optimized 50/125 micron fiber
  - Part # LTR002-EB3510/25 (2-fiber, GIGAlite-10 optical fiber)
  - Part # LTR004-EB3510/25 (4-fiber, GIGAlite-10 optical fiber)
  - Part # LTR006-EB3510/25 (6-fiber, GIGAlite-10 optical fiber)
  - Part # LTR008-EB3510/25 (8-fiber, GIGAlite-10 optical fiber)
  - Part # LTR012-EB3510/25 (12-fiber, GIGAlite-10 optical fiber)
- b) Berk-Tek High Fiber Count Adventum Riser series GIGAlite-10 laser optimized 50/125 micron fiber
  - Part # LTR12B018-EB3510/25 (18-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B024-EB3510/25 (24-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B036-EB3510/25 (36-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B048-EB3510/25 (48-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B060-EB3510/25 (60-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B072-EB3510/25 (72-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B084-EB3510/25 (84-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B096-EB3510/25 (96-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B108-EB3510/25 (108-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B120-EB3510/25 (120-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B132-EB3510/25 (132-fiber, GIGAlite-10 optical fiber)
  - Part # LTR12B144-EB3510/25 (144-fiber, GIGAlite optical fiber)

G. Optical Fiber NON CONDUCTIVE Plenum (OFNP) Tight Buffered With GIGAlite LASER ENHANCED 62.5/125 optical fibers

1 Each Multimode Fiber shall be:

- a) Graded-index optical fiber wave-guide with nominal 62.5/125 $\mu$ m-core/cladding diameter.
- b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
- c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61. Information transmission capacity shall be measured in accordance with the latest revision level of ANSI/EIA/TIA-455—204
- d) The measurements shall be performed at 23 degrees C +/- 5 degrees.
- e) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.0
- f) Bandwidth 200 MHz-km @ 850nm.
- g) Bandwidth 500 MHz-km @ 1300nm.
- h) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 500m/1000m for 850nm and 1300nm respectively
- i) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 600m/1200m for 850nm and 1300nm respectively

2 Physical Characteristics:

- a) Shall be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
- b) Shall be suitable for use in risers, plenums and horizontal applications.

- c) 900µm tight-buffered construction
- d) Shall be available with a fiber stand count range from 6 to 72.
- e) Shall have an UL-OFNP/FT6 Flame Rating.
- f) Strength members shall be aramid yarn.
- g) Suitable for underground or aboveground conduits.
- h) Tight buffered fibers shall be color coded in accordance with EIA/TIA 598 with an overall orange jacket.
- i) Suitable for operation between -20° to 75° C.
- j) Shall comply with ICEA S-83-596

### 3 Design Make:

- a) Berk-Tek Premise Distribution cable with GIGAlite 62.5/125 micron fiber
  - Part # PDP006- GB3510/25 (6-fiber, GIGAlite optical fiber)
  - Part # PDP008- GB3510/25 (8-fiber, GIGAlite optical fiber)
  - Part # PDP012- GB3510/25 (12-fiber, GIGAlite optical fiber)
  - Part # PDP6B018- GB3510/25 (18-fiber, GIGAlite optical fiber)
  - Part # PDP6B024- GB3510/25 (24-fiber, GIGAlite optical fiber)
  - Part # PDP12B024- GB3510/25 (24-fiber, GIGAlite optical fiber)
  - Part # PDP6B036- GB3510/25 (36-fiber, GIGAlite optical fiber)
  - Part # PDP12B048- GB3510/25 (48-fiber, GIGAlite optical fiber)
  - Part # PDP12B060- GB3510/25 (60-fiber, GIGAlite optical fiber)
  - Part # PDP12B072- GB3510/25 (72-fiber, GIGAlite optical fiber)
  - Part # PDP12B144 –GB3510/25 (144 fiber, GIGAlite optical fiber)

