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Rochester Institute of Technology
Information & Technology Services

Standards for Communications Cabling

Section 27000- General
Section 27100- Cable Plant

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Related Documents

Document ID	Document Title	Author	Revision	Effective Date

Document Change Control

Revision	Date	Author	Section	Content Changes or Additions
2006.1	2/24/06	JES	All	Format
2006.2	3/31/06	JES	27100	Panduit jack part numbers revision
2006.3	10/11/06	JES	All	Updates
2008.1	3/13/08	JES	27160	RF Cabling

Content Owner

Name	Department	Phone Number	Alternate Contact
James Shanks	ITS Network Communications Team	585-475-5560	Greg Gardner

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27010 BASIC COMMUNICATION REQUIREMENTS

1 Regulations and Code Compliance

- 1.1 All work shall be performed in a neat and professional manner.
- 1.2 For any information that is not covered in the following guidelines, refer to the appropriate industry standard and organizations as listed below.
 - 1.2.1 American National Standards Institute, Inc. (ANSI)
 - 1.2.2 National Electrical Safety Code
 - 1.2.3 Federal Communications Commission (FCC) Publications
 - 1.2.4 Occupational Safety and Health Act
 - 1.2.5 Insulated Cable Engineers Association (ICEA) Standard
 - 1.2.6 National Fire Protection Association (NFPA)
 - 1.2.6.1 National Electric Code (NEC): ANSI/NFPA 70
 - 1.2.6.2 Central Station Signaling Systems: ANSI/NFPA 71
 - 1.2.6.3 National Fire Alarm Code: ANSI/NFPA 72
 - 1.2.6.4 Protection of Electronic Computer Data Processing Equipment: ANSI/NFPA 75
 - 1.2.6.5 Standard for Installation of Lighting Protection Systems: ANSI/NFPA 780
 - 1.2.7 National Electrical Code
 - 1.2.8 Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - 1.2.9 National Electrical Safety Code
 - 1.2.10 Electronics Industries Association
 - 1.2.10.1 ANSI/EIA/TIA 568B.1 through 568B.1-4, *Commercial Building Telecommunications Cabling Standard Part 1: General Requirement and all addendums*
 - 1.2.10.2 ANSI/EIA/TIA 568B.2 through 568B.2-6, *Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components and all addendums*
 - 1.2.10.3 ANSI/EIA/TIA 568B.3 through 568B.3-1, *Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components and addendum*
 - 1.2.10.4 ANSI/EIA/TIA 569-B, *Commercial Building Standards for Telecommunications Pathways and Spaces, 2003*
 - 1.2.10.5 ANSI/EIA/TIA 606-A, *Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2002*
 - 1.2.10.6 ANSI/EIA/TIA 607-A, *Commercial Building Grounding and Bonding Requirements for Telecommunications, 2002*
 - 1.2.10.7 ANSI/EIA/TIA 758 through 758-1 *Customer-owned Outside Plant Telecommunications Cabling Standard and addendum*
 - 1.2.11 International Telecommunications Union (ITU), formally CCITT
 - 1.2.12 BICSI
 - 1.2.13 CSA
 - 1.2.14 UL
 - 1.2.15 NEMA
 - 1.2.16 IEEE
- 1.3 The Contractor shall comply with the NEC and all other federal, state, local and laws, codes and ordinances.

- 1.4 The Contractor shall be responsible for placement of outside plant cables within Owner- provided pathways without splices.
- 1.5 For all work in manholes and cable vaults, the contractor shall be responsible for ensuring that safe operating procedures are followed; work equipment is adequate and personnel have received proper training. Safety equipment shall be inspected and approved by an authorized representative of the Owner.
- 1.6 The Contractor shall provide the Owner with applicable warranty certification at time of Proposal response.
- 1.7 The Contractor shall be responsible for measuring required cable distances and shall not exceed appropriate cable length standards.
- 1.8 Product/Materials substitutions require written Owner approval at the time of Proposal response.
- 1.9 The Contractor shall provide the Owner with a copy of his asbestos insurance before work begins.
- 1.10 The Contractor shall provide the Owner with a copy of his Confined Spaces permit.
- 1.11 The Contractor shall be courteous to all personnel on the project, including students and other contractors.
- 1.12 Documentation shall be required for all categories and will be specified in the Specific Execution sections. Generally, documentation shall be required for all backbone pathway usage, cable pair counts, and building entrance details. Documentation shall be required for horizontal wiring jack numbers, redlined blueprints indicating final locations, and jack numbers. Test results as specified under "Testing" shall be required for all categories.
- 1.13 Subcontractors shall not be accepted without Owner approval. Proposed use of subcontractors shall be indicated as part of the Proposal.

