

DIVISION 27 SPECIFICATIONS

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Section 271100 - TELECOMMUNICATION ROOMS

PART 1 - GENERAL

1.1 SUMMARY

A. SCOPE

1. This section includes the minimum installation requirements for equipment and cabling infrastructure in Telecommunication Rooms.

Minimum composition requirements and installation methods for the following:

- 1) Floor Mounted Racks
 - 2) Wall Mounted Racks and Brackets
 - 3) Wall Mounted Cabinets
 - 4) Floor Mounted Cabinets
 - 5) Cable Management Hardware
 - 6) Cable Supports/Ladder Rack
 - 7) Category 6 Patch Panels
 - 8) Fiber Patch Panels
 - 9) Back Boards
 - 10) Punch down Blocks
 - 11) Cross Connect Wire
 - 12) Grounding Bars
 - 13) Power Strips
 - 14) Rack Mounted Shelves
 - 15) Network Electronics
 - 16) Optical Fiber Patch Cords
 - 17) UPS Backup Power
2. Related Sections include the following:
 - a) 17150 Backbone Cabling Requirements
 - b) 17160 Horizontal Cabling Requirements

1.2 QUALITY ASSURANCE

- A. All Telecommunications Room (TR) equipment 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 & Telecommunications Department. Equipment and materials shall be of the quality and manufacturer indicated. The equipment specified is based on the acceptable manufacturers listed. Where "acceptable manufacturers" 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 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. NEMA - 250
 6. Federal Communications Commission 47 CFR 68.
 7. BICSI Telecommunications Distribution Design Manual (10th edition)
 8. BICSI Customer Owned Outside Plant Design Manual (2nd edition)
 9. BICSI Telecommunications Cabling Installation Manual (2nd edition)
 10. ANSI/NECA/BICSI 568-2001 Standard for Installing Commercial Building Telecommunications Cabling
 11. ADA - Americans with Disabilities Act
 12. NFPA 70 - 2002, including:
 - a) NEC - Article 770
 - b) NEC - Article 800
 13. Underwriters Laboratory

1.3 SUBMITTALS

- A. Provide product data with bid for the following:
 - 1. Floor Mounted Racks
 - 2. Wall Mounted Racks and Brackets
 - 3. Wall Mounted Cabinets
 - 4. Floor Mounted Cabinets
 - 5. Cable Management Hardware
 - 6. Cable Supports/Ladder Rack
 - 7. Category 6 Patch Panels
 - 8. Fiber Patch Panels
 - 9. Punch down Blocks
 - 10. Grounding Bars
 - 11. Power Strips
 - 12. Rack Mounted Shelves

PART 2 - PRODUCTS

2.1 FLOOR MOUNTED RACKS

- A. Racks shall meet the following physical specifications:
 - 1. 19" rack mounting space.
 - 2. 7 foot high.
 - 3. Lightweight aluminum construction.
 - 4. Black polyurethane finish.
 - 5. 15" deep base with four (4) $\frac{3}{4}$ " bolt down holes.
 - 6. Have double sided 12/24 tapped holes and 5/8" to 5/8"- $\frac{1}{2}$ " standard EIA hole pattern.

- B. Acceptable Manufacturers:
 - APC (4 post) mfg #AR202

2.2 WALL MOUNTED RACKS

- A. Wall mounted racks shall meet the following physical specifications:
1. 19" rack mounting space.
 2. 38.5" high with 19 mounting spaces.
 3. Lightweight aluminum construction.
 4. Black polyurethane finish.
 5. Stationary mounting with 21" deep 14 gauge mounting brackets and 200 lb. capacity.
 6. Racks shall have double sides 12/24 tapped holes and 5/8", 5/8" 1/2" standard EIA hole pattern.
- B. Acceptable Manufacturers:
1. Chatsworth mfg # 11961-718

2.3 WALL MOUNTED CABINETS

- A. Wall mounted cabinets shall meet the following specifications:
1. 19" equipment mounting space.
 2. 38.5" high with 20 rack mount spaces.
 3. Universal mounting rails with 10/32 and 12/24 tapped holes-5/8", 5/8", 1/2" EIA standard hole pattern.
 4. Black polyurethane finish.
- B. Racks shall:
1. Have a two hinge design for front access.
 2. Have louvered sides for ventilation
 3. Have knockouts in top and bottom for cable access.
 4. Have front access.
 5. Be lockable.
- C. Acceptable Manufacturers
Chatsworth mfg # 12324-722 or mfg # 12325-722

2.4 FLOOR MOUNTED CABINET AND FRAME

- A. Floor mounted cabinets shall meet the following specifications:
1. Universal mounting rails with 10/32 and 12/24 tapped holes-5/8", 5/8", 1/2" EIA standard hole pattern.
 2. 16 gauge Aluminum (maximum strength) construction
 3. Nominal 78"x19"x30"
 4. Lockable plexiglass® hinged door on front and steel hinged door in rear.
 5. Vented roof
 6. Removable side panels.
 7. Leveling feet
- B. Acceptable Manufacturers
1. Chatsworth mfg # M-1130-71x; x refers to shipping method
 2. APC mfg # AR2800BLK (non-plexiglass, 16 gauge)

2.5 CABLE MANAGEMENT

- A. Cable management panels shall be plastic with integral wire retaining fingers.
- B. Cable management panels shall have front and back channels.
- C. Cable management panels shall have removable front and back covers.
- D. Horizontal Cable managers shall be 3"wide x 3"deep on front channel and 2"X4" on rear channel.
- E. Vertical managers shall be 3"wide x 3"deep on front channel and 2"w x 4"d on rear channel 4"w x 5"d on front channel and 4"w x 4"d on rear channel.
- F. Design Make: Panduit
1. Horizontal - mfg # WMPF1 ; Vertical – mfg # WMPV20

2.6 LADDER RACK

- A. Provide 18" ladder rack in TR as shown on drawings for horizontal cable support.
- B. Include connecting and support hardware to suit installation. Including but not limited to:
 - 1. Rack to runway mount plate
 - 2. Wall angle support bracket
 - 3. Butt splice swivel
 - 4. Connect junction
 - 5. Grounding Kit. (Metallic ladder racks must be grounded)
- C. Rack shall be a hollow or solid side bar nominally 3/8" thick by 1 1/2" high with rungs 9" on center.
- D. Shall be painted black.

2.7 CATEGORY 6 UTP PATCH PANELS

- A. Shall meet the following specifications:
 - 1. Shall meet or exceed all Category 6 component performance standards as specified in TIA 568-B.2-1
 - 2. Provide 48 ports per panel.
 - 3. Paired punch down sequence to allow pair twists within 1/2" of the termination.
 - 4. Shall be UL listed.
 - 5. Shall have 110 IDC terminations
 - 6. Sized for standard 19" equipment rack and shall in all cases have 48 ports.
 - 7. Shall be equipped with rear cable support bars.
- B. Design Make: AVAYA mfg # 700-173-743 (PM-GS3-48)

2.8 FIBER OPTIC PATCH PANELS

- A. Shall meet or exceed all TIA 568-B.3 requirements.
- B. Provide 36/48 port or 72/96 port panels as called for on drawings.
- C. Shall be rack mounted.
- D. Shall accept 6 and 8 Pack SC adapter panels.
- E. Multimode fiber shall be connected to orange bulkheads and Single mode fiber shall be connected to yellow bulkheads.
- F. Design Makes: Siecor LANscape
 - 1. CCH-03U : 36 fiber total capacity ; using six 6 fiber panels
48 fiber total capacity ; using six 8 fiber panels
 - 2. CCH-04U : 72 fiber total capacity; using twelve 6 fiber panels
96 fiber total capacity; using twelve 8 fiber panels

2.9 BACKBOARDS

- A. Shall be 4 x 8 x 3/4" BCX, fire rated plywood.
- B. Shall be painted – gray, acrylic, interior, fire retardant paint.

2.10 PUNCHDOWN BLOCKS

- A. Shall be 110 IDC style blocks.
- B. Shall be 300 pair blocks.
- C. Blocks shall include means to identify cables per ANSI/TIA/EIA-606-A
 - 1. Provide connecting clip, designation strip, plastic covers and retaining clip necessary to terminate cables.
- D. Acceptable manufacturers
 - 1. Siemens mfg # S110AB2-300

2.11 UTP CROSS CONNECT

- A. Provide modular 110 cross connect blocks for all backbone UTP terminations.
- B. Cross-connects shall be made with wire of equal gauge to that of the feed cable, which it is being connected to.
- C. Shall be UL listed
- D. Provide (1) roll of 1 pair and (1) roll of 2 pair per TR
- E. Acceptable manufacturers
 - 1. Avaya
 - a) 1 pair description: wh/bl-bl/wh (mfg # 105 597 264)
 - b) 2 pair description: wh/bl-bl/wh, o/wh-wh/o (mfg # 105 617 955)

2.12 GROUNDING BARS

- A. Provide telecommunication grounding bar (TGB) assembly as shown on drawings and #6 grounding wire from ground bar telecommunications grounding system.
- B. Grounding wire shall be appropriately bonded to the telecommunications main grounding bar (TMGB). The TMGB shall be grounded to the main electrical service grounding electrode system.
- C. NEMA approved Ground Bar Assembly to be constructed with following materials (See drawing details for additional information):
 - 1. Copper Ground Bar (1/4"x4"x10") with 9/32" holes spaced 1 1/8" apart.
 - 2. Insulators
 - 3. 5/8" Lock washers
 - 4. Wall Mounting Brackets
 - 5. 5/8-11"x1" HHCS bolts

2.13 POWER STRIP

- A. Shall be 20 amp, 115V.
- B. Shall be Rack mounted.
- C. Shall be Non-switched.
- D. Shall be Surge suppressed.
- E. Shall have 6 outlets – transformer spaced.
- F. Must have 20 amp twist lock plug.
- G. Power cord shall be 10' in length.
- H. Must meet UL 1363 and 1449 requirements.
- I. Design Make
 - 1.
- J. Acceptable Manufacturers
 - 1. Perma Power mfg # JT06B2B20 (switchless)
 - 2. Perma Power mfg # R5BZ20-15

2.14 EQUIPMENT SHELVES

- A. Equipment shelves shall be made of .090 aluminum.
- B. Color shall be black.
- C. Shall be 19" rack mountable.
- D. Acceptable Manufacturers:
 - 1. Chatsworth mfg # 40117-719

2.15 NETWORK ELECTRONICS

- A. Network Switches: Cisco Systems switches shall be used exclusively unless otherwise specified by the Network & Telecommunications Department.
- B. Media converters: Transition Networks and Allied Telesyn media converters shall be used exclusively unless otherwise specified by the Network & Telecommunications Department.

2.16 OPTICAL FIBER PATCH CORDS

- A. Shall be a duplex fiber cable meeting the transmission characteristics of the optical fiber horizontal cable.
- B. Cables shall be orange in color for multi-mode connections and yellow for single mode connections.
- C. The following configurations may be required:
 - 1. ST/ST
 - 2. SC/SC
 - 3. LC/SC
 - 4. LC/ST
- D. Acceptable Manufacturers:
 - 1. Compulink(Note: Must be 100% Corning Fiber)

2.17 UPS BACKUP POWER

- A. High Performance, uninterruptible power system, designed to prevent blackouts, brownouts, sags and surges from reaching network electronics and other sensitive electronic equipment.
- B. Provide a minimum of 30 minutes uptime in the event of an electrical outage situation.
- C. Network Management card to provide web/snmp remote management
- D. Acceptable Manufacturers: (UPS Backup Power)

* APC

1. 220 Volt Specifications

- a. SURT3000RMXLT-1TF5
providing 3000VA/2100W, Input 208V/Output 208V
- b. SURT5000RMXLT-1TF5
providing 5000VA/3500W, Input 208V/Output 208V
- c. AP9617
for UPS 10/100 B-T + Web/SNMP Mgmt
includes software

2. 110 Volt Specifications

- a. SU3000RMXL3U
providing 3000VA/2400W, Input 120V/Output 120V
- b. SU48R3XLBP
External Battery Pack
- c. AP9617
for UPS 10/100 B-T + Web/SNMP Mgmt
includes software

- EXECUTION

3.2 FLOOR MOUNTED RACKS

- A. All racks shall be anchored to the floor.
- B. Provide vertical and horizontal cable as shown on drawing.
- C. Mount with a minimum of 36" feet clear access behind and front of rack from the wall to a rack.
- D. Ground the rack to the equipment ground bar with a #6 copper wire.