### H. Optical Fiber NON CONDUCTIVE Plenum (OFNP) Tight Buffered With GIGAlite LASER ENHANCED 50/125 optical fibers

- 1. Each Multimode Fiber shall be:
  - a) Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
  - b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
  - c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
  - d) Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455—204.
  - e) The measurements shall be performed at 23 degrees C +/- 5 degrees.
  - f) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
  - g) Bandwidth 500 MHz-km @ 850nm.
  - h) Bandwidth 500 MHz-km @ 1300nm.
  - i) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 600m/2000m for 850nm and 1300nm respectivelyPhysical Characteristics:
  - j) Shall be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
  - k) Shall be suitable for use in risers, plenums and horizontal applications.
  - l) 900µm tight-buffered construction
  - m) Shall be available with a fiber stand count range from 6 to 72.
  - n) Shall have an UL-OFNP/FT6 Flame Rating.
  - o) Strength members shall be aramid yarn.
  - p) Suitable for underground or aboveground conduits.
  - q) Tight buffered fibers shall be color coded in accordance with EIA/TIA 598 with an overall orange jacket.
  - r) Suitable for operation between -20° to 75° C.
  - s) Shall comply with ICEA S-83-596

## 3. Design Make

Berk-Tek Premise Distribution Cable with 50/125 micron GIGAlite fiber

Part # PDP006- LB3510/25 (6-fiber, GIGAlite optical fiber)

Part # PDP008- LB3510/25 (8-fiber, GIGAlite optical fiber)

Part # PDP012- LB3510/25 (12-fiber, GIGAlite optical fiber)

Part # PDP6B018- LB3510/25 (18-fiber, GIGAlite optical fiber)

Part # PDP6B024- LB3510/25 (24-fiber, GIGAlite optical fiber)

Part # PDP12B024- LB3510/25 (24-fiber, GIGAlite optical fiber)

Part # PDP6B036- LB3510/25 (36-fiber, GIGAlite optical fiber)

Part # PDP12B048- LB3510/25 (48-fiber, GIGAlite optical fiber)

Part # PDP12B060- LB3510/25 (60-fiber, GIGAlite optical fiber)

Part # PDP12B072- LB3510/25 (72-fiber, GIGAlite optical fiber)

Part # PDP12B144 –LB3510/25 (144 fiber, GIGAlite optical fiber)

## I. Optical Fiber NON CONDUCTIVE Plenum (OFNP) Tight Buffered With 10 Gigabit Laser Optimized 50/125 Optical Fibers

## 1. Each Multimode Fiber shall be:

- a) Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
- b) The fiber shall comply with the latest revision of ANSI/EIA/TIA-4920000.
- c) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
- d) Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455—204 for overfilled launch.
- e) The measurements shall be performed at 23 degrees C +/- 5 degrees.
- f) Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
- g) Bandwidth: > 1500 MHz-km @ 850nm for overfilled launch,
- h) Bandwidth 500 MHz-km @ 1300nm.
- i) Bandwidth 2000 MHz-km characterized using FOTP 220
- j) Optical Fiber shall be laser optimized and guaranteed for 10 Gigabit Ethernet distances of 300m/300m for 850nm and 1300nm respectively
- k) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 1000m/550m for 850nm and 1300nm respectively

## 2. Physical Characteristics:

- a) Shall be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
- b) Shall be suitable for use in risers, plenums and horizontal applications.
- c) 900µm tight-buffered construction
- d) Shall be available with a fiber stand count range from 6 to 72.
- e) Shall have an UL-OFNP/FT6 Flame Rating.
- f) Strength members shall be aramid yarn.
- g) Suitable for underground or aboveground conduits.
- h) Tight buffered fibers shall be color coded in accordance with EIA/TIA 598 with an overall orange jacket.
- i) Suitable for operation between -20° to 75° C.
- j) Shall comply with ICEA S-83-596

## 3. Design Make:

- a) Berk-Tek Premise Distribution fiber optic Cable with GIGAlite-10 laser optimized 50/125 micron fiber

Part # PDP006- EB3510/25 (6-fiber, GIGAlite-10 optical fiber)

Part # PDP008- EB3510/25 (8-fiber, GIGAlite-10 optical fiber)

Part # PDP012- EB3510/25 (12-fiber, GIGAlite-10 optical fiber)

Part # PDP6B018- EB3510/25 (18-fiber, GIGAlite-10 optical fiber)