27100 CABLE PLANT OVERVIEW

1 *Approved Products/Materials*

1.1 Backbone Cabling

- 1.1.1 Essex PE-89; Lucent/Avaya AFMW or equivalent
- 1.1.2 Systimax 190 type protection or Circa Tel gas type protection
- 1.1.3 Systimax 4B1E gas tube protection or CT3-BAL gas tube protection
- 1.1.4 Systimax ARMM type riser cable; fire rated or approved equivalent
- 1.1.5 Systimax XLBET main distribution frames
- 1.1.6 Panduit Category 5e 110 type termination hardware: P110BW100-X
- 1.1.7 Backbone/Riser Fiber Optic Cable
 - 1.1.7.1 BerkTek PDP Premise Distribution Plenum
 - 1.1.7.2 Corning Cable Systems MIC OFNP or OFNR
 - 1.1.7.3 or approved alternate for backbone applications
- 1.1.8 Panduit or Corning Cable Systems SC connectors
- 1.1.9 Fiber Optic LIU Enclosures
 - 1.1.9.1 Panduit Opticom Rack Mount Enclosures: FRME1 through FRME4.
 - 1.1.9.2 Corning Cable Systems Lanscape patch panels
- 1.1.10 Coaxial underground backbone cable by Comm/Scope
 - 1.1.10.1 QR86OJCASS
 - 1.1.10.2 QR715JCASS
 - 1.1.10.3 QR625JCASS
- 1.1.11 Coaxial indoor riser cable by CommScope
 - 1.1.11.1 Plenum: 2312K
 - 1.1.11.2 Non Plenum: QR 540 JCAR

1.2 Horizontal Wiring

- 1.2.1 CAT5e UTP copper for voice and data applications, plenum rated, color blue
 - 1.2.1.1 CommScope Ultra II, Panduit TX5500, or BerkTek Lanmark 350
- 1.2.2 CAT 6 UTP copper for data applications, plenum rated, color green
 - 1.2.2.1 CommScope, Panduit, or BerkTek
- 1.2.3 Panduit wired outlet assemblies
 - 1.2.3.1 Jack: # CJ5E88TGIW (white)for voice applications
 - 1.2.3.2 Jack: # CJ5E88TGBU (blue)for Cat 5e wired data applications
 - 1.2.3.3 Jack: # CJ5E88TGRD (red)for Cat 5e wireless data applications
 - 1.2.3.4 Jack # CJ688TGGR (green)for Cat 6 wired data applications
 - 1.2.3.5 CATV F-connectors # CMFBAIW
 - 1.2.3.6 Blank module: #CMBIW-X
 - 1.2.3.7 Faceplates: Panduit Classic Series
 - 1.2.3.7.1 Duplex 2 port CFPE2IW
 - 1.2.3.7.2 Quad 4 port CFPE4IW
 - 1.2.3.7.3 Six Port CFPE6IW
- 1.2.4 Panduit Angled patch panels for voice and data: CPPLA48WBL
- 1.2.5 Panduit PatchRunner Vertical Management: PRV8 and door PRD8 (4 each per rack)
- 1.2.6 Panduit Horizontal Management(fiber): NCMHAEF2 (2 per rack)
- 1.2.7 Panduit Patchlink Horizontal Management(copper): WMPH2E
- 1.2.8 Chatsworth Lock Box for wireless access points: WA064-WAP
- 1.2.9 19" x 7'equipment rack:
 - 1.2.9.1 Chatsworth #55053-503