3.3 WALL MOUNTED RACKS

- A. Secure wall mounted racks to building structure with approved anchoring means
- B. Verify all existing wall construction and submit proposed anchoring methods for approval.
- C. Provide vertical and horizontal cable management both front and rear.

3.4 LADDER RACK

- A. Install as shown on the drawings.
- B. Ladder Rack to be secured to walls and top of equipment rack. Must be grounded for all metallic ladder racks.

3.5 CABLE MANAGEMENT [<PIC 1>](#) [<PIC 2>](#)

- A. Provide (1) racked mounted 3.5" horizontal cable manager at TOP OF EACH RACK INSTALLED. ALSO, provide 2 vertical cable managers for each rack installed. If two or more racks are installed side by side, install cable manager between the racks and cable managers on the outside or ends of racks.
- B. Provide one 3.5" horizontal cable manager above each 48 UTP port panel and fiber patch panel installed.
- C. Provide two 3.5" horizontal cable managers, one (1) above and one (1) below electronics, as shown on drawing.

3.6 PATCH PANELS

1. Install and label as shown on drawings.
2. Install per manufacturer's recommendations.
- 3.

3.7 OPTICAL FIBER PATCH PANELS

1. Install as shown on drawings.
2. Furnish and Install labels for each strand, as per Network & Telecommunications department management instruction in the field or as shown on drawings.
3. Install blank adapter panels in all positions not used at time of installation for fiber terminations.

3.8 VIDEO PATCH PANELS

- A. Load all panels with one coax insert.
- B. Position the panel as indicated on drawings

3.9 CABLE SUPPORTS

- A. Provide 8 inch "J" hooks 2 ft. on center for all exposed wall mounted vertical cable runs.
- B. Keep horizontal wall mounted cable runs to a minimum. In general, horizontal runs shall be on wall mounted ladder rack.
- C. Provide category 6 cable brackets 3' on center supported to building structure for all cable runs not supported by cable tray.

3.10 BACKBOARDS

- A. Linear wall space used for anchoring equipment shall be lined for the full closet width with fire treated BCX grade exterior plywood 3/4" and 8' high.
- B. Plywood for mounting termination equipment on shall be installed vertically side by side a minimum of 6" above finished floor. Mounting of said plywood shall be sufficient to support the equipment.
- C. Plywood for supporting riser cables shall be installed vertically resting directly on the finished floor. Anchoring and mounting techniques of plywood used to support backbone riser cables shall be sufficient to support a minimum of 1500 pounds of weight.
- D. In no cases shall the heads of mounting screws protrude past the face of the plywood.
- E. Contractor shall install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

3.11 MISCELLANEOUS REQUIREMENTS

- A. All cables shall be neatly “dressed out” in equipment rooms.
- B. Fire stop all sleeves and conduit openings after the cable installation is complete.
- C. Cable pathways shall incorporate the fire rated pathway :
Manufacturer : Specified Technologies, Inc.
Product : 3M / EZ Path product line
(Discuss with Network & Telecommunications manager to determine specific products to be used).

3.12 PUNCH DOWN BLOCKS

- A. Installed on plywood backboard so that top of 300 pair block is 5’6” AFF
- B. Mount Blocks with steel, zinc plated 5/16" slotted hex head #10 x 3/4" drill screws.
- A. Install Designation Strips color-coded with industry standard coded field as follows:

Description	Color
Common Equipment - PBX, Muxes	Yellow
Back Bone Cable	Orange/Yellow; Black/White
Horizontal Wiring	Blue
Inter-building Campus Backbone	Black

- C. Install Red Insulator Clips on all special circuits in the TR and at the MDF. See Section 271113 for circuit count information.

3.13 GROUNDING AND BONDING

- A. Copper bus provided in each Telecommunication Room.
- B. Bond metallic equipment racks, conduits, cable tray, ladder racks to the ground bar.
- C. All connectors and clamps shall be mechanical type made of silicon bronze.
- D. Terminals shall be solderless compression type, copper long-barrel NEMA two bolt.
- F. Bond the shield of shielded cable to the ground bar in communications rooms and spaces.

3.14 CROSS CONNECT

- A. Cross connects shall be made with 1 pair and 2 pair wire as required by circuit being connected. Coordinate cross connect colors.



Cable Management picture 1

[\(BACK\)](#)



Cable Management 2

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END OF SECTION

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SECTION 271113

EQUIPMENT ROOMS AND SERVICE ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

B. Scope

1. This section includes the minimum requirements for equipment and materials at the Main Distribution Frame (MDF) and at the Building Entrance.
2. Minimum composition requirements and installation methods for the following:
 - a) Building Entrance Terminals
 - b) Surge Protection Modules
 - c) Floor Mounted Distribution Frames
 - d) Wall Mounted Distribution Frames
 - e) Steel Ladder Racking
 - f) Grounding and Bonding
 - g) Backboards
 - h) Frame Mounted Termination Blocks
 - i) Frame Mounted Ring
 - j) UTP Cross Connects
 - k) Utility Coordination
3. Related Sections include the following:
 - a) 17150 Backbone Cabling Requirements
 - b) 17110 Telecommunication Room Requirements

1.2 QUALITY ASSURANCE

- A. 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 on 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 (10th edition)
 - 10. BICSI Customer Owned Outside Plant Design Manual (2nd edition)
 - 11. BICSI Telecommunications Cabling Installation Manual (2nd edition)
 - 12. ANSI/NECA/BICSI 568-2001 Standard for Installing Commercial Building Telecommunications Cabling
 - 13. ADA - Americans with Disabilities Act

1.3 SUBMITTALS

- A. Provide product data for the following:
 - 1. Building Entrance Terminals
 - 2. Surge Protection Modules
 - 3. Distribution Frames
 - 4. Steel Ladder Racking
 - 5. Termination Blocks

PART 3 - PRODUCTS

2.1 BUILDING ENTRANCE TERMINALS

- A. Building Entrance Terminal shall protect up to 100 lines (pairs)
- B. Dimensions shall be 4.0"W x 2.0' H x 3.95" D.
- C. Input stub (tip) cable shall be 26AWG shielded cable. Contractor shall field verify actual stub length in field.
- D. Input stub shall serve as internal fuse link.
- E. Input stub shall be equipped with a heavy duty strain relief and encapsulated cable connector.
- F. Output stub cable shall be 24 AWG shield cable. Contractor shall field verify actual stub length in field.
- G. Shall be wall or frame mountable.
- H. Shall accommodate industry standard 5 pin protection modules.
- I. Plastic components shall meet or exceed specifications set for in U.L. 497.

2.2 SURGE PROTECTION MODULES

- A. Shall be 5 pin, 3 element gas type protection modules.
- B. Module shall provide true balanced operation.
- C. Over voltage on either side shall cause the entire tube to ionize to provide a simultaneous path to ground for both sides of the circuit.
- D. Shall be UL 497 listed.
- E. Ground pin shall be tin.
- F. Tip and Ring pins shall be gold alloy.
- G. The module color shall be black.
- H. The module color shall be green for spare pair modules.
- I. The nominal DC Breakdown shall be 350V @ 100V/ μ sec.
- J. The impulse breakdown voltage shall be 700A @ 100V/ μ sec and 150A @1KV/ μ sec.
- K. The DC holding current shall be 135V for <150ms.

- L. The Surge life (min. operations) shall be as follows:
 - 1. @ 10A, 10 x 1000 μ sec >3000
 - 2. @ 100A, 10 x 1000 μ sec >300
 - 3. @ 10kA, 8 x 20 μ sec >10
 - 4. @ 20kA, 8 x 20 μ sec >1
 - 5. @ 65Arms, 11 cycles, 130A total >1
 - 6. @ 10Arms, 1sec, 20 A total >10
- M. The capacitance shall be <1pf for 1 Vrms @ 1Khz, 50 DCV.
- N. The insulation Resistance shall be >100M ohms @ 50 VDC.
- O. The fail safe operation shall be as follows:
 - 1. @ 1.0 A <50 sec
 - 2. @ 5.0 A <15 sec
 - 3. @ 20 A <10 sec
 - 4. @ 60 A <3 sec
- P. The current limiters shall be as follows:
 - 1. hold current (ma) @ 20 C = 145
 - 2. R min / max ohms = 3 / 6.

2.3 FLOOR MOUNTED FRAMES FOR PROTECTION TERMINALS

- A. Provide 84"H Frames suitable for single side mounting of Protection Terminals.
- B. Overall width of frame shall be 35.5" and Depth shall be 15".
- C. Frame shall be supplied with 12" cable runway support, junctioning bolts, aluminum bond bars, grounding screws and screw for installing the blocks.
- D. The frame shall support three (3) Protector modules. Each module shall support eight (8) Protection Terminals for a total of 2400 Pairs per frame.
- E. Rack shall have 6" vertical channel to feed cables to blocks.
- F. Lowest installed block shall be 6" A.F.F.

2.4 FLOOR MOUNTED DISTRIBUTION FRAMES

- A. Provide 84"H Frames suitable for single side mounting of 110D Termination Blocks.
- B. Frame shall be configured to support either 3600 on 12 110D blocks or 4500 pairs on 15 110D blocks as per drawings.
- C. Overall width of frame shall be 37.5" and Depth shall be 16.13".
- D. Frame shall be supplied with 12" cable runway support, junctioning bolts, bond bars, grounding screws and screw for installing the blocks.
- E. The frame shall be divided into two modules. The top module shall support 6 110D block and the bottom module shall support 9 110D block.
- F. Lowest installed block shall be 18" A.F.F.
- G. Rack shall have 6" vertical channel to feed cables to blocks.

2.5 STEEL LADDER RACKING

- A. Provide ladder rack in CER as shown on drawings for backbone cable support.
- B. Include connecting and support hardware to suit installation. Including but not limited to, racks runway mount plates, wall angle support brackets, butt splice swivels, connection junctions and grounding kit. Note: All metallic ladder racks must be grounded.
- C. Rack shall be a solid side bar nominally 3/8" thick by 1 1/2" high with rungs 9" on center.
- D. Finish shall be telco gray.
- E. 13/32" holes shall be provided in solid bar for seismic applications.
- F. Rungs shall be welded to stringer

2.6 COMPUTER FLOOR BASES

- A. Shall be adjustable in 2" increments from 8-12" or 16"-24" as required for installation environment.
- B. Shall include all mounting hardware.

2.7 GROUNDING AND BONDING

- A. Provide a #6 AWG wire suitable for grounding application.

2.8 BACKBOARDS

- A. Shall be 4 x 8 x 3/4" BCX, fire rated plywood.
- B. Shall be painted – gray, acrylic, interior, fire retardant paint.

2.9 WALL MOUNTED DISTRIBUTING "J" HOOKS

- A. Contractor shall install open ended distribution rings for wall mounted cross-connect fields above all wall mounted blocks. Two rings per vertical row.
- B. Design Make:
 - 1. Caddy (wall mount) (mfg # CAT32)
 - 2. Caddy (rod mount) (mfg # CAT12BC)

2.10 TERMINATION BLOCKS ON FRAME

- A. Shall be 110D style blocks.
- B. Shall be 300 pair blocks.
 - Provide connecting clip, designation strip, plastic covers and retaining clip necessary to terminate cables.

