

- 1) The operator shall be aware of any magnetic anomalies and shall consider these influences in the operation of the guidance system, if using a magnetic system.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which the new exterior telecommunications pathways are to be installed. Provide notification, in writing, of conditions detrimental to proper completion of the work.
- B. Beginning of telecommunications pathway indicates Contractor acceptance of existing conditions.

3.2 TRENCHING AND BACKFILL

- A. Perform all trenching and backfill for new underground conduit system placement as reflected in the Contract Documents.
- B. Perform pavement removal and replacement as specified.
- C. Perform pavement marking as required and specified.
- D. All utilities to be located by contractor and exposed, if necessary, prior to construction.

3.3 CONDUIT SYSTEM PLACEMENT

- A. Place new conduit system including handholes and manholes as reflected in the Contract Documents.
- B. No pathways shall have more than 180 degrees of bends.
- C. Twelve inch (12 ") clearance from all utilities is to be preserved. If not possible conduit to be encased in concrete where proper distance cannot be achieved.
- D. Telecommunication ducts shall cross below gas piping.
- E. All conduits must be cleaned thoroughly prior to installation.
- F. During construction all ends of conduit shall be plugged to prevent water and other materials from entering conduits, manholes and buildings.

- G. New and reopened trenches located under asphalt roadways shall have concrete cap or be encased in concrete.
- H. Seal all conduit junctions and fittings watertight prior to pouring concrete.
- I. Unless otherwise noted on the Contract Documents a minimum of 24" depth shall be required above conduits.
- J. Transition to PVC conduit five feet (5') from building outside wall penetrations.
- K. Bury underground plastic line marker one foot (1') above telecommunications conduit.
- L. The new conduit shall extend through the wall into the building, tunnel, or crawl space a minimum of 4".
- M. Handholes shall be placed with the long dimension in line with the conduit run. The conduit shall enter opposite ends of the short sides so that the handhole shall not be used as a 90 degree bend during cable installations.
- N. All conduits entering bottom of handhole shall be flush with the inside wall. Dirt shall be removed 6" below the bottom of conduits entering the handhole and pea-gravel shall be placed on the bottom to aid water dissipation.
- O. The ends of all metallic conduits shall be reamed and bushed.
- P. Plug ends of new conduit with watertight conduit plugs, removable conduit caulking compound, or conduit caps to ensure no foreign matter enters.

All ducts and conduits entering a building must be sealed to prevent intrusion of liquids and gases. Universal duct plugs are available in a variety of sizes for use in unoccupied ducts and conduits. In conduits where cable has been installed, conduits can be sealed using Foam Sealant, Puttys, Cementitious Compounds, and Hydraulic Cement.

All innerducts entering a building must be firestopped in accordance with ASTM E814 and UL 1479.

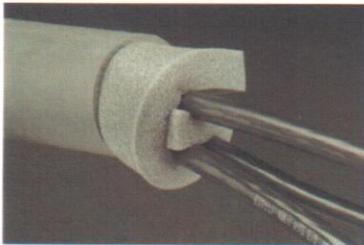
The preferred method for sealing entrance conduits is Foam Sealant.

To seal conduits entering a building utilizing Foam Sealant (Polywater® Duct Sealant) or equivalent follow the instructions below:



1.) If conduit has loose debris or rust, use a wire brush to remove all loose material. Clean cable(s) and conduit. This will remove contaminants and any residue. Roughing the surfaces with an abrasive such as steel wool or sand paper may increase the effectiveness of the Sealant.

Clean conduit with wire brush.



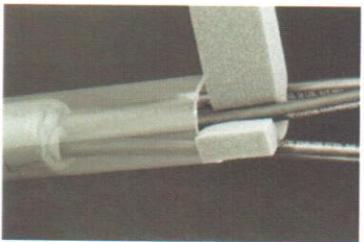
2.) Create a foam dam by wrapping foam strips around the cable (s) so that it fills the space between the cable and the conduit. The tail end of the foam strip should be at the top of the wrap. The foam strip will slow any existing water flow and contain the Sealant. Cut all foam to size as necessary.