- 1.2.9.2 Panduit #CMR19X84
- 1.2.9.3 Or equal with approval from Owner (RIT ITS Division)
- 1.2.10 Belden video wires: plenum 89292; 88281; 85230; 82120
- 1.2.11 Comm/Scope RG6 CATV cable:
 - 1.2.11.1 2275K
 - 1.2.11.2 2275V
 - 1.2.11.3 5726
 - 1.2.11.4 Or equal with approval from ITS
- 1.2.12 Comm/Scope RG11 CATV cable:
 - 1.2.12.1 2285K,
 - 1.2.12.2 5901,
 - 1.2.12.3 5913,
 - 1.2.12.4 Or equal with approval from ITS
- 1.2.13 Panduit hinged wall mount bracket: WBH3
- 1.2.14 Semtron coaxial cable demarcation panel: PN JP150-48-F.81L, brushed stainless
- 1.2.15 Panduit Crimped Coax Connecters
 - 1.2.15.1 F15M10S11-X
 - 1.2.15.2 F15M12S11-X
- 1.3 Miscellaneous
 - 1.3.1 The duct sealant system shall be designed to seal the area between the cable and conduit to ensure a watertight seal. The duct sealant system shall be Raychem Telecommunications or Electrical duct sealing system Series TDUX or RDSS.
 - 1.3.2 The pull rope for empty conduits or inner ducts shall be polyester woven Dandy-line by Arnco or equal.
 - 1.3.3 Empty conduit and inner duct plugs shall be nonmetallic, provide watertight seals, and have provisions to tie off a pull rope in conduit. Acceptable manufacturer shall be Carlon, MAEPG series.
 - 1.3.4 Interduct types shall be as follows:
 - 1.3.4.1 Flexible Engineered Fabric innerducts by MaxCell.

27110 COMMUNICATIONS SPACES

Note: This section included for design purposes only. Spaces to be provided by others.

1 Spaces

- 1.1 Communications spaces shall be located in the central area of a building, dedicated to telecommunications functions, and provisioned for each 10,000 square feet of area; ensuring that no wired outlet run exceeds 90 meters.
- 1.2 A minimum of 100 square feet of space per floor up to 10,000 square feet shall be provided. A minimum of 70 square feet of space shall be provided for each 5000 square feet of space.
- 1.3 A minimum of two walls shall be covered with $\frac{3}{4}$ " fire-rated plywood (8' x 4') located to ensure maximum useable space for mounting hardware.
- 1.4 Plywood backboard shall be painted with two coats of nonconductive, fire retardant paint of a light color.
- 1.5 A twelve-inch wide ladder rack should be mounted on the same wall(s) as the plywood backboards.
- 1.6 Pathways entering the space shall enter above or in close proximity to the plywood backboard.
- 1.7 Pathways entering through the floor shall not protrude more than 2" above finished floor height.
- 1.8 A minimum of (fifty) 50foot candles of light shall be provided; avoid florescent lighting.
- 1.9 Proper cooling and ventilation shall be provided
- 1.10 A minimum of a 36" x 80" door opening shall be provided and the door shall be keyed to a key specified by the Owner.
- 1.11 Two (2) dedicated 15 amp, 110-volt, ac duplex electrical outlets on separate circuits shall be provided and located on each data rack. A single quad box is acceptable.
- 1.12 One (1) dedicated 20 amp, 220-volt, ac electrical outlet on separate Emergency circuit shall be provided and located on each data rack. A single quad box is acceptable.
- 1.13 One (1) dedicated 15 amp, 110-volt, ac duplex electrical outlet on separate circuit shall be provided and located for the RF distribution system.
- 1.14 A minimum one (1) 15 amp, 110-volt wall-mounted convenience outlet shall be provided in each space
- 1.15 A ground buss connected to primary building ground shall be provided in each space.
- 1.16 All codes listed in Quality Assurance shall apply; space shall be fire-stopped compliant with all codes.
- 1.17 The space shall resemble an office type environment, have tile floors (not carpet) and concrete shall be sealed to avoid dust.

2 Grounding System

- 2.1 The TBB shall be designed and/or approved by a qualified PE, licensed in the state where the work is to be performed. The TBB shall adhere to the recommendations of the TIA/EIA-607A standard, and shall be installed in accordance with best industry practice.

2.2 A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

27120 BUILDING SERVICE ENTRANCES

Note: This section included for design purposes only. Entrance Facilities to be provided by others.