2.11 UTP CROSS CONNECTS

- A. Cross connect wire shall be of same gauge (22AWG and 24 AWG) as the feed cable to which it is being connected to, typically cross connect wire will be 24 AWG single twisted pair and dual twisted pair wire as required for circuit being connected.
- B. Cross connect wire colors shall be:
 - 1. White-Blue for voice circuits
 - 2. White-Orange for Ethernet

PART 4 - EXECUTION

3.1 BUILDING ENTRANCE TERMINALS

- A. Shall be frame mounted.
- B. Field verify actual length required for the input and output stubs.
- C. If scope of work does not include splicing of the tip cable to the feed cable, provide clear labeling at the splice end of the tip cable referencing; rack, row and block information. Coordinate with Network & Telecommunications Department.
- D. Terminate output stub to appropriate block on distribution frame. Coordinate with Network & Telecommunications Department.
- E. Install # 6 Grounding wire as straight as possible from terminal to Grounding Bar.

3.2 SURGE PROTECTION MODULES

- A. Contractor shall fully protect all pairs entering a building.
- B. Include unit cost per module in bill of materials.

3.3 FLOOR MOUNTED DISTRIBUTION FRAMES

- A. Install frames as indicated on drawings.
- B. Install as per manufacturers instructions.

3.4 COMPUTER FLOOR BASES

- A. Install as per manufacturers instructions.

3.5 STEEL LADDER RACKING

- A. Install all ladder rack and associated mounting hardware in a manner that will allow it to support its maximum rated load.
- B. Secure ladder rack to rack when the ladder rack and the top of the rack are at the same height and as additionally required by drawings and field conditions.
- C. Install as per manufacturer instructions. Must be grounded.

3.6 GROUNDING AND BONDING

- A. If required, install grounding bar as per the drawings and connect a #4 or #6 copper ground cable to the electrical service ground or independently driven ground rod.
- B. If there is no electrical service ground available, install a ½" diameter, 5 ft. grounding rod at least 6 ft. away from other existing electrodes. Installation of any grounding rod shall be in compliance with NEC Section 800 and its subsections and ANSI TIA/EIA 607.
- C. Bond equipment to grounding bar as required with #6 AWG copper ground cable.

3.7 BACKBOARDS

- A. Linear wall space used for anchoring equipment shall be lined for the full closet width with fire treated BCX grade exterior plywood 3/4" and 8' high.
- B. Plywood for mounting termination equipment on shall be installed vertically side by side a minimum of 0" above finished floor. Mounting of plywood shall be sufficient to support the equipment.
- C. Plywood for supporting riser cables shall be installed vertically resting directly on the finished floor. Anchoring and mounting techniques of plywood used to support backbone riser cables shall be sufficient to support a minimum of 1500 pounds of weight.
- D. In no cases shall the heads of mounting screws protrude past the face of the plywood.

3.8 TERMINATION BLOCKS ON FRAME

- A. Install color Designation strips as follows:

<u>Description</u>	<u>Color</u>
Common Equipment - PBX, : Muxes	Yellow
Back Bone Cable	Orange/Yellow
Back Bone Cable	Black/White
Horizontal Wiring	Blue
Inter-building Campus Backbone (Buried Cable)	Black

- B. Install Red Insulator Clips on all special circuits in the MDF.

3.9 GROUNDING AND BONDING

- A. Provide pre-drilled tin plated copper bus bar, with standard NEMA bolt hole sizing and spacing for connectors being used, in all communication equipment rooms.
- B. All connectors and clamps shall be mechanical type and made of silicon bronze.
- C. Terminals shall be solderless compression type, copper long-barrel NEMA two bolt.
- D. Provide #6 AWG conductor from the bus bar to the electrical system equipment ground.
- E. Bond the ground bar in the main communication equipment room to dedicated communications equipment panel board where applicable.
- F. Bond metallic equipment racks to the ground bar.
- G. Bond the shield of shielded cable to the ground bar in communications rooms and spaces.

END OF SECTION

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SECTION 270528

INTERIOR COMMUNICATION PATHWAYS

PART 5 - GENERAL

1.1 SUMMARY

- SCOPE

1. This section includes minimum requirements for the following:
 - a) Interior Horizontal Cabling Communication Pathways
 - b) Interior Backbone Cabling Communication Pathways
2. Minimum composition requirements and installation methods for the following pathways:
 - a) Conduit
 - b) Innerduct
 - c) Sleeves
 - d) Cable tray
 - e) Cable hangers
 - f) Wireways and wire troughs
 - g) Power/communication poles
 - h) Underfloor duct
 - i) Floor Boxes and Poke Throughs
 - j) Surface Raceways – Metallic
 - k) Surface Raceways – Non-Metallic
 - l) Outlet Boxes
 - m) Related Sections include the following:
 - 1) 17150 Backbone Cabling Requirements
 - 2) 17160 Horizontal Cabling Requirements

1.2 QUALITY ASSURANCE

- A. All pathways and associated equipment 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 & Telecommunications 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. National Electric Code (NFPA 70) including the following Articles:
 - a) 318 - Cable Trays
 - b) 331 - Electrical Nonmetallic tubing
 - c) 348 - Electrical metallic tubing
 - d) 349 - Flexible metallic tubing
 - e) 350 - Flexible metal conduit
 - f) 351 – Liquid-Tight Flexible metal conduit and Liquid-Tight flexible nonmetallic conduit.
 - g) 352A - Surface Metal Raceways
 - h) 352B - Surface Nonmetallic raceways
 - i) 353 – Multioutlet Assembly
 - j) 354 - Underfloor raceways
 - k) 362 - Metal Wireways and nonmetallic Wireways
 - l) 370 - Outlet, Device, Pull and Junction Boxes, Conduit Bodies and Fittings
 - m) 645 - Information Technology Equipment
 - n) 770 - Optical Fiber Cables and Raceways
 - o) 800 - Communications Circuits
 2. The following American National Standards Institute (ANSI) standards:
 - ANSI-C80.3 Specification for Electrical Metallic Tubing, Zinc-coated
 3. The following Telecommunication Industry Association (TIA) standards.
 - a) ANSI/TIA/EIA – 568-B Commercial Building Telecommunications Cabling Standard
 - b) ANSI/TIA/EIA – 569-A Commercial Building Standard for Telecommunications Pathway and Spaces
 - c) EIA/TIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - d) EIA/TIA-607 Commercial Building Grounding and Bonding requirements for Telecommunications

4. The following BICSI guidelines
 - a) BICSI Telecommunications Distribution Design Manual (10th edition)
 - b) BICSI Customer Owned Outside Plant Design Manual (2nd edition)
 - c) BICSI Telecommunications Cabling Installation Manual (2nd edition)
5. The following UL Standards:
 - a) UL 1, 2000 Flexible Metal Electrical Conduit
 - b) UL 3, 1999 Flexible Nonmetallic Tubing for Electric Wiring
 - c) UL 5, 1996 Surface Metal Electrical Raceways and Fittings
 - d) UL 360, 1996 Liquid-Tight Flexible Steel Conduit, Electrical
 - e) UL 514B, 1996 Fittings for Conduit and Outlet Boxes.
 - f) UL 797, 1997 Electrical Metallic Tubing
 - g) UL 870, 1995 Electrical Wireways, Auxiliary Gutters and Associated Fittings

1.3 SUBMITTALS

- Provide product data for the following:
 1. Conduit
 2. Sleeves
 3. Cable tray
 4. Cable hangers
 5. Wireways and wire troughs
 6. Power/communication poles
 7. Underfloor duct
 8. Floor Boxes and Poke Throughs
 9. Surface Raceways – Metallic
 10. Surface Raceways – Non-Metallic
 11. Outlet Boxes

PART 6 - PRODUCTS

2.1 CONDUIT

- A. Rigid Galvanized Steel Conduit
 - Shall be hot-dipped galvanized steel, including threads.
- B. Electrical Metallic Tubing
 - Electrical Metallic Tubing shall be electro-galvanized steel.
- C. Rigid Non-Metallic PVC Conduit
 - 1. Extra-Heavy wall conduit: Schedule 80, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and normal above ground use.
 - 2. Heavy wall conduit: Schedule 40, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and concrete encasement.
- D. Fittings
 - 1. Rigid galvanized steel fittings shall be fully threaded and shall be of the same material as the respective raceway system.
 - 2. Fittings for electrical metallic tubing shall be single screw indenter fittings for conduits up to 2" and double screw indenter fittings for conduits 2" and larger.
 - 3. Fittings for rigid non-metallic conduit shall be solvent cemented in accordance with the manufacturer's instructions.
 - 4. Connectors shall have insulated throat up to and including 1" size. For sizes 1-1/4" and larger, provide plastic insulating bushing.
 - 5. Die-cast or pressure cast fittings are not permitted.
 - 6. Provide conduit body types, shapes and sizes as required to suit application and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.
- E. Expansion Fittings
 - 1. Provide expansion fittings with external grounding straps at building expansion joints.
 - 2. Galvanized steel expansion joints for RGS or EMT conduit, PVC for PVC conduit.
 - 3. Minimum 4" movement in either direction.
 - 4. Weatherproof for outdoor applications.
 - 5. At expansion joints in concrete pours, provide Deflection/Expansion fittings capable of movement of 3/4" in all directions from the normal.

F. Waterproofing Seals

1. Provide watertight expanding link-type seals for installation between the conduit and the sleeve or core drilled hole.
2. Design Make: Link Seal, or approved equal

G. Pull and Junction Boxes

- Shall be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type cover boxes installed in damp or wet locations shall be of rain-tight construction with gasketed cover and threaded conduit hubs. In no case shall boxes be sized smaller than as indicated in Article 370 of the National Electrical Code for conduit and conductor sizes installed. Boxes shall be NEMA approved for the environmental condition of the location where they will be installed.

H. Flush floor junction boxes

- Flush floor junction boxes shall be recessed cover boxes designed for flush mounting in masonry. (Approved by Network & Telecommunications Department)

2.2 INNERDUCT

- A. Shall be constructed of a PVC Riser rated or plenum rated plastic as required.
- B. Shall be 1" or 1 1/4" in diameter as called for on the drawings.
- C. Shall be orange in color.
- D. Shall be UL listed to 2024 standard.

2.3 CABLE TRAY

- A. Trough Bottom Cable Trays shall be aluminum construction including accessories. Maximum rung spacing 8 in. on centers is welded to side rails with flanges in 4-in. wide channel rungs. Aluminum alloy side rails and rungs. Standard lengths 12 ft. - 0 in. long. Cover required where called for. Provide divider strip where called for. Minimum radius of horizontal elbows shall be 12 in. Provide special radius elbows where required for field conditions.

Loading Data:

<u>Useable Tray Width</u>	<u>Load Depth</u>	<u>NEMA Depth</u>	<u>Std.</u>	<u>Span</u>	<u>Lbs / Ft</u>	<u>Deflection</u>
6"	4"					
8"	4"					
12"	4"	3"	12A	10'	81	1.20"
12"	6"	5"	12B	10'	112	0.59"
18"	4"	3"	12A	10'	81	1.20"
18"	6"	5"	12B	19'	112	0.59"
24"	4"	3"	12A	10'	81	1.20"
24"	6"	5"	12B	10'	112	0.59"

- Provide a safety-loading factory of 1.5 for uniformly distributed loads when supported as a simple span in accordance with the NEMA standard listed.

2.4 CABLE HANGERS

- A. Provide prefabricated, zinc coated, carbon steel hangers designed specifically for UTP and Optical Fiber cable installations.
- B. Hangers shall have open top, rolled edges and a 3" or 4" minimum diameter loop.
- C. Provide beam clamps, rod fasteners, flange clips and brackets as job conditions require.
- D. Use of ERICO cable hangers as described in 270528-17
- * Hangers must be approved by Network & Telecommunications Department.

2.5 WIREWAYS AND WIRE TROUGH

- A. Wireway shall be steel, enclosed type. Provide hinged, JIC sectional NEMA dust resistant, oil tight type where subjected to moisture, in Pump Rooms, Mechanical, Electric and Fan Rooms, exterior walls, Maintenance Shops, and similar locations. Size to meet NEC fill requirements or larger as noted on Contract Documents. Provide knockouts along runs. Provide all elbows, tees, pull-boxes, fittings, hangers, reducers, supports, etc., to meet installation requirements.
- B. Cover: Hinged Screw cover with full gasketing
- C. Connector: [Slip-in] [Flanged].
- D. Fittings: Lay-in type with removable top.
- E. Finish: Electro-coated ASA-49 Gray Epoxy Paint over Phosphate Primer.
 - Approved by Network & Telecommunications Department.

