

**SECTION 25150
BACKBONE CABLING**

PART 1 - GENERAL

1.1 SUMMARY

A. SCOPE

1. This section includes the copper and fiber backbone cable and the termination requirements from a Switch Room/MDF to a BDF or ER or TR and from a BDF to a ER or TR and from a ER to TR and from a TR to another TR.
2. This section includes minimum requirements for the following:
 - a) Outside Plant (OSP)
 - 1) Outdoor Rated Optical Fiber Cables
 - 2) Heavy Wall Innerducts
 - 3) Optical Fiber Connectors - SM/MM
 - 4) Optical Fiber Splicing Trays for Exterior Enclosures
 - 5) Optical Fiber Splice Enclosures
 - 6) 24 AWG Underground Rated Copper Cables (PE89)
 - 7) Vault Closures
 - 8) End Caps
 - 9) Plugs
 - 10) Bushings
 - 11) Lubricants
 - 12) Sealing Kits
 - 13) Clamps
 - 14) Bonding Harnesses
 - 15) Dome Enclosures
 - 16) Encapsulated Enclosures
 - 17) Encapsulants
 - 18) Splicing Tapes
 - 19) Splicing Modules – Filled
 - 20) De-Gel Stripper
 - 21) Installation, Termination and Splicing Methods
 - b) Inside Plant (ISP)
 - 1) Plenum and Riser Rated Optical Fiber Cables

RPI - <<Project Name>>

Project # <<XXXXX>>

<<date>>

- 2) Riser and Plenum Rated Innerducts
- 3) Optical Fiber Connectors – SM/MM
- 4) ARMM/CMR Copper Cables
- 5) Splicing Modules
- 6) Splicing Tapes
- 7) Clamps
- 8) Split Riser Splice Cases
- 9) Bonding Connectors
- 10) Grounding Braid

1.2 QUALITY ASSURANCE

- A. All cable shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Network & Telecommunication Department. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Materials and work specified herein shall comply with the applicable requirements of:
 1. ANSI/TIA/EIA - 568-B Commercial Building Telecommunications Cabling Standard
 2. ANSI/TIA/EIA - 569-A Commercial Building Standard for Telecommunications Pathway and Spaces
 3. EIA/TIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 4. EIA/TIA-607 Commercial Building Grounding and Bonding requirements for Telecommunications
 5. NFPA 70 - 2002, including:
 - a) NEC - Article 770
 - b) NEC - Article 800
 6. Underwriters Laboratory
 7. NEMA - 250
 8. Federal Communications Commission 47 CFR 68.
 9. BICSI Telecommunications Distribution Design Manual (9th edition)
 10. BICSI Customer Owned Outside Plant Design Manual (2nd edition)
 11. BICSI Telecommunications Cabling Installation Manual (2nd edition)

RPI - <<Project Name>>

Project # <<XXXXX>>

<<date>>

12. ANSI/NECA/BICSI 568 -2001 Standard for Installing Commercial Building Telecommunications Cabling
 13. ISO/IEC 11801
 14. Bellcore GR-20
- C. The fiber optic cable specified in this project may be used to support an ATM or Gigabit Ethernet network. At the time of installation all fiber optic products shall support the latest draft or formal specification released by the IEEE 802.Z (for Gigabit Ethernet).
- 1.3 SUBMITTALS
- A. Manufacturers catalog sheets, specifications and installation instructions for all products to be installed within the scope of work included under this contract. (submit with bid) (See www.division17.com)
 - B. Test Results and Documentation as per Section 25170.

PART 2 - PRODUCTS

INSIDE PLANT

INSIDE PLANT - FIBER

2.1 PLENUM AND RISER RATED OPTICAL FIBER CABLES

- A. Multimode Fiber
 1. Shall be graded-index optical fiber waveguide with nominal 62.5/125um-core/cladding diameter. The primary coating diameter of 900um UV cured acrylate buffer material.
 2. The fiber shall comply with ANSI/EIA/TIA-492AAAA
 3. Transmission Characteristics for Multimode Fiber Optic Cable: Each cabled fiber shall meet the graded performance specifications below. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61. Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455-51 or 30. The measurements shall be performed at 23 degrees C +/- 5 degrees.
 - a) Maximum attenuation dB/Km @ 850/1300 nm: 3.25/1.0
 - b) Bandwidth 200 Mhz-km @ 850nm
 - c) Bandwidth 500 Mhz-km @ 1300nm
 - d) Distance vs. bandwidth using a LED transmitter operating at a 1300nm wave length:
- B. Single Mode
 1. Class IVa dispersion - unshifted single mode optical fibers complying with ANSI/EIA/TIA-492BAAA. Primary coating diameter of 250um UV cured acrylate buffer material.
 2. The zero dispersion wavelength shall be between 1300 nm and 1324 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall

be no greater than 0.093 ps/km-nm². Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175.