1 Entrance Facilities

- 1.1 The locations and size of the building entrance shall be appropriate for application and placed no farther than 50 feet from the primary communications space for copper cabling.
- 1.2 If actual entrance is farther than 50 feet from the primary communications space, a rigid, metallic and grounded conduit, sized for the application, shall be installed to extend to the communications space.
- 1.3 All open space in the pathway system and empty pathways shall be plugged with a rubber conduit plug, water plug, or duct sealer (appropriate for application).
- 1.4 A $\frac{3}{4}$ " metallic conduit for primary building ground wires, from the entrance location to primary building ground location, shall be provided.
- 1.5 The Owner shall have clear access to the building entrance at all times..
- 1.6 A minimum of two (2) 4' x 8' x $\frac{3}{4}$ " plywood backboards, installed on two or more walls, and fireproofed, shall be provided.
- 1.7 The door to the space shall be provisioned to open outward and have a minimum opening of 36" x 80".
- 1.8 The space shall have one duplex outlet on an emergency power circuit.
- 1.9 The space shall be safe and environmentally clean.

2 Grounding System

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

27130 INTERIOR COMMUNICATIONS PATHWAYS

Note: This section included for design purposes only. Pathways to be provided by others.

1 Interior Horizontal Communication Pathways

- 1.1 All communications horizontal pathways shall be rigid, metallic, and/or PVC compliant with applicable codes; flex pathway is not compliant with code.
- 1.2 All communications pathways shall be adequately supported, sized for application, provisioned for future growth, and in compliance with return air plenum codes.
- 1.3 Vertical wired outlet pathways shall be a minimum of 1' rigid galvanized conduit, installed from the wired outlet box, stubbed above ceiling tiles, finished smooth at both ends with bushings, and visible at the ceiling and outlet-box location.
- 1.4 Vertical wired outlet pathways shall be installed with a pull wire that is accessible and visible at the ceiling and outlet box location.
- 1.5 Vertical wired outlet pathways shall be provisioned with a minimum 4" x 4" outlet box; 2.5" deep, with cutouts at the back and a mud-ring to accommodate single duplex outlets.
- 1.6 The Contractor shall bond metallic cable trays to vertical metallic conduit and to the primary building ground.
- 1.7 Power poles must be 1' in diameter, separate from the electric, stubbed at ceiling, and provisioned for mounting communications wired-outlet assemblies.
- 1.8 Wired outlet pathways shall comply with EIA/TIA standards and use no floor cores.
- 1.9 All interior, horizontal pathways shall be fire-stopped-compliant with all applicable codes.

2 Grounding System

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

27140 EXTERIOR COMMUNICATIONS PATHWAYS

Note: This section included for design purposes only. Pathways to be provided by others.

1 Exterior Communication Pathways

- 1.1 All exterior communications pathways shall be rigid metallic and/or PVC (not flex), adequately supported, reamed at each end, clean, dry, and free of debris.
- 1.2 All exterior communications pathways shall be placed at a minimum depth of 36".
- 1.3 All exterior communications pathways shall be sized appropriately for the application, with provisions for future growth. Each must be installed with a non-corrosive pulling wire, with a minimum pulling strength of 200 pounds, which is left in all pathway runs.
- 1.4 All exterior communications pathways shall have a tracer wire installed end to end and can be reached with entry to the space.
- 1.5 All exterior communications pathways shall have a maximum of two (2) 90-degree bends between pulling points.
- 1.6 All exterior communications pathways shall protrude not more than 2" into the floor of the building entrance or other communications spaces.
- 1.7 All exterior communications pathways shall be bonded/grounded compliant with all codes listed in the Quality Assurance section.

NOTE: All specifications for exterior communications pathways also apply to interior vertical/horizontal riser type pathways.