2.6 POWER/COMUNICATION POLES

- A. Poles shall contain a communication and power divider and be nominally 2-1/4" square by height required.
- B. Constructed of a minimum of .070" thick, anodized aluminum extrusion, with removable trim plate and cover.
- C. Unit shall be furnished with top plate mounting assembly for easy installation to accessible ceiling; bushings need to be installed.
 - Approved by Network & Telecommunications Department.

2.7 FLOOR BOXES

- Flush Floor Box:
 - 1. Boxes shall be fully adjustable constructed of cast iron, nominally 4.38"L x 3.19"w x 3.19"D (single gang) 4.38"L x 6.38"w x 3.19"D (two gang)
 - 2. Boxes shall house leveling screws for adjusting box to accept floor flange after pour.
 - 3. Boxes shall have 1" conduit hubs on each end and 3/4" conduit hubs on each side.
 - 4. Provide Brass floor rings and brass cover-plate with duplex flaps.
- Acceptable manufacturer: Wiremold
- a) Raised Floor Box (mfg # AC8850, AC8105, AC8840, AC104)
 - b) Concrete Floor Box (mfg # RFB4-SS with RAKMII cover (ss = shallow steel)
 - c) Concrete Floor Box (mfg # RFB4-4DB with RAKMII cover)

2.8 SURFACE METALLIC RACEWAY

[Note on raceways: Wiremold products preferred for raceway applications. See Network & Telecommunications management for specifications, product numbers and approval.]

- A. Single channel suitable for up to (10) 0.2" O.D. Cables
- Two piece raceway with single compartment, length as indicated on the drawings. Nominal 1-9/32" x 3/4" with snap on cover. Color shall be ivory.
[Approved by Network & Telecommunications Department]
- B. Single channel suitable for up to (50) 0.2" O.D. Cables
- Two piece raceway with single compartment, length as indicated on the drawings. Nominal 2-3/4" x 1-7/16" with flush, snap on cover. Color shall be ivory. Provide devices in the raceway as indicated on plans.
[Approved by Network & Telecommunications Department]
- C. Two channel with devices suitable for up to (48) #12 AWG conductors or (50) 0.2" O.D. Cables.
- Two piece raceway with divider for power and communications, length as indicated on the drawings. Nominal 4-3/4" x 1-3/4" with flush, snap on cover. Color shall be gray. Provide devices in the raceway as shown on plans
[Approved by Network & Telecommunications Department]
- D. One-piece raceway
1. Shall have Ivory finish
 2. Size race way as required based on the following:
 - a) .025" steel suitable for (2) 0.2" O.D. cables
 - b) .040" steel suitable for (3) 0.2" O.D. cables
 - c) .040" steel suitable for (5) 0.2" O.D. cables
[Approved by Network & Telecommunications Department]
- E. Provide miscellaneous boxes, fittings and supports designed and manufactured by the raceway manufacturer as required to make a complete job.
[Approved by Network & Telecommunications Department]

2.9 SURFACE NON-METALLIC RACEWAY

[Note on raceways: Wiremold products preferred for raceway applications. See Network & Telecommunications management for specifications, product numbers and approval.]

- A. Manufactured of rigid UV stabilized PVC compound with matte texture with “office white” finish. Provide the manufacturers standard fittings as required for the installation. All system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics.
- B. Shall have a voltage rating of 300 V AC maximum.
- C. Shall be UL listed.
- D. Fitting shall comply with EIA/TIA UTP/Optical Fiber bend radii requirements.
- E. Raceways shall have the following wiring capacities:
 - 1. One Piece, Single Channel - .32 sq. in. suitable for (5) 0.18” O.D. cables
 - 2. One Piece, Dual Channel - .97 sq. in. suitable for (6) 0.18” O.D. cables
 - 3. Two Piece, Single Channel - .29 sq. in. or .87 sq. in. suitable for (4) 0.18” O.D. cables or .87 sq. in. suitable for (13) 0.18” O.D. cables
 - 4. Two Piece, Triple Channel – 1.514 sq. in. per channel suitable for (24) 0.18” O.D. cables per channel without devices.
- F. Design Make:
 - 1. One-Piece Raceway:
 - 2. Two-Piece Raceways, Single Channel Raceway:
 - 3. Two-Piece Raceway, Triple Channel Raceway:
 - a) Provide Communication devices as specified in wiring devices and indicated on the drawings.
 - b) Provide divider in raceways utilized for power and communications.

[Approved by Network & Telecommunications Department]

2.10 OUTLET BOXES

A. Outlet Boxes and Covers

1. Shall be galvanized steel, not less than 2 ¾" deep X 4 11/16" square or octagonal, with knockouts.
2. Outlet boxes exposed to moisture, exterior, wet or damp locations shall be cadmium cast alloy complete with threaded hubs and gasketed screw fastened covers.
3. Boxes shall be approved for the environmental condition of the location where they will be installed.
4. Install with mud ring where possible

[Approved by Network & Telecommunications Department]

B. Non Metallic Surface Outlet Boxes

1. Shall be Manufactured of rigid UV stabilized PVC compound with matte texture with "office white" finish. Provide the manufacturers standard fittings as required for the installation. All system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics.
2. Shall have a voltage rating of 300 V AC maximum.
3. Shall be UL listed.
4. Shall be of size indicated drawings.
5. Shall be of sufficient depth to maintain CAT 6 bend radii requirements.

[Approved by Network & Telecommunications Department]

C. Low Voltage Mounting Brackets

1. Shall mount to any wall thickness from ¼" – 1".
2. Shall be constructed of a non-metallic material.

[Approved by Network & Telecommunications Department]

2.11 SUPPORTING DEVICES

- A. Supports, support hardware and fasteners shall be protected with zinc coating or treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic. Products used in outdoor applications shall be hot dipped galvanized.
- B. Provide clevis hangers, riser clamps, conduit straps, threaded c clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps as applicable.
- C. 14 gauge U-Channel systems with 9/16 inch diameter holes at a minimum of 1 7/8 inches on center in the top surface. Provide fittings and accessories that match and mate channel.
- D. Provide carbon steel or wedge or sleeve type expansion anchors, steel springhead toggle bolts and heat-treated steel power driven threaded stud fastening equipment as required by construction types.
- E. Provided field fabricated supporting devices such as angles, channels, pipe supports, etc. All fabricated supports shall be of metal construction as called for in 2.1.

[Approved by Network & Telecommunications Department]

PART 7 - EXECUTION

3.1 CONDUIT

1. Electrical Metallic Tubing, Rigid Metal Conduit and Rigid PVC are allowed conduit types. Flexible metal conduit is not allowed.
2. Install with a minimum of bends and offsets. Bends shall not kink or destroying the interior cross section of the raceway. Factory made bends shall be used for raceway's 1" trade size and larger. Bends radius shall be 6 times the internal diameter for conduit sizes up to 2 inches. A conduit greater than 2 inch shall have bend radius at least 10 times the diameter of the conduit.
3. Runs exceeding 100 feet or 180 degrees total bends shall be broken with suitable sized pull or splice boxes. (LB or similar conduit fittings are not acceptable for runs of riser cables. [Must be approved by the Network & Telecommunications]
4. Do not locate riser pull boxes at bends without prior review and approval by Network & Telecommunications Department. Where possible use instead sweeps for the bend and locate in a straight pull nearby.
5. Conduit runs to work areas shall serve no more than one (1) communication outlet.
6. Conduits shall be sized to accept 40% future growth; sizing shall account for fire code capacity restrictions.
7. Plug the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.
8. Secure within three feet of each outlet box, junction box, cabinet or fitting.
9. Provide a #14 AWG fish wire in all "Spare" or "Empty" conduit runs to facilitate future installation of cables.
10. Install raceways in concrete floor slabs as follows:
 - a) All conduits in concrete floor slabs shall be rigid galvanized steel with concrete tight threaded fittings.
 - b) Provide expansion fittings where conduits cross building expansion joints.
 - c) Install conduit below the reinforcing mesh.
 - d) Locate conduits to provide a minimum of 2" of concrete around conduit.
 - e) Obtain approval from the Network & Telecommunication Department prior to installing conduit larger than 1" trade size in concrete slabs.

- f) Wherever a cluster of four-(4) or more conduits rise out of floor exposed, provide neatly formed 4-in. high concrete envelope, with chamfered edges, around raceways.

11. Provide conduit supports based on the following table:

<u>Conduit Trade Size</u>	<u>Type of Run</u>	<u>Horizontal Spacing in Feet</u>	<u>Vertical Spacing in Feet</u>
1", 1 ¼"	Concealed	8	10
1 ½", & LARGER	Concealed	10	10
½", ¾"	Exposed	5	7
1", 1 ¼"	Exposed	7	8
1 ½" & larger	Exposed	10	10

12. Where conduits puncture roof, install pitch pockets as required in order that the roof warranty is maintained.
13. Conduit System Installation:
- Cable in exterior, above grade locations: Rigid Galvanized Steel
 - Interior locations: Electrical Metallic Tubing
 - Cable below grade: PVC Schedule 40
14. Identification: Clearly label conduit at exposed ends indicating closet or outlet where conduit terminates and the length of the conduit. Label pull boxes indicating destination of conduits entering and exiting.
15. Include intra- and inter-building raceways. Including conduits, sleeves and trays for the placement of cables from the communications center to communications rooms, from the communications center to the entrance room or space and from communication center to communication center in different building in a campus environment.

B. Conduit fill shall be as follows:

<u>Trade Size</u>	<u>Area of Conduit (square inches)</u>	<u>1 Cable 53% Fill (sq. in.)</u>	<u>2 Cables 31% Fill (sq. in.)</u>	<u>3 Cables & Over 40% Fill (sq. in.)</u>
1"	0.87	0.46	0.27	0.35
1 ¼"	1.51	0.80	0.47	0.60
1 ½"	2.05	1.09	0.64	0.82
2"	3.39	1.80	1.05	1.36
2 ½"	4.82	2.56	1.49	1.93
3"	7.45	3.95	2.31	2.98
3 ½"	9.96	5.28	3.09	3.98
4"	12.83	6.80	3.98	5.13
5"	20.15	10.68	6.25	8.06

- C. Backbone pathways shall be in the form of 4" conduits or sleeves between the main communication equipment rooms and spaces and closets shall be provided as shown on drawings:
- D. Fire stop all pathways as called for in section 25010 of this document. This includes using 3M / EZ Path fire rated pathways by Specified Technologies, Inc. (www.stifirestop.com).
- E. All backbone conduits shall be marked with 1" reflective tape every 25 feet. Coordinate color with Network & Telecommunications Department.
- F. Pull boxes shall be marked with 1" wide reflective tape.
- G. Stub out conduits into closets only enough to attach connector and bushings, except conduits shall rise a minimum of 6 inches above the finished floor.
- H. Bush all conduit ends.
- I. Conduits shall be concealed except in the following areas:
 1. Mechanical Rooms
 2. Electric Rooms
 3. Manufacturing areas
 4. Garage or maintenance areas

- 5. Unfinished basements or crawl spaces
- J. Do not install raceways adjacent to hot surfaces or in wet areas.
- K. Install conduits to edges of access boxes so as to maximize the total number of conduits that can be routed through the pull box.
- L. Provide expansion fittings with external grounding straps at building expansion joints.
- M. Do not install conduit horizontally in concrete or block partitions.
- N. Arrange neatly to permit access to the raceway, outlet, pull, and junction boxes, and work installed by other trades.
- O. If it is necessary to burn holes through webs of beams or girders, call such points to the attention of the Network & Telecommunications Department and receive written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.
- P. Core drill, sleeve, and fire stop all penetrations through existing floors.
- Q. Support all raceways with malleable iron pipe clamps or other approved method. In exterior or wet locations, provide minimum ¼" air space between raceway and wall. Secure raceway within 3 ft. of each outlet box, junction box, cabinet or fitting.
- R. Install junction and pull boxes in readily accessible locations. Equipment, piping, ducts and the like shall not block access to boxes. Provide all necessary junction or pull boxes required due to field conditions and size as required by the National Electrical Code.