Part # PDP6B024- EB3510/25 (24-fiber, GIGAlite-10 optical fiber)  
Part # PDP12B024- EB3510/25 (24-fiber, GIGAlite-10 optical fiber)  
Part # PDP6B036- EB3510/25 (36-fiber, GIGAlite-10 optical fiber)  
Part # PDP12B048- EB3510/25 (48-fiber, GIGAlite-10 optical fiber)  
Part # PDP12B060- EB3510/25 (60-fiber, GIGAlite-10 optical fiber)  
Part # PDP12B072- EB3510/25 (72-fiber, GIGAlite-10 optical fiber)  
Part # PDP12B144 –EB3510/25 (144 fiber, GIGAlite-10 optical fiber)

## 2.8 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 #6 AWG copper bonding conductor between the protector ground lug and the TR ground point. Approved manufacturer of protection units is Porta Systems.

## 2.9 PATCH CORDS

The contractor shall provide factory terminated and tested UTP and optical fiber patch cords and equipment cords for the complete cabling system. The UTP patch cables shall meet the requirements of ANSI/TIA/EIA-568-B for patch cord testing.

A. Copper (UTP) patch cords shall:

1. be an Ortronics MC5EXX-xx Category 5e enhanced frequency series for a NetClear<sup>GT</sup> solution.
2. be manufactured in standard lengths of 3 feet, 5 feet, 7 feet, 9 feet, and 15 feet.
3. be constructed of 100 ohm, 4 pair, 24 AWG, stranded conductor, unshielded twisted pair copper per the requirements of the ANSI/TIA/EIA 568-B.2 standard.
4. have contact plating shall be a minimum of 50 micro inches of gold in the contact area over 50 micro-inch of nickel, compliant with FCC part 68.5.
5. be ANSI/TIA/EIA 568-B compliant.
6. use 8 position connector, un-keyed.
7. be capable of universal T568-A or T568-B wiring schemes.
8. Modular connector shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
9. be constructed of 100 ohm, 4-pair, 24 AWG, stranded conductor, unshielded twisted pair copper per the requirements of the ANSI/TIA/EIA 568-B standard for category 5e performance.
10. have a performance marking indelibly labeled on the jacket (by the manufacturer).
11. have the ability to accept color-coded labels compliant with TIA/EIA-606 labeling specifications.
12. have "snagless" protection for the locking tab to prevent snagging and to protect locking tab in tight locations.
13. have strain relief boot to protect UTP cable from excessive bending stress.
14. be manufactured by an ISO 9001 registered company.

B. Optical Fiber patch cords shall:

1. contain two (2) multi-mode optical fibers.
2. use multi-mode, graded-index fibers with a 62.5 micron core.
3. be capable of transmission at both 850 nm and 1300 nm wavelengths.
4. be manufactured in standard lengths of 1 m (3.27 ft), 2 m (6.56 ft), 3 m (9.84 ft), 4 m (13.11 ft), 7m (22.95 ft), and 10 m (32.79 ft), and special ordered in any other lengths.
5. shall have actual measured loss of the patch cord be supplied with the patch cord
6. be manufactured by an ISO 9001 registered company.

## 2.10 GROUNDING AND BONDING

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.
- B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding bus bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. 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, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
- D. 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 busbars shall be identified and labeled in accordance with the System Documentation Section of this specification.

## 2.11 FIRESTOP

- A. A firestop 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. Firestop 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 firestop 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 firestopped.
- C. Firestop 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 firestop system, stamped/embossed by the PE shall be provided to the Owner's Technical Representative prior to installing the firestop system(s).

**PART 3 EXECUTION****3.1 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 12 mm (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 25mm (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).

**3.2 HORIZONTAL DISTRIBUTION CABLE INSTALLATION**

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the TIA/EIA-569-A maximum fill for the particular raceway type or 40%.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. 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.
- F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.

- G. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- H. 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.
- I. 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.
- J. 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.
- K. 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.
- L. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- M. 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.
- N. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

### 3.3 HORIZONTAL CROSS CONNECT INSTALLATION

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B standard, manufacturer's recommendations and best industry practices.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. 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.
- E. The cable jacket shall be maintained as close as possible to the termination point.
- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

### 3.4 OPTICAL FIBER TERMINATION HARDWARE

- A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.
- B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- C. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- D. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- E. A maximum of 12 strands of fiber shall be spliced in each tray
- F. All spare strands shall be installed into spare splice trays.