27150 BACKBONE CABLING REQUIREMENTS

1 General Interior Backbone Cable Installation

- 1.1 Backbone cables shall be installed separately from horizontal distribution cables.
- 1.2 A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- 1.3 Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits.
- 1.4 Where cables are installed in an air-return plenum, riser-rated cable shall be installed in metallic conduit.
- 1.5 Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- 1.6 All backbone cables shall be securely fastened to the sidewall of the TR on each floor.
- 1.7 Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- 1.8 Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
- 1.9 Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

2 Copper Backbone General Specifications

- 2.1 Adequate care shall be exercised when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed. Prior to placing cable, the Contractor shall verify the structural integrity and clear passage (water, silt) of each conduit by passing a squeeze and slug, test mandrel, or owner-approved projectile through each length, where applicable. All obstructed ducts shall be reported to the Owner immediately.
- 2.2 Immediately after cable placement, temporary tags with the cable number and pair count shall be attached to each end of each cable section.
- 2.3 Cables and equipment shall be supported and secured as indicated. Where the specific method of support is not shown, adequate supports and fasteners shall be used to secure cables and equipment in position. Metallic supports and fasteners shall be hot-dipped galvanized steel in manholes and vaults having metallic cable racks, and shall be non-metallic material in manholes and cable vaults having non-metallic cable racks. All cables and equipment installed in exterior locations shall be secured so that they cannot be dislodged or damaged by winds of up to 125 miles per hour.
- 2.4 Caution shall be used when bending cables to avoid kinks or other damage to the sheath. The bend radius shall be as large as possible with a minimum of not less than 10 times the outer diameter of the cable. Minimum radii shall be increased when necessary to meet cable manufacturer's recommendations. Bending operations in manholes and vaults shall be performed in accordance with the procedures and instructions of the manufacturer. Cable bending shoes shall be used in duct or conduit ends when bending cable exiting a duct or conduit. The

- bending shoes shall remain in place until racking, splicing, and tying is complete. Cables shall not rest against the edge of the duct or conduit mouth.
- 2.5 Cable reels shall be located and aligned so that the cable is pulled off the top of the reel into the trench or conduit in a long, smooth bend without twisting. Cable shall not be pulled from the bottom of a reel or subjected to reverse bends from those formed by factory reeling. A cable feeder guide of proper size shall be used at the mouth entrance. Un-terminated cables shall be laid in the specified routing and locations as indicated.
 - 2.6 Un-terminated cable ends shall be cleared, capped, and sealed. The lubricant shall be compatible with, and intended for use with our specified Essex cables. Soap and grease lubricants are prohibited.
 - 2.7 Support and rack cables are required at manholes and building entrances such that any strain on the cable shall not be transmitted to the splices or entrance points. Cables shall be tie-wrapped to strut supports.
 - 2.8 In all cases, cable shall be placed in accordance with good workmanlike standards, BICSI and ANSI standards.
 - 2.9 Trenching or directional boring installation methods of cables shall be allowed and approved by the Owner before work begins. The Owner shall approve Backfill over cables.
 - 2.10 The Owner shall determine conduit assignments as determined before work starts. As a rule, cables having high-pair counts shall be placed in the lowermost corner of the duct bank.
 - 2.11 Cable placed by directional boring shall be as follows:
 - 2.11.1 Minimum cable bending radius shall be eighteen (18) inches or larger
 - 2.11.2 Cable placement depth shall be thirty-six (36) inches minimum or as indicated on drawings
 - 2.11.3 Cables shall be placed immediately after the bore is completed by hand-pulling methods. Use of boring equipment to pull the cable through the opening requires Owner approval.
 - 2.12 The Contractor shall provide Systimax 190 type protector blocks with Systimax type 4BIE protector modules to be mounted on plywood backboards except as noted.

3 Copper Backbone General Splicing Specifications

- 3.1 The Contractor shall provide all labor, materials and equipment to splice cables at termination points within buildings. The Contractor shall provide splice enclosures, cable connectors, splice supports, tape, cleaning materials, cable ties, and other items required for complete installation. All metallic cable shields shall be bonded and connected to building grounds at all termination points.
- 3.2 All cable splices shall be protected from damage at sheath openings by mechanically protecting all conductors using LUCENT/AVAYA type 200 splice cases or equivalent, which shall be approved by the Owner.
- 3.3 All cable shall be thoroughly cleaned and scuffed in an appropriate manner to ensure a good mechanical bond when splicing. Scotchcast Brand 4435 non-conductive aluminum oxide abrasive strip or Owner-approved equivalent shall be used. All cable shall be thoroughly cleaned with a non-toxic, environmentally safe solvent, 3M Brand 4414, 4415, or Owner-approved equivalent.
- 3.4 All cable splices shall be supported by a minimum of two cable hooks or brackets. Where vertical racking is not present, horizontal racking for support may be used utilizing 3M Brand RC-100 rack adapters or Owner-approved equivalent.
- 3.5 Underground cable splicing shall use Systimax 710 Series or 3M-MS2-4000 series supermini modular connectors. This modular splicing shall be used in all splice

enclosures. The Contractor shall mark or tag the cable pair counts spliced on the cable splice enclosure.