Wrap cable (s) with foam strip



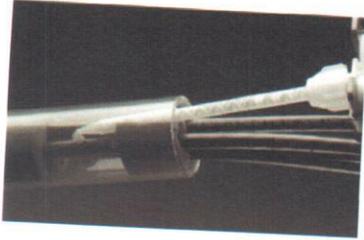
3.) Using a rod or screwdriver, push the foam 5 inches into the conduit. Make sure there are no voids in the foam dam for the Sealant to flow through.

Insert foam 5 inches



4.) Wrap a second foam strip around the cable (If more than one cable, separate cables with foam strip). Tail end of the foam strip should be at the top of the wrap. Push second foam strip into the conduit until the edge is flush with the conduit entrance.

separate cable (s) with foam



Dispensing the Foam Sealant

5.) Insert the mixing nozzle into top wrap of foam so the tip extends into the space between foam strips. Inject Sealant above cable for better coverage. Use desired amount of foam Sealant. Rapid injection will produce better mixing.

Sealant will expand fully in 2 to 5 minutes



Rising Foam

6.) Remove cartridge and mixing nozzle. Sealant may seep between the crevices of the foam dam as it expands. Excess sealant may be trimmed and removed.

Sealant will harden (set) in 10-15 minutes



Checking for voids

7.) After the Sealant has fully set and cured, use a screwdriver to check for voids in the Sealant. Foam Sealant should be solid throughout the conduit. If any holes or voids are detected during the inspection, use a screwdriver to cut into foam and enlarge a path for new material. Attach a new mixing nozzle and inject Sealant directly into the void area.

3.4 HORIZONTAL DIRECTIONAL DRILLING

- A. DC-Net Project Managers shall be notified 48 hours in advance of starting horizontal directional drilling. The drilling shall not begin until a DC-Net

- project manager is on site, and agrees that the proper preparations for the procedure have been made.
- B. No work shall commence until all Traffic Control and proper permits are in place as applicable for the specific operation.
 - C. Site Preparation:
 - 1) Prior to any alterations to the work site, all entry and exit points shall be legibly marked.
 - 2) No alterations to the work site beyond what is required shall be made.
 - D. Path Survey:
 - 1) The entire drill pathway shall be precisely surveyed with entry and exit stakes placed at their appropriate locations within the areas reflected in the Contract Documents.
 - 2) In the case of magnetic guidance systems, the drill pathway must be surveyed for any surface geomagnetic deviation and or anomalies.
 - E. All pertinent environmental regulations shall be observed.
 - F. Following drilling operations, all equipment shall be de-mobilized and the work site returned to its original condition. All excavations shall be backfilled and compacted to 95% of original density. Landscaping shall be restored to its original site condition.

3.5 SAFETY

- A. The contractor must comply with all Government regulations for asbestos, lead, and confined spaces.
- B. All applicable federal and local safety regulations shall be adhered to and conducted in a safe manner.
- C. Manholes shall be guarded per NESC C-2-1997, 423.A:
 - 1) When covers of manholes, handholes, or vaults are removed, the opening must be protected with a barrier, temporary cover, or other suitable safeguard.
- D. Test for gas in manholes and unventilated vaults per NESC C-2-1997, 423.b and C including but not limited to:

- 1) The atmosphere shall be tested for combustible or flammable gas(es) before entry.
 - 2) When combustible or flammable gas(es) are detected, the work area must be ventilated and made safe before entry.
 - 3) Unless utilizing continuous forced ventilation, a test must be made for oxygen deficiency.
 - 4) Provisions shall be made for adequate continuous supply of air. This statement reflects evaluation of both the quantity and quality of the air.
 - 5) No smoking shall be permitted in Manholes, Handholes, and or Vaults.
 - 6) Where open flames may be used in Manholes, Handholes, or Vaults, extra precautions must be taken to ensure adequate ventilation.
- E. All outside plant (OSP) construction must be fenced off and holes must be covered off hours and when not in use.