Liquid Tight Conduit specification:

Conduit Size	Part Number
1"	8433

(referencing :

http://www2.aimsfasteners.com:8080/product_nonmetallicelec.html)

3.2 SLEEVES

- 1. Enter information here about sleeve – support, firestop and size as per drawing

3.3 CABLE TRAYS

- A. Hang Cable tray using threaded, galvanized rod hangers, with rods extended through support steel and double nutted; implementing Quick-Support Center Rod PVC Sheath (Cat. No. WBCRSHEATH : for protecting cables from threaded rod when hanging WB Series Cable Tray from center rod hangers). Size support member within load rating of member section; and without visible deflection. Install cable tray level and straight..
- B. A minimum of 12" headroom shall be provided above all cable trays.
- C. Provide aluminum body expansion connectors at building expansion joints. Minimum 4-in. movements, greater if expansion movement conditions warrant.
- D. Provide external grounding strap at expansion joints, sleeves, crossovers and at other locations where tray continuity is interrupted.
- E. Provide necessary elbows, tees, crosses, risers, offsets, fittings, reducers, connectors, clamps, rod suspension, trapeze hangers, etc., as required to make a complete job, coordinate with the Network & Telecommunications Department.
- F. Provide conduit to tray fitting at each conduit entrance to tray.
- G. Install divider in trays where cables of different systems are carried in the same tray.
- H. Provide (1) 6" long piece of ½" EMT conduit on each threaded rod hanger to prevent scoring of cable insulation when cable is pulled in.
- I. Install fire stop wall frames around cable tray at penetrations through fire rated walls, and where called for. Seal these openings with pliable fire resistant sealant.
- J. Cable Trays shall not pass through any firewall or fire-rated soffits. Cable tray shall end before the firewall and transition to a minimum of two (2) 4" EMT sleeves with connectors and insulated bushings as called for in this specification section.

3.4 CABLE HANGERS

- A. Provide cable hangers a maximum of 3' on center wherever cable tray or conduit is not present.
- B. Ceiling ties and rods shall not be used to hang cable or cable supports without the approval of the Network & Telecommunications Department.
- C. Load hangers as recommended by the manufacturer. Provide hangers side by side on a common bracket where cable quantities require.
- D. Do not install cables loose above lock-in type, drywall or plaster ceilings.
- E. Cables shall be installed at least 3 in. above the ceiling tiles and shall not touch the ceiling.
- F. Do not support cable from ceiling system tie wires or grid in fire rated systems.

- G. Provide a minimum of 2 spare bracket mounted hangers in new construction.
- H. Utilize ERICO CADDY CABLECAT adjustable Cable Support when cables trays are not needed ; determine with Network & Telecommunications management prior to installation (www.ericom.com/products/CADDYcfcCableCatAdjCblSprt.asp).

Part numbers:

Adjustable Cable Support:

- CAT425WM - wall mount – vertical surface
- CAT425 - 1/4” Threaded rod or horizontal surface mount
- CAT425A6 - 3/8” Threaded rod or horizontal surface mount

Hammer-On Flange Clips:

- CAT42524SM – Hammer-on 1/8” – ¼” flange
- CAT42558SM - Hammer-on 5/16” – ½” flange
- CAT425912SM – Hammer-on 9/16” – ¾” flange

Beam Clamp :

- CAT425BC – Screw-on 1/8” – ½” flange (rotates 360 degrees)
- CAT425BC200 – Screw-on 1/8” – 5/8” flange (rotates 360 degrees)

Purlin :

- CAT425AF14 – Hammer-on 1/16” – ¼” Z purlin
- CAT425VF14 – Hammer-on 1/16” – ¼” vertical flange
- CAT425WMCD18 – under floor pedestal

3.5 WIREWAYS AND TROUGHS

- A. Insert installation requirements

3.6 POWER/COMMUNICATION POLES

- A. Insert installation requirements

3.7 UNDERFLOOR DUCT

1. The method of pour and depth of concrete shall determine the positioning of the duct as follows (Verify floor structure prior to submitting layout drawings):
 - a) Monolithic pour - installed at the midpoint of the slab
 - b) Slab on grade - midpoint of slab
 - c) Double pour floor - installed in structural slab, Second pour buries the duct system.
 - d) Post tensioned pour - preset inserts shall be used
 - e) Prefabricated concrete - buried in concrete topping
2. Location: Locate runs parallel to outside wall five foot on center with final runs two feet from walls. Provide cross runs as indicated on drawings.

3. Provide conduit access to cross runs as indicated on drawings.
4. Perform cutting, hole sawing and drilling necessary for installation of wiring to devices, through service fitting, from under floor raceway. Provide devices and service fittings at points of use indicated. Install raceway aligned, level, and parallel or perpendicular to building walls or as indicated. Underfloor raceways shall be free from burrs, sharp edges, dents and mechanical defects. Provide caps or plugs on open raceway ends and on boxes and openings.
5. Provide flush service boxes with trim rings and carpet or tile flanges as indicated on the plans.
6. Seal raceways, cells, inserts and trenches to prevent the entrance of water, concrete or foreign matter into the raceway system, before and during pouring of slab or placing of fill. Provide tape or sealing compound at joints, as recommended by the duct manufacturer.
7. Install all products in accordance with manufacturer's instructions.
8. Provide expansion fittings with bonding jumper where duct crosses building expansion joints.
9. Securely hold junction boxes and raceways in place during concrete pours to avoid floating or other movement.
10. Install under-floor duct with tops of preset inserts 1/8" below finished floor line. Locate raceways as indicated on Drawings.
11. Place schedule on the inside of cover-plate of each junction box indicating distance to first insert in each direction, measured from the center of the box. Also, include the pane-board and circuit number of each circuit located in the junction box. Use self-adhesive labels for schedule.
12. Support Couplers and Supports: Join raceway lengths using combination support couplers where practical. Provide additional supports at intervals of not over 5 feet (1.5 m), within 30 inches (750 mm) each side of junction boxes, and as close as practical to elbows, bends, and terminations.
13. Install insert within 12 inches (30 mm) of edge of junction box. Align inserts on same centers for all services.
14. Do not extend inserts into special floor finishes, such as terrazzo, marble, or wood.
15. Install a duct marker in each insert adjacent to junction box, at end of each duct run, on both sides of permanent partitions, and on both sides of change of direction of duct. Install markers flush with finished floor material. In carpeted areas, install marker screws level with carpet backing.
16. Install surface service fittings after installation of floor finishes. Cut floors as necessary. Following duct manufacturer's

recommendations. Replace damaged floor construction and finish.

17. Install trench duct trim flush with cover-plates; maintain covering of factory-applied tape for protection.

3.8 FLOOR BOXES AND POKE THROUGHES

- A. Floor outlet boxes shall be installed flush with finished floor, adjust level and tilt as required. Where finished floor is terrazzo, provide boxes specifically designed for installation in terrazzo. Where floors are to receive carpet, provide floor outlet with carpet flange.
- B. Coordinate the location of flush floor boxes with furniture layout. Provide coordination drawings for approval.

3.9 SURFACE RACEWAY - METALLIC

- A. Provide raceway as shown on the drawings. Leave a tagged nylon pull tape in each raceway (including raceways in use). Bush ends of all stubbed out raceways.
- B. Cut raceways square, ream ends to remove burrs, and bush where necessary.
- C. Install raceways parallel or perpendicular to building walls, floors and ceilings.

3.10 SURFACE RACEWAYS – NON METALLIC

- A. Support with expansion anchors, concrete inserts, masonry inserts or toggle bolts as field conditions require. Provide supports every 4 foot on center.
- B. Provide all fittings, connectors, elbows, tees, boxes etc. as required for the installation.
- C. Surface raceway shall be filled to 40% maximum.

3.11 BOXES AND CABINETS

- A. Consider location of outlets shown on drawings as approximate only. Study architectural, electrical, process piping, mechanical, plumbing, structural, roughing-in, etc., drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between drawings, contact Network & Telecommunication Department for decision prior to installation.
- B. Outlet boxes in separate rooms shall not be installed "back-to-back" without the approval of the Network & Telecommunications Department.
- C. Outlet boxes shall be sized to accommodate the wiring device(s) to be installed.
- D. Outlet boxes installed in plaster, gypsum board or wood paneled walls shall be installed with raised plaster covers or raised tile covers.

- E. Outlet boxes installed in tile, brick or concrete block walls shall be installed with extra-deep type raised tile covers or shall be 3-1/2" deep boxes with square corners and dimensions to accommodate conductors installed.
- F. Surface ceiling mounted outlet boxes shall be minimum 4" square, 1-1/2" deep, galvanized sheet metal.
- G. Surface wall mounted metallic outlet boxes shall be cast type boxes having threaded or compression type threadless hubs. Exterior boxes shall be cast type with threaded hubs and gasketed cover plates secured by non-ferrous screws.
- H. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment centerline as follows:
 - 1. Desktop telephone outlets 18"
 - 2. Data outlets 18"
 - 3. Data or desktop telephone outlets, above hot water or steam baseboard heaters. Do not install receptacle outlets above electric baseboard heaters. 30"
 - 4. Television outlet 18"
 - 5. Wall Mounted 48"
 - 6. Bracket Mounted Television 96"
- I. Where structural or other interference prevent compliance with mounting heights listed above, consult Network & Telecommunication Departments for approval to change location before installation.
- J. Where communications outlets are shown on, behind, below or above furniture or millwork. Verify the exact location and mounting height with the project coordinator. The communications contractor shall be responsible for moving all communications outlets that are in conflict with furniture or millwork, including cutting, patching and painting, at no cost to the Network & Telecommunication Department.
- K. Pull boxes used for angle or U pulls shall have a distance between each raceway entry inside the box and the opposite wall of the box of at least 6 times the trade-size diameter of the largest raceway. This distance being increased by the sum of the trade size diameters of the other raceways on the same wall of the box and have a distance between the nearest edges of each raceway enclosing the same conductor of at least 6 times the trade size diameter of the raceway or 6 times the trade size diameter of the larger raceway if they are of different sizes.
- L. Install outlet boxes as per sizes indicated on the drawings.
- M. Install Low Voltage Mounting Brackets for fishable wall installation location that does not have an available outlet box.

3.12 SUPPORTING DEVICES

- A. Hangers and Supports:

1. Provide steel angles, channels and other materials necessary for the proper support of wall-mounted cabinets, racks, panels, etc.
2. Cabinets, large pull boxes, and cable support boxes shall be secured to ceiling and floor slab and not supported from conduits. Small equipment boxes, etc., as approved by Network & Telecommunication Department, may be supported on walls. Racks for support of conduit and heavy equipment shall be secured to building construction by substantial structural supports.

3.13 FURNITURE RACEWAYS

- A. Furniture Pathways - Shall comply with UL 1286 and NEC Article 605.
- B. It shall be the contractors' responsibility to verify the furniture layout and communication outlet with respect to the furniture. Obtain approved shop drawings from the architect detailing furniture heights, cable openings etc. Prior to roughing in the outlet box, verify height and location for all communication outlets near furniture or cabinetry. Boxes roughed in the wrong location shall be relocated at the contractors' expense.
- C. Provide a concealed transition from outlet box to furniture.

3.14 GENERAL

- A. Support raceways from building construction. Do not support raceways from ductwork, piping, or equipment hangers.
- B. Support outlet, pull, and junction boxes independently from building construction. Do not support from raceways.
- C. Coordinate all raceway runs with other trades.
- D. All open raceways shall be installed a minimum of 6 in. away from any light fixture or other source of EMI (Electro-magnetic interference).
- E. All horizontal pathways shall be bonded and grounded per the NEC Article 250.
- F. In all cases, horizontal pathways shall be sized for a minimum of 50% future growth.