3. The nominal mode field diameter shall be 8.7 um to 10.0 um with a tolerance of +/- 0.5 um at 1300 nm when measured in accordance with ANSI/EIA/TIA-455-164 or ANSI/EIA/TIA-455-167.
4. Transmission Characteristics:
 - a) Maximum attenuation dB/Km @ 1310/1550 nm: 1.0/1.0
 - b) The cutoff wavelength shall <1279 nm when measured in accordance with ANSI/EIA/TIA-455-170
 - c) Distance vs. bandwidth using a Laser transmitter operating at a 1310 nm wavelength:

C. Physical Characteristics:

1. 900 um tight buffer.
2. 2.0 mm sub-unit diameter.
3. OFNR/OFN Flame Rated meeting U.L. 1666.
4. Suitable for indoor installations.
5. Strength members shall be FGE/Aramid yarn with extruded PVC sub-cable jacket.
6. Secondary thermoplastic type buffer over each fiber.
7. Suitable for underground or aboveground conduits.
8. Shall have individual fiber tube colors per TIA/EIA-598 and overall orange jacket.
9. Provide stiff central member with cables stranded around center.
10. Provide ripcord for overall jacket.
11. Suitable for -40° to 80° C.
12. Suitable for lashing.
13. Must be UV rated for exterior installation.

[100 % Corning fiber]

2.2 OPTICAL FIBER CONNECTORS – SM/MM

A. Physical Characteristics

1. Provide duplex 568SC connectors
2. The 568SC connectors shall meet ANSI/EIA/TIA-604-3 standards.
3. Multimode connectors shall be orange colored, Single Mode connectors shall be yellow colored.
4. The connector shall have an optical axial pull strength of 2.2 N at 0 degree angle and an optical off axial pull strength of 2.2 N at a 90 degree

angle, with a maximum 0.5 dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.

- B. Transmission Characteristics
 - 1. The maximum optical attenuation per each mated field installed 568SC connector pair shall not exceed 0.5 dB.
 - 2. The total optical attenuation through the cross-connect from any terminated optical fiber to any other terminated fiber shall not exceed 1.0 dB.
 - 3. Shall have a return loss greater than or equal to 20 dB for multimode fiber and greater than or equal to 26 dB for single mode fiber.
 - 4. The connectors shall sustain a minimum of 500 mating cycles without degrading this performance.

INSIDE PLANT - COPPER

2.3 CMP COPPER CABLES

- A. Backbone UTP cables shall consist of 24 AWG, groups of 50/100 pair thermoplastic insulated copper conductors following the ANSI/ICEA S-80-576 color code. The 50/100 pair groups shall be bound together and covered by a protective sheath consisting of an overall thermoplastic jacket an underlying metallic shield and one layer of dielectric material applied over the core.
- B. Provide plenum rated cable.
- C. Transmission Characteristics:
 - 1. The resistance of any conductor, measured in accordance with ASTM D 4566 shall not exceed 9.38 ohms per 100m at 20 degrees C.
 - 2. The resistance unbalance between the two conductors of any pair shall not exceed 5%.
 - 3. The mutual capacitance of any pair shall not exceed 6.6 nF per 100m.
 - 4. The capacitance unbalance to ground at 1 kHz of any pair shall not exceed 330 pF per 100m.
 - 5. The characteristic impedance shall be 100 ohm +/- 15% from 1 kHz to 16 MHz.
 - 6. The attenuation shall meet the requirements of the horizontal cable specified in section 25160.
 - 7. The insulation between each conductor and the core shield shall be capable of withstanding a minimum dc potential of 5 kV for 3 seconds.
 - 8. The propagation delay of any pair at 10 MHz should not exceed 5.7 ns/m.
 - 9. The Power Sum NEXT loss shall meet the following:

<u>Frequency (MHz)</u>	<u>NEXT loss (dB)</u>
0.150	53
0.772	43
1.0	41

4.0	32
8.0	27
10.0	26
16.0	23

2.3.1 ARMM COPPER CABLES

- A. Shall be of size indicated on the drawings.
- B. Shall consist of a core of 24 AWG solid annealed copper conductors, color coded in accordance with telephone industry standards.
- C. Transmission Characteristics:
 - 1. The nominal resistance of any conductor shall not exceed 27.3 ohms per 1000 feet at 20 degrees C.
 - 2. The mutual capacitance of any pair shall not exceed 15.7 nF per 1000 feet at 1 kHz.
 - 3. The maximum attenuation at 1.0 MHz shall not exceed 6.8 dB per 1000 feet.
- D. Conductors shall be twisted to form pairs. Cable having more than 25 pairs shall be assembled in units, each individually identified by color coded unit binders.
- E. The core shall be covered with a plastic tape.
- F. The core and tape shall be overlaid with a corrugated shield applied longitudinally with overlap using the following materials:
 - 1. .008 inch coated aluminum
 - 2. .005 inch copper
 - 3. Shall be bonded to outer jacket to form an ALVYN sheath.
- G. The outer jacket shall consist of a fire retardant sheath that meets NEC low flame requirements.
- H. Cable shall be suitable, listed and marked for use in a riser application. (CMR)
- I. Manufacturer's cable code, pair size, manufacturing plant location, month and year or manufacture shall be marked on cable every two feet.

2.4 VAULT AND RISER CLOSURES

- A. Closure shall consist of a black solid or split PVC sleeve as indicated on the drawings.
- B. Minimum inside diameter shall be 5" (127mm).
- C. Minimum inside length shall be 26" (660mm).
- D. Actual sizes shall be indicated on the drawings. Otherwise, closure to be sized to accommodate the maximum number of cable pairs to be spliced and the type of connector to be used for splicing.
- E. Closure shall be flame retardant.

- F. Closure shall be re-enterable.
- G. When assembled with properly sized end caps, bushing, plugs and clamps, the closure shall be air and water tight.

2.5 VAULT CLOSURE END CAPS

- A. At MDF and BDF locations, multiple End caps shall be sized precisely to fit the diameter of the tip cables entering the closure.
- B. Number of openings in the multiple end caps shall be determined by dividing the number pairs in the feed cable by 100 and doubling that number. (i.e. 1200 pair cable would have 24 openings for tip cables.
- C. Collared Cap opening can be up to 6.35mm (1/4") larger than the feed cable diameter.
- D. Actual end cap to be provided shall be based on the diameter of the feed cable to be spliced.

2.6 PLUGS

- A. Use tapered or collared plugs as required to fill extra opening in end caps.
- B. Use sealant to seal if inside diameter of hole is less than 6.35mm (.25").

2.7 BUSHINGS

- A. Use rubber or variable bushing as required to reduce standard opening in end caps to accommodate custom diameters.
- B. Use KBS-1 to seal if inside diameter of hole is less than 6.35mm (.25").

2.8 LUBRICANTS

- Lubricant shall evaporate are use and shall not damage closure elements in any way.

2.9 SEALING KITS

- Shall consist of a urethane adhesive designed for sealing split vault sleeves and split end caps.

2.10 CLAMPS

- A. Provide Sleeve and Collared clamps as required to complete work.
- B. Adhere to all manufacturer installation guidelines.

2.11 BONDING HARNESSSES

- A. Shall be used to ground the shields of the spliced cables.
- B. Bonding harness shall be 14 AWG and sized according to closure.
- C. Adhere to all manufacturer installation guidelines.

2.12 SPLICING MODULES

- A. All splicing modules shall have an integrated encapsulate in all environments. (ISP and OSP).

- B. Crimping process shall strip the installation from the wire and trim the excess wire.
- C. The module shall create a gas tight connection.
- D. All modules shall have test entry ports on the front side of the module.
- E. Straight splicing modules, shall have a yellow cover and body top and the base and body bottom shall be dark gold.
- F. Pluggable/Bridge splicing modules, shall have a transparent cover, the body top and bottom shall be blue and the insulator shall be red.
- G. Design Make:
 - Straight Splicing Modules
 - a) Pluggable/Bridge Splicing Modules
 - b) Wire connectors may be used for small pair count splices, pending Network & Telecommunication Department approval.