Chapter 3.) 271100 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

SECTION 271100 EQUIPMENT ROOM FITTINGS

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. Make available all services, labor, materials, tools, and equipment essential for the complete and proper installation within the Telecommunications Rooms (TRs) and the Equipment Rooms (ERs) as specified in the Contract Documents.
- B. This section includes the minimum requirements and installation methods for the following:
 - 1) Equipment Racks and Cable Routing Hardware

- 2) Copper Terminations Equipment
- 3) Fiber Termination Equipment
- 4) Grounding and Bonding

1.2 QUALITY ASSURANCE

- A. All installation work in the TRs and ERs shall be performed in a professional and workmanlike manner. All methods of construction that are not explicitly described shall be subject to the control of DC-Net.
- B. All equipment and materials shall be of the quality and manufacturer indicated in the Contract Documents. The equipment specified is based on the acceptable manufacturer listed.
- C. Materials and work specified herein shall comply with the relevant requirements of:
 - 1) ANSI/NFPA 70 – National Electrical Code (NEC) Articles 250, 300 and 645.
 - 2) ANSI/TIA -568-C.0- Generic Telecommunications Cabling Standard.
 - 3) ANSI/TIA -568-C.1- Commercial Building Telecommunications Cabling Standard.
 - 4) ANSI/TIA -568-B.2- Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components, including applicable addendum.
 - 5) ANSI/TIA -568- C.3 – Optical Fiber Cabling Components Standard
 - 6) ANSI/TIA -569- B – Commercial Building Standard for Telecommunications Pathways and Spaces
 - 7) ANSI/TIA -604 Series – Fiber Optic Connector Intermateability Standards
 - 8) ANSI/TIA -606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings
 - 9) ANSI/TIA -607 – Commercial Building Grounding and Bonding Requirements for Telecommunications

10) BICSI Telecommunications Distribution Methods Manual

11) FCC CFR 47 Part 68 – Connection of Terminal Equipment to the Telephone Network

1.3 ARCHITECTURAL REQUIREMENTS

- A. New Telecommunications Rooms (TRs) and Equipment Rooms (ERs) shall be designed in compliance with the space, electrical, and environmental requirements of ANSI/TIA - 569 -A – Commercial Building Standard for Telecommunications Pathways and Spaces. Smaller spaces or enclosures shall not be acceptable without prior written approval from DC-Net.
- B. The locations for all TRs and ERs shall be designed to be within a 150' radius of all areas to be served with the understanding to maintain ANSI/TIA distance standards for telecommunications cabling.
- C. Corridor access with the door to swing out is required for all new TRs and ERs, which shall comply with common area access requirements. No other rooms shall lead directly to or from the TR or ER.
- D. All walls of the TRs and ERs will be covered with rigidly fixed ¾" A - C fire - resistant or non-combustible plywood backboard, void free, 8' high, painted with two coats of light colored fire retardant paint.
- E. TRs and Telecom ERs shall be open to the structure above (no suspended ceiling).
- F. The floor, walls and ceiling of the TRs and ERs shall be sealed to reduce dust. The floor shall be sealed concrete.
- G. The TRs and ERs shall not be shared for other purposes including, but not limited to, custodial, access services, electrical, mechanical, storage, etc.
- H. Equipment not related to the support of the TR or ER (e.g., piping, ductwork, pneumatic piping, electrical equipment, plumbing, etc.) should not be installed in, pass through, or enter the room.
- I. No equipment, hardware, piping, etc. shall be added in or near any TR or ER that will change the temperature or humidity of these rooms without written agreement from DC-Net prior to design and installation.

- J. The MDF room shall be designed to allow future UPS floor space in the footprint. Empty conduits are to be installed running from the UPS location to each data closet. Ensure sufficient wall space is available for future electrical breaker panels that will feed all communication rooms.
- K. New TRs and ERs shall not be adjacent to any electrical room or room containing a transformer or motors. Electrical power systems in or adjacent to the TRs and ERs should be configured such that their electromagnetic fields do not interfere with telecom cabling or equipment.
- L. As-built files shall be a part of the final punch list and not complete until DC-Net receives the final as-built files.