- 3.6 The Contractor shall not splice any outside cables without approval of the Owner.
- 3.7 Splicing of cross-connect terminals and secondary cable access stubs not in line, or straight splice or diminis/taper splice locations shall use Scotchlock - ULG splicing connectors or Lucent Technologies, Inc. 700 type connectors.
- 3.8 Cable splices shall be performed in accordance with manufacturer specifications and with good workmanlike standards, BICSI standards and ANSI standards.
- 3.9 All metallic cable shields shall be grounded by a #6AWG minimum ground wire to a low-resistance ground, in compliance with EIA/TIA 607 A standards. The Contractor in each closet shall provide connections to new grounding buss bars. The grounding bus bar shall be grounded to cold water pipe in a building or to the primary building ground as required.

4 Fiber Optic Backbone General Specifications

- 4.1 Fiber optic cables shall be free of material and manufacturing defects and free of dimensional non-uniformities that would seriously impair the functionality of the cables. The fiber optic cables shall also be free from surface imperfections and internal defects that would prevent them from meeting the mechanical and transmission requirements of this Specification.
- 4.2 The fiber optic cables shall be terminated into rack-mounted fiber optic patch panels. The final fiber optic patch panel shall consist of the applicable fibers field terminated onto field installable SC connectors. Pre-connectorized fiber assemblies (pigtailed) shall not be used. Each connector shall exhibit an insertion loss of 0.5 dB or less and a return loss of .30dB or better.
- 4.3 Personnel who have had at least three (3) years experience in placing cables in conduit, cable trays, and underground duct systems shall perform Cable installation work.
- 4.4 Fiber-optic cable terminations and testing shall be made by journeymen cable splicers who have had a minimum of three (3) years experience in terminating and one (1) year in testing fiber optic cables.
- 4.5 Cables shall be provided in continuous lengths, without splices, from termination to termination.
- 4.6 Cables and equipment shall be supported and secured; metallic supports and fasteners shall have a corrosion-resistant finish.
- 4.7 Utilizing Panduit J-Mod System (j-hook) or equivalent (no bridal rings) and velcro cable ties shall be used as necessary to properly secure the cable. Exposed cable runs in communications closets shall be protected with inner-duct and secured to walls, cable trays, and racks.
- 4.8 Caution shall be used when bending cable to avoid kinks or other damage to the sheath. The bend radius shall be as large as possible with a minimum of ten (10) inches. Minimum radius shall be increased when necessary to meet cable manufacturer's recommendation.
- 4.9 Adequate pulling lubricant shall be used to minimize pulling tension and prevent sheath damage when pulling cables. Lubricant shall be applied to the cable sheath with a lubricator. When pulling has been completed, the exposed cable ends shall be wiped clean of lubricant. All lubricant spills shall be cleaned up immediately. Lubricants shall be certified by the lubricant manufacturer to be compatible with and intended for use with plastic sheathed cables. Soap and grease type lubricants are prohibited.
- 4.10 It shall be the Contractor's responsibility to ensure that the cable-pulling procedures being used do not exceed the maximum pulling tension as specified by the cable manufacturer.

- 4.11 The cable shall be carefully inspected for sheath defects or other irregularities, as it is pulled out from the reel. If defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the discretion of the Owner. A system of communications, visual or otherwise, shall be maintained between pulling and feed locations so that pulling can be stopped instantly, if necessary.

5 *Optical Fiber Termination Hardware*

- 5.1 Fiber slack shall be neatly coiled within the fiber splice tray or enclosure.
- 5.2 Each cable shall be individually attached to the respective fiber enclosure by mechanical means. The cable strength member shall be securely attached to the cable strain-relief bracket in the enclosure.
- 5.3 Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- 5.4 Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- 5.5 A maximum of 12 strands of fiber shall be spliced in each tray.
- 5.6 All spare strands shall be installed into spare splice trays.