2.13 SPLICING TAPES

- A. Shall be an all weather, Vinyl Plastic material.
- B. Shall resist:
 - 1. Water
 - 2. Acids
 - 3. Alkalies
- C. Shall be flame retardant
- D. Shall not be affected by sunlight.
- E. Shall release smoothly in zero weather and will not ooze adhesive in hot climates.

2.14 BONDING CONNECTORS

- A. Shall consist of a base and upper member, two securing nuts and a plastic shoe to aid connector installation and protect the conductors.
- B. Base and upper members shall be made of tin plated tempered brass, slightly curved so as to exert a continuous spring form on sheath and shield after clamping.

2.15 GROUNDING BRAID

- A. Shall be a flat tin plated copper braid conductor.
- B. Shall have eyelets at regular intervals.
- C. Eyelets shall fit shield connector studs up to 6 mm (1/4") in diameter.

OUTSIDE PLANT

OUTSIDE PLANT - FIBER

2.16 OUTDOOR RATED OPTICAL FIBER CABLES

- A. Multimode Fiber
 - 1. Shall be graded-index optical fiber waveguide with nominal 62.5/125um-core/cladding diameter. The primary coating diameter of 900um UV cured acrylate buffer material.
 - 2. The fiber shall comply with ANSI/EIA/TIA-492AAAA
 - 3. Transmission Characteristics for Multimode Fiber Optic Cable: Each cabled fiber shall meet the graded performance specifications below. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61. Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455-51 or 30. The measurements shall be performed at 23 degrees C +/- 5 degrees.
 - a) Maximum attenuation dB/Km @ 850/1300 nm: 3.25/1.0
 - b) Bandwidth 200 Mhz-km @ 850nm
 - c) Bandwidth 500 Mhz-km @ 1300nm
- B. Single Mode
 - 1. Class IVa dispersion - unshifted single mode optical fibers complying with ANSI/EIA/TIA-492BAAA. Primary coating diameter of 250um UV cured acrylate buffer material.
 - 2. The zero dispersion wavelength shall be between 1300 nm and 1324 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.093 ps/km-nm². Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175.
 - 3. The nominal mode field diameter shall be 8.7 um to 10.0 um with a tolerance of +/- 0.5 um at 1300 nm when measured in accordance with ANSI/EIA/TIA-455-164 or ANSI/EIA/TIA-455-167.
 - 4. Transmission Characteristics:
 - a) Maximum attenuation dB/Km @ 1310/1550 nm: 1.0/1.0
 - b) The cutoff wavelength shall <1279 nm when measured in accordance with ANSI/EIA/TIA-455-170
 - c) Distance vs. bandwidth using a Laser transmitter operating at a 1310 nm wavelength:
- C. Physical Characteristics:
 - 1. OFNR/OFN Flame Rated meeting U.L. 1666.
 - 2. Shall be gel-filled.
 - 3. Strength members shall be FGE/Aramid yarn with extruded PVC sub-cable jacket.
 - 4. Secondary thermoplastic type buffer over each fiber.
 - 5. Suitable for underground or aboveground conduits.

6. Shall have individual fiber tube colors per TIA/EIA-606 and overall orange or black jacket.
7. Provide stiff central member with cables stranded around center.
8. Provide ripcord for overall jacket.
9. Suitable for -40° to +75° C.
10. Suitable for lashing.
11. Must be UV rated when used for exterior/aerial installations.

2.17 HEAVY WALL INNERDUCT

- Shall be 1" heavy wall construction.

2.18 OPTICAL FIBER CONNECTORS

- See inside plant category for same, this section.