1.4 COMMUNICATIONS REQUIREMENTS

- A. New Telecommunications Rooms (TRs) and Equipment Rooms (ERs) shall be designed in compliance with the space, electrical, and environmental requirements of ANSI/TIA - 569 -A – Commercial Building Standard for Telecommunications Pathways and Spaces. Smaller spaces or enclosures shall not be acceptable without prior written approval from DC-Net.
- B. The locations for all TRs and ERs shall be designed to be within a 150' radius of all areas to be served with the understanding to maintain ANSI/TIA distance standards for telecommunications cabling.
- C. All walls of the TRs and ERs will be covered with rigidly fixed $\frac{3}{4}$ " A - C fire - resistant or non-combustible plywood backboard, void free, 8' high, painted with two coats of light colored fire retardant paint.
- D. The TRs and ERs shall not be used for other purposes including, but not limited to, custodial, access services, electrical, mechanical, storage, etc.
- E. Equipment not related to the support of the TR or ER (e.g., piping, ductwork, pneumatic piping, electrical equipment, plumbing, etc.) should not be installed in, pass through, or enter the room.
- F. No equipment, hardware, piping, etc. shall be added in or near any TR or ER that will change the temperature or humidity of these rooms without written agreement from DC-Net prior to design and installation.
- G. The MDF shall be designed to allow future UPS floor space in the footprint. Empty conduits are to be installed running from the UPS location to each data closet. Ensure sufficient wall space is available for future electrical breaker panels that will feed all communication rooms.

- H. New TRs and ERs shall not be adjacent to any electrical room or room containing a transformer or motors. Electrical power systems in or adjacent to the TRs and ERs should be configured such that their electromagnetic fields do not interfere with telecom cabling or equipment.
- I. DC-Net supplied prints shall be used for design on all projects with updates for each project.
- J. Communication as-built files shall be a part of the final punch list and not complete until DC-Net receives the final as -built files.
- K. A minimum of two 4 inch conduits shall be installed in all drywall ceilings greater than 3 feet wide and at all corners that are drywall.

PART 2 – PRODUCTS

2.1 GROUNDING AND BONDING

- A. #4 and #6 AWG wire suitable for grounding application.
- B. All connectors and clamps shall be mechanical type made of silicon bronze.
- C. Terminals shall be solderless compression type, copper long-barrel NEMA two bolt.
- D. Telecommunications Bonding Backbone (TBB): Minimum No. 6 AWG insulated copper conductor.
- E. Telecommunications Grounding Busbar (TGB): Minimum 6 mm thick x 50 mm wide predrilled copper busbar with standard NEMA bolt hole sizing and spacing.
- F. All grounding equipment shall be UL listed for that purpose.

PART 3 – EXECUTION

3.1 RACKS AND CABLE ROUTING HARDWARE

- A. The Telecommunications Rooms (TRs) and Equipment Rooms (ERs) may be equipped with some existing hardware, such as plywood backboards, grounding bus bars, equipment racks, ladder cable runway, horizontal and

vertical cable management, and copper and fiber termination equipment. Existing hardware already be in place will be shown on the project drawings.

- B. Examine TRs and ERs and verify conditions are as shown on project drawings. Provide notification in writing of conditions deviating from drawings or detrimental to proper completion of the work.
- C. Beginning of installation in the TRs and ERs indicates Contractor acceptance existing conditions.
- D. Install new equipment racks with vertical and horizontal cable management in the TRs and ERs as required for project and as shown on drawings. All equipment racks shall be securely anchored to the concrete floor using minimum 3/8" hardware or as specified by rack manufacturer.
- E. Install new ladder cable runway for cable routing in the TRs and ERs as required for project and as shown on drawings. All ladder cable runway shall be securely anchored to the walls with support kits and brackets as specified by manufacturer. Secure equipment racks to ladder cable runway with all-thread covered with EMT conduit sleeve.
- F. Install plywood backboard on the walls in the TRs and ERs as required for the project and as shown on drawings. All plywood backboard shall be securely anchored to the walls.
- G. Install D -rings on plywood backboard for cable routing in the TRs and ERs as required for the project and as shown on drawings.
- H. All new cables shall be supported using ladder cable runway, D- rings, and cable management hardware and shall be neatly dressed -out in the TRs and ERs.
- I. Clamp all new cables at the entrance to the TRs and ERs for strain relief.
- J. Firestop all sleeves and conduit openings after the cable installation is complete.
- K. The hardware layout in the racks shall follow the DC-Net standard format as shown in the typical rack layout drawings.
- L. Equipment placement shall be coordinated with DC-Net staff.