END OF SECTION

[<TOP/HOME>](#)

SECTION 270543

EXTERIOR COMMUNICATION PATHWAYS

PART 8 - GENERAL

1.1 SUMMARY

A. SCOPE

1. Minimum composition requirements and/or installation methods for the following materials and work are included in this section:

- a) Trenching and Excavation
- b) Underground Duct
- c) Innerduct
- d) Aerial Installations
- e) Manholes, Vaults and Handholes

B. SUBMITTALS

1. Product data for:

- a) Precast manholes, handholes
- b) Ductbank materials
- c) Aerial hardware

1.2 QUALITY ASSURANCE

A. The contractor shall engage the services of a qualified installer for all excavation and concrete work.

B. All work shall be done in a neat and workmanlike manner. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval by the Network & Telecommunications 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.

C. Materials and work specified herein shall comply with the applicable requirements of:

- 1. The following Articles of the National Electric Code (NFPA 70)
 - a) 343 - Nonmetallic underground conduit with conductors
 - b) 346 – Rigid metal conduit
 - c) 347 – Rigid nonmetallic conduit
- 2. The following National Electrical Manufacturers Association (NEMA) Standards
 - a) NEMA, RN1, 1998 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

- b) NEMA, TC3, 1999 PVC fittings for use with Rigid PVC Conduit and tubing
 - c) NEMA. TC 6. 1999 PVC and ABS Plastic Utilities Duct for Underground Installation
 - d) NEMA, TC8, 1999 Extra strength PVC Plastic Utilities Duct for Underground Installation
 - e) NEMA, TC9, 1999 Fittings for ABS and OVC Plastic Utilities Duct and Fittings for Underground Installation
 - f) NEMA, TC 10, 1999 PVC and ABS Plastic Communications Duct and Fittings for Underground Installation
3. The following American National Standards Institute (ANSI) standards:
- a) ANSI-C80.2 Specification for Rigid Steel Conduit, Enameled
4. The following Telecommunications Industry Association (TIA):
- a) ANSI/TIA/EIA – 568-B Commercial Building Telecommunications Cabling Standard
 - b) ANSI/TIA/EIA – 569-A Commercial Building Standard for Telecommunications Pathway and Spaces
 - c) EIA/TIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - d) EIA/TIA-607 Commercial Building Grounding and Bonding requirements for Telecommunications
5. The following BICSI guidelines
- a) BICSI Telecommunications Distribution Design Manual (10th edition)
 - b) BICSI Customer Owned Outside Plant Design Manual (2nd edition)
 - c) BICSI Telecommunications Cabling Installation Manual (2nd edition)
6. The following U.L. Standards:
- a) U.L. 6, 2000 Rigid Metal Electrical Conduit
 - b) U.L. 651, 1995 Schedule 40 and 80 PVC Conduit

1.3 PROJECT CONDITIONS

- A. The following conditions apply to excavation:
1. Identify maintain and protect existing building services which cross the excavation area.
 2. Protect utilities, sidewalks, structures, pavements and other facilities from damage caused by settling, lateral movements, undermining, washouts and other hazards created by excavation work.
 3. Locate and verify existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
 4. Verify subsurface conditions prior to excavation work.

PART 9 - PRODUCTS

2.1 TRENCHING AND EXCAVATION FILL

- A. Sand: Clean, coarse, and free of organic matter.
- B. Crushed Stone: Crushed stone or gravel, washed, graded, free of organic materials, 1 in. to No. 4 size. Graduation per ASTM C33, Table II, Size 57, as follows:

<u>Sieve No.</u>	PERCENT PASSING <u>Maximum</u>	<u>Minimum</u>
1-1/2 in		100
1 in	100	95
1/2 in	60	25
#4	10	0
#8	5	0

- C. Gravel Fill: Well-graded natural inorganic sand and gravel conforming to following graduations:

<u>Sieve No.</u>	PERCENT PASSING <u>Maximum</u>	<u>Minimum</u>
4 in		100
1 in	100	60
#4	85	25
#16	60	10
#50	30	4
#200	5	0

- D. Pea Gravel: Rounded stone, 3/4 in. maximum diameter, and 1/8 in. minimum diameter. Stone crushings of 1/8 in. to 1/2 in. meeting ASTM C33, Paragraph 9.1 may also be used.

- E. Ordinary Fill: Well-graded, natural inorganic soil, meeting the following requirements:
1. Free of organic and other compressible materials, debris and frozen materials, and of stones larger than 4 in. maximum dimension.
 2. Be of such nature and character that it can be compacted to the specified densities.
 3. Free of highly plastic clays, of materials subject to decay, decomposition, or dissolution, and of cinders, ash and other corrosive materials.
 4. Maximum dry density of not less than 115 lbs. per cu. ft.
 5. Material from excavation on the site may be used as ordinary fill if it meets the above requirements.

2.2 MANHOLES, VAULTS AND HANDHOLES

- A. Provide pre-cast or cast-in-place reinforced concrete designed for H-20 loading.
- B. Shall have angled corners, cut on 45 degrees for optimum cable racking.
- C. Covers and frames shall be cast iron, with a minimum opening of 27" suitable for H-20 loading. Covers shall have open pick holes and have "Telephone", "Communications", "Signal" or "CATV" cast in 2" high lettering on the cover, per Network & Telecommunication Department directive.
- D. Floors shall be 6 inches thick with a 12" diameter sump hole. In wet soil, reinforced floor with 5/8" bars, 8 inches on center.
- E. Adjust frame to grade by providing a minimum two courses of bricks with all joints fully filled with mortar both inside and outside the collar. Provide layer of mortar on top course for bricks.
- F. Provide cable racks with "T" slots for attaching support hooks. Provide two per wall.
- G. Provide pulling irons on each wall 12" below duct.

2.3 DUCTBANKS

- A. Ductbanks shall have 4" diameter PVC ducts.
- B. Concrete for encapsulating ducts shall be 3/8" aggregate with a nominal compressive strength of 3000 pounds per square inch.
- C. Provide a minimum of four #5 continuous reinforcement bars the entire length of the ductbank.
- D. Concrete shall be 3" thick at the top, bottom and sides of ducts.
- E. Where ductbanks penetrate foundation, footings or outside walls, rigid metallic conduits with expandable rubber shields shall be used.
- F. Provide a 6" wide warning marker tape above duct 18" below grade.

2.4 INNERDUCT

- A. Shall be 1" or 1 1/4" in diameter as called for on the drawings.
- B. Shall be orange in color.
- C. Acceptable Manufacturers:
 - 1. .

2.5 AERIAL INSTALLATIONS

- A. Messenger Strand System
 - 1. Provide 3/16" diameter 7-wire galvanized "6M" steel messenger strand as noted on the drawings. Messenger strand to be manufactured to ASTM A475 specifications and be accepted by both REA and Bell Telephone standards. Strand to be at least a utilities grade, have a minimum breaking strength of 5,500 pounds, have a left lay and have at least an "A" rated galvanized coating weight.
 - 2. Strand Attachments:
 - a) Provide and install the appropriate S guy bolts, B beam clamps, wall straps, brackets, etc., as necessary to adequately support the strand as typically indicated.
 - b) S guy bolts (or commonly called anchor rods or thimbleye bolts) shall be a minimum 5/8" diameter with a straight shank and be designed for attaching messenger strand deadends. The bolt length shall be at least 4" longer than the width of the structural steel flange it will be attached to.
 - c) B beam clamps, or approved equivalent, shall be designed to be used for dead-ending strand on the flange of structural steel members (columns and beams). B beam clamp shall be designed to be used with a 5/8" S guy bolt.
 - 3. Strand Connectors:
 - a) Provide and install all B strand connectors, suspension/cable clamps, grounding tap clamps, hangers, 1-bolt and 3-bolt clamps to adequately support the strand as typically indicated
 - b) For strand runs in excess of 15' between structural columns, additional 1/2" rod supports and appropriate strand clamps (either 3-hole clamps or Kindorf C-708 supports) shall be provided and installed on minimum 25' centers, per the project manager's direction.
 - 4. Strand Cable Rings:
 - a) Provide and install cable rings, or equivalent, to all strand runs after strand is installed. Rings shall be spaced on maximum 16" centers with the latching ring oriented in the same direction. Ring size required for each strand run shall be identified on the drawings.

PART 10 - EXECUTION

3.1 EXCAVATION AND TRENCHING

A. Preparatory Work

1. Build lines to grade and elevations shown. Provide stakes, grade boards, cleats, nails, instruments. Locate and stake each new run for its entire length. Verify elevations given. Start excavation at low point. Notify Engineer of elevation discrepancies. Protect marks and stations. Before excavating work, coordinate with Network & Telecommunication department. Furnish schedule of operations to Network & Telecommunication department. Provide and maintain temporary bridges, walks and bridges over excavations where underground utility lines, sewers, water lines, etc., cross access roads, walks, and streets. Make necessary arrangement with authorities having jurisdiction. Provide the services of a Licensed Surveyor for layout of the following:
WRITE SPECIAL
2. Examine substrates, areas and conditions, with the installer present, for compliance with requirements for installation tolerances and other conditions affecting installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Protection

1. Provide bracing, shoring, sheathing and other work for: protection of personnel, the contract work, excavations, trees, shrubs, existing structures, and surrounding properties. Slope sides of excavations to comply with local codes and ordinances. Provide, erect, and maintain barricades, warning signs, flags, and lights to provide protection for work, workmen, public, and property. Plank walks, pavements, and curbs to be crossed by equipment. Protect adjacent property, existing fences, trees, shrubs, roads, curbs, sidewalks, manholes, hydrants, and other items:
2. Restore, repair, rebuild or replace any such items damaged or destroyed to condition equal to that existing before such damage occurred.
3. Establish conditions, before starting work, by taking photographs to determine state to which existing conditions must be restored. Submit such photographs notarized, identified and dated for record.

C. Existing Utilities

1. Every attempt has been made to indicate existing utilities as accurately as possible from existing drawings, surveys, and data. Report immediately other utility lines encountered, but not shown on the drawings. Notify New York State Underground Facilities Protection Organization (UFPO), where same exists, before starting work. Phone **1-800-962-7962** for information and location of nearest organization address and telephone number. Verify exact location of existing utility lines where work crosses existing utilities and where connections are to be made by test hole before starting work. Notify utility companies, municipalities, Rensselaer Polytechnic Institute organizations, and other involved jurisdictions when excavation occurs within vicinity of existing underground service such as sewers, water, electric, gas, telephone, including such services owned by Rensselaer Polytechnic Institute. If existing service lines, utilities and utility structures which are to remain in service are uncovered or encountered during this excavation, they shall be protected from damage, and securely supported as directed and approved by the involved jurisdiction. Comply with Section 753 of Penal Law of New York with regard to work in vicinity of combustible gas piping. Immediately report damage or injury to utility lines to Fire Department, Police Department and appropriate utility company (e.g. NIMO). Repair or replace utility lines damaged or injured as directed and approved by the involved jurisdiction. Excavate by hand in proximity to existing underground utility lines; take extreme care when excavating around ductbanks carrying energized cable. Remove plug or cap inactive or abandoned utilities encountered during construction operations. The location of such utilities shall be noted on the record drawings. Verify "inactivity" of services with involved jurisdiction before start of work.

D. Cutting and Patching

1. Before starting work, obtain necessary permits and pay fees and charges for same. Cut paved areas as called for, perpendicular to surface and in straight saw-cut lines. Replace pavements, roadways, streets, blacktop areas, walks, disturbed by excavating operations with materials equal to adjacent pavements.

E. Methods

1. Provide for buried work in contract both inside and outside of building. Excavate to proper depth and width for installation work as called for and comply with rules set forth by << State >> Department of Labor. Remove materials including masonry work, rubble, earth, brickwork, concrete, sand, debris, abandoned pipe lines, drains and sewers, rocks, boulders, and concrete, all of which is considered "earth excavation." Provide for legal disposition of excess excavated materials. Make allowance for gravel fill, sand bases, form work, floor slabs, manholes, anchor and thrust blocks, sheet piling, drainage pumps, and work space.