6 *Coaxial Backbone General Specifications*

- 6.1 The cable shall not be subjected to a bend radius less than that specified by the cable manufacturer during installation. Extreme caution shall be exercised to protect the outer layer of the cable from puncture by building projections and other objects. Punctured sections of cable shall be replaced at the Contractor's expense.
- 6.2 The appropriate coring and cable preparation tool shall be used in all splicing.
- 6.3 Housing-to-housing adapters and right angle fittings shall be used in all locations where possible. No reverse loops shall be allowed.
- 6.4 All passive devices shall be strand mounted or supported by a special standoff bracket when the housing mount cannot be used, or when interconnected to another device by an entry-to-entry connector.
- 6.5 Splicers shall use 75-ohm resistor/jumpers and an ohmmeter in the following manner to ensure no opens or shorts in the line.
 - 6.5.1 A 75-ohm resistor shall be attached to one end of the cable section to be spliced by connecting one side to the center conductor and the other to the shield. Zero the ohmmeter and measure the resistor being used; mark that reading on the meter face with a grease pencil or triangular piece of tape. The splicer can now continue to the next device and prepare the cable using the DST/SST-appropriate coring tool and clean the center conductor, then measure the center conductor to ground. The reading should be approximately the same as the reference measurement. The device is then installed and the output measurement taken and should read the same. If the device installed is a line extender or trunk amplifier, a continuity jumper (no resistor) should be placed from center conductor to center conductor. A special 75-ohm jumper can be placed in a bridger amplifier to allow the splicer to work from the amplifier to the terminating tap. This jumper shall have an alligator clip and lead soldered to one side of four (4) 75 ohm resistors which is connected to a ground while an individual lead and clip are soldered to the other end of each 75 ohm resistor for connection to the bridger port center conductor.
- 6.6 Grounding Systems: The grounding system shall be in accordance with applicable portions of NFPA No. 78, UL-467 and ANSI EIA/TIA 607 and shall be a continuity system at each station. Conductor connections to ground rods, buried conductors,

and coaxial grounding clamps shall be made with noncorrosive exothermic weld or non-bolted compression type bonding clamps. Fences and other fixed metallic equipment of any type within ten (10) feet of the ground or radial extensions shall be bonded to the grounding system. Connections to coaxial lines shall be made with manufacturers' recommended grounding kits. Bonding of dissimilar metals shall be made only with approved type connectors. Electronic components in the cable distribution plant shall be directly connected to the ground system. Each cable shall be grounded with a grounding block at the point of building penetration, and the grounding block shall be directly connected to a ground system.

27160 HORIZONTAL CABLING REQUIREMENTS

1. *Work Area Outlets*

The wire outlet assemblies shall be a 4' x 4" box with mud ring to reduce the presentation to a single gang box and with a 1" rigid conduit stubbed at the ceiling with a pulling wire.

If the walls cannot be fished, the wire shall be installed in approved surface raceway following special guidelines for raceway usage.

Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B document, manufacturer's recommendations, and best industry practices.

Pair untwist at the termination shall not exceed 3.18mm (0.125 inch).

Bend radius of the cable in the termination area shall not be less than four (4) times the outside diameter of the cable.

The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

Data jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).

Voice jacks shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

2. *Horizontal Distribution Cable Installation*

2.1 Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

2.2 A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

2.3 Cable raceways shall not be filled greater than the TIA/EIA-569-A maximum fill for the particular raceway type or 40%.

2.4 Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points or consolidation points.

2.5 Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

2.6 The cable's minimum bend radius and maximum pulling tension shall not be exceeded.

2.7 If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at a maximum of 48-inch intervals and 24-inch maximum for all exposed vertical cable runs. At no point shall cable(s) rest on acoustic ceiling grids or panels.