3.2 GROUNDING AND BONDING

- A. Mount new TGBs on plywood backboard in TRs as shown on project drawings. The location for the TGBs shall be coordinated with DC-Net.
- B. Mount new TMGB on plywood backboard in main ER as shown on project drawings. The location for the TMGB shall be coordinated with DC-Net.
- C. Install new TBB from the TMGB in the ER to the TGBs in the TRs as shown on project drawings. Connect the TBB to the TMGB and TGBs in accordance with TIA - 607 and NEC. All grounding conductors leaving the ER and TRs shall be in a separate conduit from all communication cabling.
- D. Bond all metallic surfaces of new racks, ladder cable runway, and equipment in the TRs and ERs to the TGB or TMGB in the same room with #6 AWG grounding wire as straight as possible.
- E. Bond all metallic raceways (conduit, cable tray, etc.) entering the TRs and ERs to the TGB or TMGB in the same room with #6 AWG grounding wire as straight as possible.
- F. All grounding items shall be installed in complete compliance with Division 26 – Electrical and NEC.

Chapter 4.) 271300 COMMUNICATIONS BACKBONE CABLING

SECTION 271313 Communications Copper Backbone Cabling

PART 1- GENERAL

1.1 GENERAL

- A. This section provides the requirements for the installation of multi-pair unshielded twisted pair (UTP) cables and associated hardware for copper backbone cabling. Included in this section are the product requirements for cable, termination hardware and other required hardware. Installation practices and test requirements are also indicated in this section. Contractor shall provide a complete tested and warranted Structured Cabling System (SCS).
- B. Contractor shall install all structural cabling elements in accordance with the most stringent requirements of the NEC, local building codes, ANSI/TIA/EIA commercial building wiring standards, ANSI/NECA/BICSI 568.2006 standard

for installing telecommunications systems and all relevant BICSI manuals. Contractor must submit Drawings and receive approval from DC-Net's Project Manager for any deviations from standards or drawings due to field conditions.

1.2 REFERENCES

- A. NFPA 70 National Electric Code.
- B. Authority Having Jurisdiction (AHJ).
- C. Local Building Codes.
- D. UL® Standard 910 "Test method for fire and smoke characteristics of cable used in air handling spaces." Provide products that are UL® listed and labeled for such use. UL® testing bulletin. Underwriters Laboratories (UL®) cable certification and follow up program. UL® Standard 1666 "Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts."
- E. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance ANSI/TIA/EIA, including associated Addenda:
 - 1) ANSI/TIA/EIA-568-C.1 -Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements.
 - 2) ANSI/TIA/EIA-568-B.2 - Commercial Building Telecommunications cabling standard - Part 2: Balanced Twisted Pair Cabling Components.
 - 3) ANSI/TIA/EIA-569-A - Commercial Building Standard for Telecommunications Pathways and Spaces.
 - 4) ANSI/TIA/EIA-606-A - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - 5) ANSI-J-STD-607-A - Commercial Building Grounding Earthing and Bonding Requirements for Telecommunications.
 - 6) ANSI/TIA/EIA-758 - Customer Owned Outside Plant Telecommunications Cabling Standard.

- F. National Electrical Manufacturers Association (NEMA).
- G. ANSI/NECA/BICSI 568-2001 Standard for Installing Commercial Building Telecommunication Cabling.
- H. American Society for Testing Materials (ASTM).
- I. Institute of Electrical and Electronic Engineers (IEEE).