Start excavation at rough grade and provide form work and sheet piling where required.

2. Trench excavation:
 - a) By open cut, to proper depth and grade no wider than required for placement of work and not more than 100 ft. in advance of utility being installed.
 - b) Should trench bottom be wet, unstable, and/or otherwise incapable of supporting the contract work, immediately report it to Network & Telecommunication Department Representative. Should it be deemed unsuitable, excavate to depth as directed and back fill with gravel to trench depth, or provide concrete cradling.
 - c) Should rock be encountered, excavate 6 in. deeper and fill space between trench bottom and pipe with coarse sand, well tamped to form firm bed.

F. Shoring, bracing, sheathing:

1. In addition to governing codes, protect sides of excavations with sheeting and bracing where necessary to prevent sliding or caving of banks and to protect adjacent structures. Remove as back fill is placed.
2. Provide at locations adjacent to existing manholes, hydrants, and similar items.

G. General excavation:

1. As required for all buried work. This shall include, but not be limited to, piping, tanks, ductbanks, conduits, footings, manholes, anchors, concrete pads, thrust blocks, fixture bases, and other work in contract.

H. Backfill

1. Provide bedding around piping with coarse sand from 6 in. below to 8 in. above. Apply by hand and compact under and at sides by mechanical means
2. Piping, jackets and sand bed must be inspected and tested prior to backfill of any nature. Provide necessary anchors, thrust blocks, for testing.
3. Fill remainder of trench in 12 in. layers, use ordinary fill material, except as otherwise specified. Do not use frozen material. Remove boulders, stones, broken rock, wood, bricks, blocks, and debris from fill material before backfill operation.
4. Under roadways, manholes, drives, parking areas, walks, slabs, on grade and at utility entrance to building provide backfill in 6 in. layers with gravel or crushed stone, free from organic or other unsuitable material, to grade. Thoroughly compact each layer.
5. Compaction to not less than 95% density compared to maximum laboratory tests by weight, per modified ASTM D1557-64T, latest

editions, method "A" under slab on grade, roadways, drives, and other paved areas and 85% for general grading. Submit certified results of tests by an approved soil testing laboratory.

I. Removal of water

1. Provide pumps, hoses, pipe, labor and fuel, necessary to keep excavations free of water accumulation. Maintain and operate equipment. Discharge water in manner not interfering with any trade's work and not to undermine or disturb existing or adjacent structures or land. Grade to prevent surface water from flowing into all excavations and trenches. Do not discharge dirt, backfill, debris, into sanitary or storm drainage systems.

J. Rock Excavation

1. Rock Excavation defined as:
 - a) Ledge rock requiring blasting or air hammer for removal.
 - b) Boulders in excess of 1-1/2 cu. yds. in size. Demonstrate that material in question cannot be removed with a 1-1/2 yd. backhoe or shovel.
 - c) Procedure: Should rock be encountered, remove only upon written order of the Network & Telecommunication Departments representative.
2. Measurement of rock excavation, for purpose of payment to Contractor, will be taken 1 ft. wider than ductbank, manhole, pipe or conduit being installed. No allowance made for additional rock taken out accidentally or for convenience of Contractor beyond amount required for installation of work. Rock excavation claimed must be measured each day and verified by Network & Telecommunication Departments Representative. Maintain daily accounting. No claim for extra compensation honored except through procedures outlined above.
 - a) Blasting: NOT ON CAMPUS

K. Job completion

1. On completion of the work, clean the entire site; remove surplus earth, large stones and debris, to off-site legal disposal. Remove tools and equipment and leave the entire area in a neat condition.
2. Rough grade to 6 in. below finished grade. Scarify subsoil to depth of 2 in. to achieve bond between topsoil and subsoil.
3. Repave, reseed and completely restore the area to the condition prior to the start of excavation and trenching work

<<Additional Customer specific restoration requirements, such as seed mix, straw, run-off, catch-basin cleaning of run-off material, settling, periodic watering, racking of stone, top-soil mix, who performs first few cuttings, etc. >>

3.2 MANHOLES, VAULTS AND HANDHOLES

- A. Locate to avoid unnecessary hazards and cause minimum interference with normal traffic flow. Locate outside traveled parts of road wherever possible.
- B. Seal all conduits watertight after conduits or ductbanks are complete.
- C. Coordinate the installation with the Division 16 contractor's work.

3.3 DUCTBANKS

- A. Where ductbanks enter manholes they shall be centered as nearly as possible to the center between roof and floor and end walls.
- B. Where possible, the trench walls shall act as forms for concrete encasement. Provide wood forms where soil conditions require it.
- C. Securely tie raceways in place to prevent floating.
- D. Clean raceway to remove any concrete, dirt or other obstructions, by drawing cylindrical brushes through duct [with prior approval from the Network & Telecommunication Department].
- E. Provide metallic elbows where conduits rise out of ground.
- F. Seal all conduits watertight prior to pour.
- G. Provide bushings or bell ends at each conduit termination.

3.4 AERIAL INSTALLATION

- A. Fasten cable messenger strand to buildings and poles using galvanized steel wall straps, suspension clamps, etc.
- B. Use an approved cable guide and lashing device to secure the cable to messenger strand.
- C. Clamp cable to exterior of building with approved galvanized steel cable clamps.

END OF SECTION

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SECTION 271300
BACKBONE CABLING

PART 11 - 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
 - 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 (10th edition)

10. BICSI Customer Owned Outside Plant Design Manual (2nd edition)
 11. BICSI Telecommunications Cabling Installation Manual (2nd edition)
 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 270800.

PART 12 - 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. All fiber connectors shall meet ANSI/EIA/TIA-604-3 standards.
2. Multimode connectors shall be orange colored, Single Mode connectors shall be yellow colored.
3. The connector shall have an optical axial pull strength of 33 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.
4. Connectors must be fusion-spliced, factory polished pigtails (see Network & Telecommunications management for part numbers).

B. Transmission Characteristics

1. The maximum optical attenuation per each mated field installed fiber 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 271500.
 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 of 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 after 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 ECAPSULATED 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.
- 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 13 – 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 270543 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 271113.
 - 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.
 - P. Cables shall be tested and the results documented on Network & Telecommunication Department provided or approved test sheets as specified in section 270800.
 - Q. Cables shall be labeled as specified in section 270800.
- 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.
- L. Test, label and document as per section 270800.

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. Connectors must be fusion-spliced, factory polished pigtailed (see Network & Telecommunications management for part numbers).

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 270800.

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 270800.

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

- 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

[<TOP/HOME>](#)

SECTION 271500
HORIZONTAL CABLING

PART 14 - GENERAL

1.1 SUMMARY

• SCOPE OF WORK

1. Horizontal cabling is the portion of the cabling system that extends from the work area to the Telecommunications Room or communications center in the case where the communication center serves as a communication closet for an area. The horizontal cabling shall be configured in a star topology. The horizontal cabling includes the horizontal cables, the mechanically terminated jacks/inserts and the faceplates that the jacks/inserts snap into, in the work area.
2. This section includes minimum requirements for the following:
 - a) <<CATEGORY 6>> UTP Cable from TR to Workstation
 - b) <<CATEGORY 6>> Jacks
 - c) <<CATEGORY 6>> Patch Cables
 - d) Faceplates
 - e) Installation and Termination Methods
3. . Related Sections include the following:
 - a) 17150 Backbone Cabling Requirements
 - b) 17160 Horizontal Cabling Requirements

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 & Telecommunications Management. 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. Strictly adhere to all <<CATEGORY 6>> installation practices when installing UTP data cabling.

- C. 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. NEMA - 250
 6. Federal Communications Commission 47 CFR 68.
 7. BICSI Telecommunications Distribution Design Manual (10th edition)
 8. BICSI Customer Owned Outside Plant Design Manual (2nd edition)
 9. BICSI Telecommunications Cabling Installation Manual (2nd edition)
 10. ANSI/NECA/BICSI 568-2001 Standard for Installing Commercial Building Telecommunications Cabling
 11. ADA - Americans with Disabilities Act
 12. NFPA 70 - 2002, including:
 - a) NEC - Article 770
 - b) NEC - Article 800
 13. Underwriters Laboratory

1.3 SUBMITTALS

- A. Manufacturers catalog sheets, specifications and installation instructions for all cable, <<CATEGORY 6>> inserts, faceplates and jacks.
- B. If providing pre-standards manufacturer system solution, submit installer/contractor certification documentation and channel certification information and requirements from manufacturer.

PART 15 - PRODUCTS

2.1 100 OHM UNSHIELDED TWISTED PAIR CABLE (UTP)

A. Physical Characteristics:

1. Shall be plenum/pvc rated and meet applicable requirements of ANSI/ICEA S-80-576. All 4 pairs must be F.E.P. No 2x2 or 3x1 F.E.P. cables will be allowed.
2. The diameter of the insulated conductor shall be .048 in. maximum.
3. Shall consist of (4) 24 AWG Twisted pairs.
4. The color coding of pairs shall be:

Pair 1	W-BL; BL
Pair 2	W-O; 0
Pair 3	W-G; G
Pair 4	W-BR; BR
5. The overall diameter of the cable shall be less than 0.25 inches.
6. The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 400 N minimum.
7. Cable shall withstand a bend radius of 1 inch at -20 degrees Celsius without jacket or insulation cracking.
8. Labeled third party "Verified Category 6".
9. Blue cable shall be provided for all cables terminated to patch panels in the TR's that are designated for data services.

B. Transmission Characteristics:

- Shall meet TIA 568-B.2-1 standard for Category 6 UTP cable.

C. Acceptable Manufacturers:

- AVAYA

2.2 <<CATEGORY 6>> JACKS

- A. Physical Characteristics:
 - 1. Shall be functional from -10 degrees F to 140 degrees F.
 - 2. Shall be tested in accordance with ANSI/EIA/TIA-568-B.2-1 for Category 6
 - 3. Shall be modular RJ45 jacks that snap into user configurable faceplates meeting durability requirements specified in IEC 603-7. Provide impact resistant faceplates nylon with label indicating Room number and patch panel port [A-Z].
- B. Shall be 110 IDC, RJ45 type suitable for eight 22-26 AWG wires and be certified <<CATEGORY 6>> compliant.
- C. Conductors shall be separated and aligned internally by jack comb.
- D. Wired in accordance with EIA/TIA <<T568B>> polarization sequence.
 - Design Make: AVAYA ; mfg # MPS100E- 003

2.3 FACEPLATES

- A. Faceplates installed in office area shall be high impact thermoplastic flush mounted design.
- B. Single gang faceplates shall be 2.75" x 4.5".
- C. Double gang faceplates shall be 4.5" x 4.5".
- D. Faceplates shall be UL listed.
- E. Design Make:
 - Acceptable Styles:
 - a) Plastic
 - AVAYA –
Single gang: mfg# M10A-003
Double gang: mfg# M12L-003
 - b) Stainless Steel
 - AVAYA –
Single gang : mfg # 630B4H ; 105 983 142
Double gang: mfg # M12SP; 108 615 188
 - c) Modular Furniture Faceplate Assemblies
 - AVAYA – M13C-246
 - d) Surface Mount Boxes
 - AVAYA –
Single gang: mfg # M101SMB
Double gang: mfg # M102SMB

2.4 WALL PHONE WALL JACK ASSEMBLY

- A. Shall be constructed of plastic
- B. Shall have mounting lugs designed to mate with corresponding telephone base plate or adapter.
- C. Shall mount to single gang outlet box.
- D. Shall be wired to TIA-568B.
- E. Design Make: SPC Technology. Mfg # TA-5-6

2.5 100 OHM UTP PATCH CABLES

- F. Physical Characteristics.
 - 1. Shall have stranded conductors and meet <<CATEGORY 6>> performance criteria as defined by TIA 568-B.2-1 for Category 6
 - 2. Lengths required will range from 4' to 15' as required by customer. See Bid Forms.
 - 3. Shall be blue in color.
 - 4. Insulated conductor diameters shall not exceed (0.047 in.).
- G. Design Make: Avaya

PART 16 - EXECUTION

INSTALLATION

A. UTP Cable:

1. All wiring concealed in walls or soffits shall be installed in metal conduits.
2. All exposed wiring shall be installed in surface raceway.
3. All wiring above ceilings shall be installed in cable tray or open top cable hangers.
4. Cable above accessible ceilings shall be supported 3' on center from cable support attached to building structure.
5. Do not untwist cable pairs more than 0.5 in. when terminating.
6. The Contractor shall be responsible for replacing all cables that do not pass <<CATEGORY 6>> requirements.
7. Maximum length shall be 60 meters.
8. Cable shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced.
9. Install cable in neat and workmanlike manner. Neatly bundle and tie all cable in closets. Leave sufficient cable for 90° sweeps at all vertical drops.
10. Maintain the following clearances from EMI sources.
 - a) Power cable - 6 in.
 - b) Fluorescent Lights - 12 in.
 - c) Transformers - 36 in.
11. Do not install <<CATEGORY 6>> cable with more than 110N (25 lbs) pull force, as specified in EIA/TIA and BICSI practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on: long pulls inside conduit, pulls of multiple cables into a single small bore conduit, on conduit runs greater than 100 lineal feet with bends of opposing directions, and in conduit runs that exceed 180 degrees of accumulated bends. Use of tensile rated cords (i.e. fishing line) should be used for difficult or questionable pulls - to judge to go/no-go condition of the conduit and pulling setup.
12. Cables jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper ("shiners") shall be replaced.
13. Firestop all opening where cable is installed through a fire barrier.