OUTSIDE PLANT – COPPER

2.19 UNDERGROUND RATED BACKBONE COPPER CABLES

- A. Shall be of size indicated on the drawings.
- B. Shall consist of a core of 24 AWG solid annealed copper conductors, color coded in accordance with telephone industry standards.
- C. Transmission Characteristics:
 1. The nominal resistance of any conductor shall not exceed 135.5 ohms per mile at 20 degrees C.
 2. The resistance unbalance between the two conductors of any pair shall not exceed 4%.
 3. The mutual capacitance of any pair shall not exceed 83 +/- 4 nF per mile at 1000 Hz.
 4. The capacitance unbalance pair to ground at 1000 Hz of any pair shall not exceed 800 pF per 1000 feet.
 5. The capacitance unbalance pair to pair at 1000 Hz of any pair shall not exceed 80 pF per 1000 feet.
 6. The dielectric strength of the insulation shall be capable of withstanding a conductor to conductor minimum dc potential of:
 - a) 3 kV for 3 seconds for PE-89.
 - b) 4 kV for 3 seconds for PE-39.
 7. The dielectric strength of the insulation shall be capable of withstanding a conductor to shield, minimum dc potential of:
 - 15 kV for 3 seconds (single jacket) and 20 kV for 3 seconds (double jacket).
 8. The maximum attenuation at 772 kHz at 20 degrees C shall not exceed:

- a) 5.6 dB per 1000 feet for PE-89
 - b) 4.9 dB per 1000 feet for PE-39
- D. Conductors shall be twisted to form pairs. Cable having more than 25 pairs shall be assembled in units, each individually identified by color coded unit binders.
 - E. The core shall be covered with a non-hygroscopic tape.
 - F. The cable shall be filled with a filling material that seals air spaces in the cable core, meeting or exceeding REA compound flow tests.
 - G. The core and tape shall be overlaid with a corrugated shield applied longitudinally with overlap using the following materials:
 1. .008 inch coated aluminum
 2. .005 inch copper
 3. Gopher resistant types shall use 0.10 inch copper, .006 inch bimetallic alloy 194 (copper/stainless or steel/copper) or .008 inch coated aluminum/.006inch coated steel (CACSP).
 4. Shall be bonded to outer jacket to form an ALVYN sheath.
 - H. The outer jacket shall consist of a high molecular weight polyethylene.
 - I. Cable shall be suitable, listed and marked for use in a duct application.
 - J. Manufacturer's cable code, pair size, manufacturing plant location, month and year or manufacture shall be marked on cable every two feet.
- 2.20 ENCAPSULATED CLOSURE.
- A. Minimum inside diameter shall be 5" (127mm).
 - B. Minimum inside length shall be 26" (660mm).
 - C. Actual sizes shall be indicated on the drawings. Otherwise, closure to be sized to accommodate the maximum number of cable pairs to be spliced and the type of connector to be used for splicing.
 - D. Closure shall be re-enterable.
 - E. When assembled the closure shall be air and water tight.
- 2.21 END CAPS AND CLOSURE EXTENSION SLEEVES FOR ENCAPSULATED CLOSURE
- Actual end caps and closure extension sleeves to be provided shall be based on the quantity and diameter of the feed cables to be spliced.
- 2.22 SPLICING TAPES
- See inside plant category for same, this section.
- 2.23 BONDING HARNESSSES
- See inside plant category for same, this section.
- 2.24 ENCAPSULANTS
- A. Encapsulant shall be transparent.

RPI - <<Project Name>>

Project # <<XXXXX>>

<<date>>

- B. Encapsulant shall be on low viscosity to allow it to penetrate around connectors and wires.
- C. When splice is re-entered, the encapsulant must easily come off hands.
- D. Must possess sufficient tack to adhere well to the splice components during expansion and contraction caused by temperature changes.
- E. When new gel is poured, it must bond thoroughly to existing gel in the closure.
- F. Shall be compatible with the cable insulation.
- G. Shall not be corrosive to copper and must not support fungi or mold growth.
- H. Shall cure quickly. (20- 30 minutes)

2.25 SPLICING MODULES – FILLED

- See inside plant category for same, this section.

2.26 DE-GEL STRIPPER

- A. Shall be non toxic.
- B. Shall be compatible with the cable insulation.
- C. Shall not be corrosive to copper.

PART 3 – EXECUTION

OUTSIDE PLANT - FIBER

3.1 OUTDOOR RATED OPTICAL FIBER CABLES

- A. Shall be composite fiber optic cable for all ER to TR connections.
- B. Install cable inside of an innerduct.
- C. Adhere to all manufacturer installation guidelines.
- D. A service loop of 15 feet shall be maintained at all points of termination. Service loops shall not exceed manufacturer's recommended bend radius and shall be neatly dressed and shall not interfere with other cables and termination equipment.
- E. Pulling tensions shall not exceed those recommended by the fiber optic cable manufacturer.
- F. Manufacturer's minimum specified bend radius shall not be exceeded.
- G. In the event that cabling is totally dielectric (nonmetallic) and installed in a nonmetallic duct, a #6 copper wire shall be placed in the conduit with the cable to be used as tracer for cable locating purposes.