1.3 SUBMITTALS

A. Product Data:

- 1) The contractor shall submit product data sheets and samples for all products specified under this section.
- 2) Products requiring submittals shall include but not limited to the following:
 - a) All cabling and wire.
 - b) Patch Cables.
 - c) All connectors and required tools.
 - d) All termination system components for each cable type.
 - e) All equipment room and telecommunications room horizontal cable management.
 - f) All grounding system components.
 - g) All firestop systems (including manufacturer published installation requirements).
 - h) All cable raceway and support hardware.
 - i) Other apparatus required for a complete and functional system.
- 3) Products requiring samples shall include but not limited to the following:

- a) All cabling and wire.
- b) Patch Cables
- c) All connectors and required tools.
- d) All termination system components for each cable type.
- e) All equipment room and telecommunications room horizontal cable management.
- f) All grounding system components.
- g) All firestop systems (including manufacturer published installation requirements).
- h) All cable raceway and support hardware.

B. Drawings

- 1) The contractor shall submit Drawings.

C. Project Closeout Test Data

- 1) The contractor shall provide test documentation.

D. As-Built Documentation

- 1) The contractor shall submit as-built documentation.

E. Warranty

- 1) The contractor shall provide a warranty.

PART 2 – PRODUCTS

2.1 CABLE

A. Multi Pair Category 3

- 1) Category 3, 24 AWG. The cable shall be available in 100, 200, and 300 pair counts. The cable shall be conformance tested to meet ANSI/TIA/EIA-568-B.2 for category 3 cables. Where 300 pair cables are specified, three 100-pair cables of equal quality may be substituted.
- 2) Pairs shall be color coded in accordance with ANSI/ICEA S-80-576. Cables with more than 25 pairs are to be assembled with sub-units of 25 pair and have continuous color coded binders. The core shall be overlaid with a corrugated aluminum sheath, which is bonded to an outer jacket of PVC plastic to form an alvyn sheath. The PVC sheath shall have improved frictional properties, allowing the cable to be installed in conduit without the use of pulling lubricants.

- 3) Cable jacket material shall conform to Article 800 NEC for use as non-plenum cables. Cables shall be UL® type CMR (riser) and/or UL® listed for fire safety.
 - 4) Armored cable shall be in a flexible metal jacket for crush resistance.
- B. 25-Pair Category 3
- 1) 25- pair count cable shall be comprised of 24 AWG twisted pair copper conductors individually insulated with PVC and sheathed in a riser rated thermoplastic outer jacket. Pairs shall be color coded in accordance with ANSI/ICEA S-80-576.
 - 2) Cable jacket material shall conform to Article 800 NEC for use as plenum or non- plenum cables. Cables shall be UL® type CMR (riser) and/or UL® listed for fire safety.
 - 3) Cable meet or exceed ANSI/TIA/EIA-568-B.2 for category 3 compliance.

2.2 PATCH PANELS

- A. Patch panel shall be high density such that 24-ports occupy 1 rack unit and 48 ports occupy 2 rack units.
- B. Patch panel shall use Category 6, RJ45 jacks in 6- or 8- port modules.
- C. Patch panel jack (UMJ 8 position/8 conductor) shall terminate to a 110D-type insulation displacement contact, printed circuit board, to lead frame mounted connector.
- D. Patch panel jack shall be universal modular jack, 8 position, un-keyed unless noted otherwise.
- E. Patch panel jack shall support termination of 22, 24 and 26 AWG solid conductor, four pair, unshielded twisted pair copper cable.
- F. Patch panel shall have rear-mounted cable management bar to ensure proper bend radius and strain relief for cabling.
- G. Patch panel shall have the ability to accept color-coded identification tabs and port protecting shutters.

- H. Patch panel shall be compliant with ANSI/TIA/EIA-606-A labeling specifications.

2.3 SUPPORTING HARDWARE

- A. Use only the manufacturer's approved cable supporting hardware such as split mesh support grips (Kellum grips) or messenger wire approved for use.
- B. Messenger Wire shall be rated such that the planned installation weight of the cabling shall not exceed 60% of the rated breaking strength.