B. Inserts and Faceplates

1. All cables shall be terminated with high density modular jacks that snap into a faceplate mounted on a wall outlet box, surface raceways or power pole.
2. Outlet boxes shall be secured to building with mechanical fasteners. Adhesive fasteners are not allowed.
3. All extra openings to be filled with blank inserts.
4. Terminate cable per EIA/TIA <<T568B>> standard pin assignments.
5. Locate so that combined length of cables and cords from panel to phone or computer does not exceed 3m.

END OF SECTION

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SECTION 270800

TESTING, IDENTIFICATION AND ADMINISTRATION

PART 17 - GENERAL

1.1 SUMMARY

SCOPE

1. This section includes the minimum requirements for the testing, certification administration and identification of backbone and horizontal cabling.
2. This section includes minimum requirements for the following:
 - a) UTP testing and testers
 - b) Fiber optic testing and testers
 - c) Labels and Labeling
 - d) Documentation
3. Related Sections include the following:
 - a) 17150 Backbone Cabling Requirements
 - b) 17160 Horizontal Cabling Requirements.

1.2 QUALITY ASSURANCE

- A. All testing procedures and testers shall comply with applicable requirements of:
 1. ANSI/TIA/EIA 568- B.1 Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements
 2. ANSI/TIA/EIA 526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
 3. ANSI/TIA/EIA 526-14A Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant.
- B. Identification and administration work specified herein shall comply with the applicable requirements of:
 1. ANSI/TIA/EIA – 606-A Administration Standards.
 2. ANSI/TIA/EIA – 569-A Pathway and Spaces
 3. ANSI/TIA/EIA – 568-B Telecommunications Cabling Standard.
 4. ANSI/TIA/EIA – 758-A Customer Owned Outside Plant Telecommunications Cabling Standard
 5. BICSI Telecommunications Cabling Installation Manual
 6. BICSI Telecommunications Distribution Methods Manual

1.3 SUBMITTALS

- A. Manufacturers catalog sheets and specifications for fiber and copper cable testers.
- B. Test reports

PART 18 - PRODUCTS

2.1 OPTICAL FIBER CABLE TESTERS

- A. Multimode optical fiber light source
 1. Shall be capable of testing to TIA 568-B.1 and ANSI/TIA/EIA 526-14A criteria.
 2. Shall meet the launch requirements of ANSI/EIA/TIA-455-50B.
 3. Provide 850nm and 1300nm +/- 20 nm wavelength LED light sources
 4. Spectral width of sources shall be <= 50nm for 850nm wavelengths and <= 140nm for 1300nm wavelengths.
 5. The output of the light source shall be 8 MW for 62.5um core optical fiber
 6. Output Stability +/- 0.40 dB from 0 to 50 degrees C
 7. Long Term output stability +/- 0.10dB at 25 degrees C
 8. Power shall be from rechargeable Ni-Cad batteries
 9. Connector types shall include: MTRJ, ST and SC
 10. Acceptable Manufacturers: Fluke ; mfg# DPS2000 + Fiber Test Kit (or better)
- B. Single mode optical fiber light source
 1. Shall be capable of testing to TIA 568-B.1 criteria.
 2. Shall meet the requirements of ANSI/TIA/EIA 526-7.
 3. Provide 1300nm and 1500nm +/- 20 nm wavelength Laser light sources
 4. Output Stability +/- 0.40 dB from 0 to 50 degrees C
 5. Long Term output stability +/- 0.10dB at 25 degrees C
 6. Power shall be from rechargeable Ni-Cad batteries
 7. Connector types shall include: MTRJ, ST and SC
 8. Design make:
 9. Acceptable Manufacturers:
 - Fluke – DPS2000 (or better)

- C. Power Meter
 - 1. Shall be capable of testing to TIA 568-B.1 criteria.
 - 2. Provide 850nm, 1300nm and 1500nm +/- 20 nm wavelength test capability
 - 3. Measurement range shall be from 10 to -60 dBm
 - 4. Accuracy shall be +/- 5% at 0 to -50dBm and +/- 10% 10 to 0dBm and -50 to-60 dBm.
 - 5. Resolution shall be 0.1 dB
 - 6. Connector types shall include: ST and SC
 - 7. Design make:
 - 8. Acceptable Manufacturers:
 - a) Fluke - Model 43 B (or better)
- D. Optical Time Domain Reflectometer (OTDR)
 - 1. Shall be capable of testing to TIA 568-B.1 criteria.
 - 2. Shall have a front CRT display
 - 3. Connector types shall include: ST and SC
 - 4. Design Make: Fluke or better

2.2 100 OHM UTP TESTER

- A. Shall be capable of testing to TIA 568-B.1 criteria.
- B. Physical interface shall be modular RJ-45 connector and a serial port with DB-9 connector.
- C. Shall have auto-testing to determine if cable meets the requirements of TIA/EIA 568-B.1, ISO Class C, D, 10 Base-T, Token Ring, Fast Ethernet and ATM standards.
- D. Acceptable Manufacturers:
 - Fluke or better

2.3 LABELS

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or laser printed type.
- C. Where used for cable marking provide vinyl substrate with a white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.
- D. Where insert type labels are used provide clear plastic cover over label.
- E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18" above all direct buried services, underground conduits and duct-banks.
- F. Acceptable Manufacturers:
 - Brothers (or better)

PART 19 - EXECUTION

3.1 OPTICAL FIBER CABLE TESTING

- A. Test all fibers with launch and far end cable of sufficient length for the OTDR to be able to see through all installed connectors.
- B. Localized attenuation shall not exceed 0.50 dB at any point.
- C. Backbone multimode fiber shall be tested at both 850nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A method B.
- D. Backbone single mode fiber shall be tested in at both 1310nm and 1550 nm in accordance with ANSI/EIA/TIA-526-14A method A.1.
- E. Multimode fiber shall conform to the following:

850 nm:

<u>Length (meters)</u>	<u>Attenuation (dB)</u>
500	3.25
1000	5.0
1500	6.5
2000	8.5

1300 nm:

<u>Length (meters)</u>	<u>Attenuation (dB)</u>
500	2.2
1000	3.0
1500	3.8
2000	4.5

F. Single Mode Fiber shall conform to the following (note: taken at 1550nm)

Inside:

<u>Length (meters)</u>	<u>Attenuation (dB)</u>
500	2.0
1000	2.5
1500	3.0
2000	3.5
2500	4.0
3000	4.5

Outside:

<u>Length (meters)</u>	<u>Attenuation (dB)</u>
500	1.8
1000	2.0
1500	2.2
2000	2.5
2500	2.8
3000	3.0

3.2 100 OHM UTP CABLE TESTING

- A. The testing parameters called for in this section shall include the horizontal Link/ **channel** for all installed drop locations.
- B. Test cable with test set to match the NVP for the cable as stated by the cable manufacturer of the cable being installed.
- C. The test parameters shall include Wire Map, Length, Attenuation, PS-NEXT, PS-ACR, PS-ELFEXT and Return-Loss
- D. Wire Map
 - The wire map test shall verify pair to pin termination at each end and check for connectivity errors. The wire map shall indicate the following for each of the eight conductors:
 - a) Continuity to the remote end
 - b) Shorts between any two or more conductors
 - c) Crossed pairs
 - d) Reversed Pairs
 - e) Split Pairs
 - f) Any other miss wiring
- E. Cable Performance
 - Must meet the minimum acceptable values as indicated in TIA/EIA 568B.1 **Category 6 (TIA/EIA 568B.2-1)** requirements.

3.3 IDENTIFICATION & LABELING

- A. Confirm specific labeling requirements with customer's project coordinator prior cable installation or termination.
- B. Cables
 - 1. Backbone cables shall be marked at each endpoint and at all intermediate pull/ access points or junction boxes. Label shall indicate origination and destination TR ID, sheath ID and strand or pair range.
 - 2. Horizontal cables shall be marked at each end, on the sheath indicating the TR, patch panel and panel port to which the cable is wired. Faceplates and Patch Panels

C. Faceplates and Patch Panels

1. Optical Fiber Patch Panels

- a) Fiber patch panels shall be marked using adhesive labels indicating the range of circuits installed to it.
- b) Each port shall be labeled with the origination and destination with the individual strand ID.

2. Faceplates

- Shall be labeled to indicate the room number and panel port [A thru Z] to which the cable is wired for each cable that it houses.

3.4 RECORD COPY AND AS - BUILT DRAWINGS

- Provide record copy drawings periodically through out the project as per 25030 or as requested by the project manager and at end of the project. Record copy drawings shall include notations reflecting the as built conditions of any additions to or variation from the drawings provided.

3.5 TEST RESULTS

1. Horizontal Copper Cabling
 - a) The Contractor shall test all cables and submit all horizontal copper cable test result data in electronic format, with the resulting file formatted with one test result per 8.5"x 11" page.
 - b) To provide the test results in an acceptable format:
 - 1) Export or Download the test results from the cable tester to a *.txt format.
 - 2) Then open the *.txt file in Microsoft WORD 6.0 and save the file as a *.doc file.
2. Fiber Optic Cables
 - a) The Contractor shall test all fiber optic cables and submit all fiber test result data in an electronic format and provide one (1) hard copy of the test results showing graphically, the entire length of the fiber.
 - Reports shall show circuit ID, cursor marks, total attenuation, date of installation and test used.
 - b) Contractor shall submit (1) copy of software capable of viewing the electronic test result files.
3. High Pair Count Copper Cables
 - a) The Contractor shall test all high count copper cables and submit test result information in an electronic format. Minimal acceptable formats are Word 6.0 or Excel 95/97.
 - b) See project coordinator for required format for test report documentation.

END OF SECTION

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SECTION 270810
SUPPORT AND WARRANTY

PART 20 - GENERAL

1.1 WORK INCLUDED

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

1.2 CONTRACTOR REQUIREMENTS

- A. Certifications.
 - Cabling Contractor must be Avaya and Corning certified.
- B. 1) Avaya installation must have a warranty of 25 years.
2) Contractor must have more than two (2) RCDD people on staff and 10% of staff BISCI certified.

1.3 SUBMITTALS

- A. Submit manufacturer warranty information with bid
- B. Contractor certification to provide warranty with bid.

PART 21 PRODUCTS

2.1 NOT INCLUDED IN THIS SECTION

END OF SECTION

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