3.2 HEAVY WALL INNERDUCT

- Install 1/8" polypropylene monofilament utility rope with a minimum pull tensile strength of 200 pounds. This rope shall have footage marked printed on it.

3.3 OPTICAL FIBER CONNECTORS

- See inside plant category for same, this section.

OUTSIDE PLANT – COPPER

3.4 UNDERGROUND RATED COPPER CABLES

- A. All underground cable shall have been manufactured within 6 months of purchase date.
- B. All open ends of the cable shall have sealing caps installed at the factory prior to shipping so that infiltration of moisture between shipment and installation is prevented.
- C. Contractor shall provide notice 2 days advance notice prior to pulling any cable greater than 400 pairs in size or when a winch is planned for use.
 - Network & Telecommunications Department shall be present to observe all pulling activities of cable greater than 400 pair or when a winch is planned for use.
- D. Cable bend radius shall be at least 10 times the diameter of the cable.
- E. Contractor shall be responsible for verifying that ducts are ready for occupancy prior to cable placement.
- F. Contractor shall assume responsibility for any difficulties or damage to the cable during placement.
- G. Cable feeder guides shall be used between the cable reel and the face of the duct.
- H. Cable shall be watched and inspected for sheath defects, as it is payed off the reel. Pulling operation shall be stopped and Network & Telecommunication Department shall be notified if a defect or any other irregularity is found.
- I. Cable shall be payed off from the top of the reel.
- J. Adhere to all manufacturers requirements regarding pulling tension allowable lubricants and bending radius.
- K. Use Line Tension meter during cable pull to provide accurate measurement of the force exerted on a cable as it is installed. The meter shall have a programmable overload set point with an audible and visual indication of an overload condition. The meter shall have controls to disengage the cable puller if an overload condition occurs. Provide chart recorded information of the cable pull for the Network & Telecommunication Department records.
- L. Secure all cables and splice cases as required with heavy duty tie-wraps to T-slot cable racking and steps. See section for 25140 for additional exterior pathway requirements.
- M. Cable shield shall be continuous from end to end.
- N. Ground and bond all cable at the lightning protection. Also, see section 25120.
 - All cables to be grounded at the MDF end with a minimum #6 solid soft copper ground wire as required by code.
- O. All cable pairs shall be terminated.

RPI - <<Project Name>>

Project # <<XXXXX>>

<<date>>

P. Cables shall be tested and the results documented on Network & Telecommunication Department provided or approved test sheets as specified in section 25170.

Q. Cables shall be labeled as specified in section 25170.

3.5 ENCAPSULATED CLOSURES

A. Adhere to all manufacturer installation guidelines.

B. Support closure at both end via racks and steps.

3.6 END CAPS AND CLOSURE EXTENSION SLEEVES

- Adhere to all manufacturer installation guidelines.

3.7 ENCAPSULANTS

- Adhere to all manufacturer installation guidelines.

3.8 SPLICING TAPES

- Adhere to all manufacturer usage guidelines.

3.9 DE-GEL STRIPPER

- Adhere to all manufacturer usage guidelines.

INSIDE PLANT - FIBER

3.10 PLENUM AND RISER RATED OPTICAL FIBER CABLES

A. Shall be MM/SM composite fiber optic cable for all ER to TR connections.

B. All fiber optic cable shall be installed in conduit, cable tray or supported from building structure at 3-foot centers.

C. Maintain polarization for entire system as described in ANSI/EIA/TIA-568-B.1

D. Cable shall be continuous from the ER to the ER's and TR's.

E. For ER to TR fiber runs, leave a 15' service loop at the ER end and at the TR end leave a 15' service loop.

F. For ER to ER fiber runs leave a 25' service loop at each end.

G. Adhere to all manufacturers' requirements regarding pulling tension and allowable lubricants.

H. The contractor shall be responsible for verifying the actual footage's and distances identified on the attached prints (i.e. wall-to-wall, pullbox-to-pullbox and ER to TR).

I. The contractor shall be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.

J. The contractor shall assume the responsibility for any difficulties or damage to the cable during placement.

K. Where fiber optic cable passes through a vertical riser closet or TR secure fiber to wall vertically every 48". Review fasteners, strain relief and routing with customer.