PART 3 – EXECUTION

3.1 GENERAL

- A. The backbone cabling systems shall provide interconnections between telecommunications rooms, equipment rooms and entrance facilities. The system includes backbone cables, intermediate and main cross-connects, mechanical terminations used for backbone cross- connects.
- B. Specified pulling tensions and bend radius shall be used in the installation of cables.
- C. The proximity of backbone cabling to potential sources of RFI and EMI shall be considered when installing cable.
 - 1) Maintain at least 6 inches of clearance away from fluorescent lighting fixtures and electrical conductors up to 2 kVA.
 - 2) Maintain at least 24 inches of clearance away from electrical conductors up to 5 kVA.
 - 3) Maintain at least 36 inches of clearance away from electrical conductors more than 5 kVA.
 - 4) When cabling is required to cross over electrical conductors, they must do so at a 90 degree angle.
 - 5) Electrical cabling is not permitted to lie on top of communication cabling.
- D. The contractor shall bond both ends of all cable shields to the appropriate TGB/TMGB.

- E. All cabling shall be labeled per specifications.
- F. All backbone cabling shall be run with no splices.
- G. Contractor shall adhere to TIA/EIA 568/569 specifications regarding bend radius, maximum tensile strength, and maximum vertical rise.

3.2 INSIDE PLANT CABLE

- A. The backbone cabling shall be configured in a logical star topology.
- B. The backbone shall be limited to no more than two hierarchical levels of cross-connects. No more than one cross-connect may exist between a main and a horizontal cross-connect and no more than three cross-connects may exist between any two horizontal cross-connects.
- C. The distance between the terminations in the entrance facility and the main cross-connect shall be documented by the Contractor and shall be made available to the access provider.
- D. Riser cable shall be supported on every other floor using cabling manufacturer approved supporting hardware.

3.3 PATCH CABLES

- A. Patch color codes are determined by their application. Patch cord color shall be coordinated with DC-Net Project Manager.
- B. Excessive patch cord lengths are not permitted. All patch cords shall be appropriately sized while maintaining proper cable bend radius.

3.4 TESTING

- A. Inside Plant Cable:
 - 1) Testing of all copper wiring shall be performed prior to system cutover. 100 percent of the horizontal, riser and inter-cabinet wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage.
 - 2) Multi-pair cables shall be tested to each TR. The cable runs shall be tested for conformance to the specifications of ANSI/TIA/EIA-568-C.1 and ANSI/TIA/EIA-568-B.2.

- 3) Testing shall include length, mutual capacitance, characteristic impedance, attenuation, and near-end and far end crosstalk. Any pairs not meeting the requirements of the standard shall be brought into compliance by the contractor, or replaced at no cost to DC-Net.
- 4) Test equipment shall be specifically rated for the cabling being tested, properly configured, and calibrated per manufacturer's requirements.\
- 5) Contractor shall submit current calibration certificate(s) for each piece of test equipment to be utilized. No test shall be performed with a test set that has not been calibrated within 6 months prior to testing.
- 6) No handwritten test results will be accepted. Complete, end-to-end test results and loss budget calculations must be submitted to DC-Net in both electronic format (CD or DVD format) and hard copy. If special software or license is required to review test data electronically The Contractor shall provide one copy of software and appropriate license with the test data.
- 7) Each test shall be given a test identification number. For high pair count UTP backbone cables, the cable identification shall be used as the test identification. High-count UTP backbone cables shall be divided into 1-pair increments and each shall have a unique test identifier.
- 8) Test data shall be organized and grouped by individual Telecommunications Room (TR) with the summary report followed by a detailed test sheet for each cable tested. All results shall be sorted by test identification numbers and bound in 3-ring binders (no larger than three (3) inches thick each).
- 9) Project closeout test report shall include the following:
 - a) Installation company name, contact information, project manager and installation supervisor name.
 - b) Project scope including project start and end dates, building name and address, floors where installation work was completed.
 - c) Project summary including number of work areas or equipment cabinets/racks cabled, total number of drops and type of cabling system installed. List the types of backbone cabling installed, number of backbone space locations, and

number of connections terminated. List any special or unique information regarding site conditions.