### 3.5 BACKBONE CABLE INSTALLATION

- A. Backbone cables shall be installed separately from horizontal distribution cables
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits
- D. Where backbone cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit.
- E. 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.
- F. All backbone cables shall be securely fastened to the side wall of the TR on each floor.
- G. Backbone cables spanning more than three 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.
- H. 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.
- I. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

### 3.6 COPPER TERMINATION HARDWARE

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed 12 mm (one-half inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. 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.
- E. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.
- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

### 3.7 RACKS

- A. Racks shall be securely attached to the concrete floor using a minimum 3/8" hardware or as required by local codes.
- B. Racks shall be placed with a minimum of 36 inch clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.
- C. All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 9.0 of this document.
- D. 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.
- E. Wall mounted termination block fields shall be mounted on 4' x 8' x .75" void free plywood. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.
- F. Wall mounted termination block fields shall be installed with the lowest edge of the mounting frame 18" from the finished floor.

### 3.8 FIRESTOP SYSTEM

- A. All firestop 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.

### 3.9 GROUNDING SYSTEM

- A. The TBB shall be designed and/or approved by a qualified PE, licensed in the state that the work is to be performed. The TBB shall adhere to the recommendations of the TIA/EIA-607 standard, and shall be installed in accordance with best industry practice.
- B. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed electrical contractor.

### 3.10 IDENTIFICATION AND LABELING

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets and follow the guidelines set forth in TIA/EIA-606-A. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- B. All label printing will be machine generated by Ortronics LabelMo 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.

### 3.11 TESTING AND ACCEPTANCE

#### A. General

- 1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B (B.1, B.2, B.3) and Ortronics Certification Program Information Manual. 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.
- 2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the Ortronics 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.

#### B. 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 IIE or better test unit for category 5e compliance.

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 5e Performance

Follow the Standards requirements established in:

- ANSI/TIA/EIA-568-B .1

A level IIE or better test unit is required to verify category 5e performance.

The basic tests required are:

- Wire Map
- Length
- Attenuation
- NEXT (Near end crosstalk)
- Return Loss
- ELFEXT Loss
- Propagation Delay
- Delay skew
- PSNEXT (Power sum near-end crosstalk loss)
- PSELFEXT (Power sum equal level far-end crosstalk loss)

#### C. Fiber Testing

1. All fiber testing shall be performed on all fibers in the completed end to end system. There shall be no splices unless clearly defined in an RFP. Testing shall consist of an end to end power meter test performed per 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 singlemode) in one direction.
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 a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

### 3.12 SYSTEM DOCUMENTATION

- A. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.
- B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (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.
- C. 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.

### 3.13 TEST RESULTS

- A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version 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.
- B. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B including applicable TSB's and amendments. The appropriate level IIE tester shall be used to verify Category 5e cabling systems.

- C. 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 (3.5" diskette or CD-ROM).
- D. 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.

#### 3.14 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. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD rel. 14) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.
- B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD rel. 14) form.

### PART 4 WARRANTY AND SERVICES

#### 4.1 WARRANTY

- A. The NetClear Warranty combines a 25-year extended product warranty with a 25-year applications assurance warranty. Berk-Tek and Ortronics (Manufacturer) provides the warranty directly to the end-user.
- B. An Extended Product Warranty shall be provided which warrants functionality of all components used in the system for 25 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.
- C. The Application Assurance Warranty shall cover the failure of the wiring system to support the applications that are designed for the link/channel specifications of TIA/EIA 568B. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.
- D. The contractor shall provide a warranty on the physical installation.

#### 4.2 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 performed by the Ortronics CIP Contractor / Berk-Tek OASIS Integrator shall be added to the NetClear<sup>GT</sup> warranty when registered with Ortronics or Berk-Tek.

#### 4.3 FINAL ACCEPTANCE & SYSTEM CERTIFICATION

- A. 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 Ortronics or Berk-Tek, registering the installation.

**END OF SECTION**