RPI - <<Project Name>>

Project # <<XXXXX>>

<<date>>

L. Test, label and document as per section 25170.

3.11 RISER AND PLENUM RATED INNERDUCT

A. Adhere to all manufacturer installation guidelines.

B. Support innerduct every 36" on center.

3.12 OPTICAL FIBER CONNECTORS – SM/MM

A. Adhere to all manufacturer installation guidelines.

B. Connector shall be installed with less than .50 dB of attenuation.

C. Heat Epoxied

INSIDE PLANT - COPPER

3.13 GENERAL REQUIREMENTS

A. All placements shall conform to industry standards with regard to anchoring, cable support and separation from other facilities.

B. All placements shall conform to industry standards with regard to anchoring, support, etc.

C. Cables and Innerduct shall not sag or droop but should be installed to maintain a flat plane with smooth transitions from one level or direction to another.

D. All cables entering and leaving a splice as well as the splice itself shall be appropriately racked to eliminate stress on the cables and/or connections.

E. All cables shall be sufficiently racked and supported in order to eliminate stress on the cable or splice.

3.14 CMR/CMP COPPER CABLES

A. UTP backbone cables may be installed in conduit, cable tray, or in cat 6 cable hangers 4' on center.

B. Cables above drywall ceilings shall be installed in conduit. Cables in exposed areas other than communications equipment rooms shall be installed in conduit or surface raceway.

C. Cables shall not be allowed to lay on ceiling or ceiling support structure. They must be anchored in such a way as to not interfere with other services or space access.

D. Unless otherwise specified, noted UTP backbone cables shall be sized based on two-pairs/connected voice jack. Round up to the next audible pair sizing when doing calculations.

E. Where UTP backbone cable incorporates a campus system (i.e., multiple buildings connected to the backbone), all cable shall be installed with gas tube or solid state protection devices at both ends.

F. Test, label and document as per section 25170.

3.15 ARMM COPPER CABLES

A. Secure all ARMM cables to wall within 12" of all splice enclosures

- B. UTP backbone cables may be installed in conduit, cable tray, or in cat 6 cable hangers 4' on center.
- C. Cables above drywall ceilings shall be installed in conduit. Cables in exposed areas other than communications equipment rooms shall be installed in conduit or surface raceway.
- D. Cables shall not be allowed to lay on ceiling or ceiling support structure. They must be anchored in such a way as to not interfere with other services or space access.
- E. Unless otherwise specified, noted UTP backbone cables shall be sized based on two-pairs/connected voice jack. Round up to the next audible pair sizing when doing calculations.
- F. Where UTP backbone cable incorporates a campus system (i.e., multiple buildings connected to the backbone), all cable shall be installed with gas tube or solid state protection devices at both ends.
- G. Test, label and document as per section 25170.

3.16 VAULT AND RISER CLOSURES

- A. In vault environment or other horizontally installations support splice closure at both end via racks and steps.
- B. Secure Riser closures to wall with heavy duty Panduit tie-wraps.

3.17 SPLICING

- A. Fold back method of splicing is required for all new splices.
- B. Ends of unused binder groups shall be staggered, cleared and encapsulated with capping kits.
- C. Terminal counts shall be installed as per the drawings and may not be split or multiplied.
- D. Binder group and color code integrity shall be maintained.
- E. Striped nylon cable ties shall be used to identify binder groups on both sides of the splices and at all other sheath openings.
- F. The quantity of bad pairs per sheath of 100 pairs or more shall not exceed 1% of the total pair count.
- G. Use Cover Removal Tool to remove bases and covers.
- H. Use Separation Tool to separate modules from any other module.
- I. All cable pairs shall be free of electrical opens, shorts (within and between pairs), polarity reversals, transpositions, and the presence of AC voltage, from the Communication Equipment Room to the termination hardware at the main crossconnect frame. All defects must be corrected.

3.18 SPLICING TAPES

- Tape all entries to vault and riser closures to prevent water, insects or rodents from entering enclosure.

3.19 BONDING CONNECTORS

RPI - <<Project Name>>

Project # <<XXXXX>>

<<date>>

- Install Bonding Connectors so as not to damage the conductors in the cable.

3.20 GROUNDING BRAID

- Adhere to all manufacturer installation guidelines.

END OF SECTION