- d) 4-pair cable testing data including, at a minimum, test identification, cable length, pass/fail, test parameter title, test data and test time.
- e) Installation Contractor Warranty.
- f) Structured Cabling Manufactures Warranty.
- g) As-built drawings showing cable placement pathways and termination spaces (work areas, telecommunications rooms, equipment rooms, entrance facilities, etc.).
- h) Elevation and plan view drawings for cabinet and rack elevations.

10) Acceptable copper test sets:

- a) Fluke.
- b) Agilent Technologies.
- c) Engineer approved equal.

SECTION 271323 Communications Optical Fiber Backbone Cabling

PART 1 – GENERAL

1.1 SUMMARY

- A. This section provides the requirements for the installation of fiber optic systems. Included in this section are the product requirements for the fiber optic cables, termination hardware and required support apparatus. In addition, installation and testing requirements for fiber optic systems is included in this section.
- B. Contractor shall install all structural cabling elements in accordance with the most stringent requirements of the NEC, local building codes, ANSI/TIA/EIA commercial building wiring standards, ANSI/NECA/BICSI 568.2006 standard for installing telecommunications systems and all relevant BICSI manuals including 11th Edition. Contractor must submit shop drawings and receive

approval from Owner for any deviations from standards or drawings due to field conditions.

1.2 REFERENCES

- A. NFPA 70 National Electric Code.
- B. Authority having jurisdiction (AHJ).
- C. Local Building Codes.
- D. UL® for wiring: UL® Standard 910 “Test method for fire and smoke characteristics of cable used in air handling spaces.” Provide products that are UL® listed and labeled for such use. UL®” testing bulletin. Underwriters Laboratories (UL®) cable certification and follow up program. UL® Standard 1666 “Test for Flame Propagation Height of Electrical and Optical- Fiber Cables Installed Vertically in Shafts.”
- E. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance ANSI/TIA/EIA, including associated Addenda:
 - 1) ANSI/TIA/EIA-568-C.1 -Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements.
 - 2) ANSI/TIA/EIA-568-C.3 -Commercial Building Telecommunications Cabling Standard, Part 3 Optical Fiber Cabling Components Standard.
 - 3) TIA-569-B - Commercial Building Standard for Telecommunications Pathways and Spaces.
 - 4) ANSI/TIA/EIA-606-A - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - 5) ANSI-J-STD-607-A - Commercial Building Grounding Earthing and Bonding Requirements for Telecommunications.
 - 6) ANSI/TIA/EIA-526-7 -Measurement of Optical Power Loss of installed Singlemode Fiber Plant Cable.
 - 7) ANSI/TIA/EIA-526-14A - Optical Power Loss Measurements of installed Multimode Fiber Cable Plant.

- 8) ANSI/TIA/EIA-758 - Customer Owned Outside Plant Telecommunications Cabling Standard.
- 9) ANSI/TIA/EIA-568-B-2001 - Optical Fiber Cable Color Coding.
- 10) ANSI/TIA-942 – Telecommunications Infrastructure Standard for Data Centers.

F. National Electrical Manufacturers Association (NEMA).

G. ANSI/NECA/BICSI 568-2001 Standard for Installing Commercial Building Telecommunications Cabling.

H. American Society for Testing Materials (ASTM).

I. Institute of Electrical and Electronic Engineers (IEEE).

1.3 SUBMITTALS

A. Product Data:

- 1) The contractor shall submit product data sheets and samples for all products specified under this section.
- 2) Products requiring submittals shall include but not limited to the following:
 - a) All Cabling and Wire.
 - b) Patch Cables.
 - c) All connectors and required tools.
 - d) All termination system components for each cable type.
 - e) All equipment room and telecommunications room horizontal cable management.
 - f) All grounding system components.
 - g) All firestop systems (including manufacturer published installation requirements).
 - h) All cable raceway and support hardware.