- 2.8 Cable bundling shall be minimized in all horizontal cable runs. When necessary, horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- 2.9 Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- 2.10 Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
- 2.11 Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance and at no cost to the Owner.
- 2.12 Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- 2.13 Unshielded twisted pair cable shall be installed so there are no bends smaller than four (4) times the cable outside diameter at any point in the run and at the termination field.
- 2.14 Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

3 Voice/Telemetry Horizontal Wiring General Specifications

- 3.1 Category 5e voice/telemetry horizontal wires shall be installed from the BDF/IDF to the wired outlets at each location indicated on drawings in compliance with EIA/TIA 568B standard.
- 3.2 Horizontal wires shall be installed in Owner-provided pathways as indicated on drawings.
- 3.3 The Contractor shall identify each wire for an orderly installation.
- 3.4 All voice/telemetry horizontal wires shall be terminated on Panduit rack mounted patch panels.
- 3.5 The Contractor shall terminate horizontal wires in an orderly fashion, using strain relief and cable management mechanisms.
- 3.6 Cable bundling shall be minimized in all cable runs. When necessary, the Contractor shall install bundles of wires in vertical chase ways outside of conduits; bind all wires together in one bundle in order to provide strain relief for the wires, and scribe bundle to existing structures.
- 3.7 The Contractor shall ensure that during the installation, nicks, abrasions, burning, and scuffing of wires is prevented. Wires found to be damaged shall be replaced at the Contractor's expense regardless of whether the wire passes testing.
- 3.8 Power poles, if necessary, shall have a separate section from the electric wires.
- 3.9 All horizontal wires shall be concealed.
- 3.10 Sleeves, bores, fire rated walls and floors, which are penetrated, shall be fire-stopped according to standards and codes.
- 3.11 All tie wraps shall be logical, at 90-degree angles when possible and supported from ceilings (not on top of ceiling tiles).
- 3.12 RJ31X shall be used whenever an extension is to be bridged to a security or fire alarm system and wired as follows:
 - 3.12.1 At the station cable far end:

- 3.12.1.1 The blue/white pair shall be connected to terminals 4&5 of the RJ31X.
- 3.12.1.2 The orange/white pair shall be connected to terminals 1&8 of the RJ31X.
- 3.12.2 Cross connect as follows:
 - 3.12.2.1 A feeder pair connected to the analog port in the MDF shall be connected through to the station cable blue/white pair and terminals 4&5 of the RJ31X.
 - 3.12.2.2 A second feeder pair from the MDF shall be connected through to the orange/white pair and terminals 1&8 of the RJ31X.
 - 3.12.2.3 A third feeder pair from the MDF shall be connected through to the desired analog phone extension that has the same extension number as the RJ31X.
 - 3.12.2.4 A final cross connect is placed between the second feeder pair to the third feeder pair.

4 Data Wiring General Specifications

4.1 SAME AS VOICE/TELEMETRY

4.2 The Contractor shall provide vertical and horizontal cable management as noted in materials section.

4.3 The Contractor shall mount racks according to plan supplied by the Owner

4.4 The Contractor shall ground rack to equipment ground bar using a #6 AWG wire.

4.5 All data wires shall be terminated with slack loops to facilitate the movement of any wire to any port on the patch panel and rack.

5 Horizontal Cross Connect Installation

5.1 Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B standard, manufacturer's recommendations, and best industry practices.

5.2 Pair untwist at the termination shall not exceed 3.18 mm (0.125 inch).

5.3 Bend radius of the cable in the termination area shall not exceed four (4) times the outside diameter of the cable.

5.4 Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle, separated and dressed back to the point of cable entrance into the rack or frame.

5.5 The cable jacket shall be maintained as close as possible to the termination point.

5.6 Each cable shall be clearly labeled on the cable jacket, behind the patch panel, at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view, are not acceptable.

6 Optical Fiber Termination Hardware

6.1 Fiber slack shall be neatly coiled within the fiber splice tray or enclosure.

6.2 Each cable shall be individually attached to the respective fiber enclosure by mechanical means. The cable strength member shall be securely attached to the cable strain relief bracket in the enclosure.

6.3 Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

6.4 Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle are not acceptable.

6.5 A maximum of 12 strands of fiber shall be spliced in each tray.

6.6 All spare strands shall be installed into spare splice trays.

7 *Inside Backbone Cable Installation*

- 7.1 Backbone cables shall be installed separately from horizontal distribution cables.
- 7.2 A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- 7.3 Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits.
- 7.4 Where cables are installed in an air-return plenum, riser-rated cable shall be installed in metallic conduit.
- 7.5 Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- 7.6 All backbone cables shall be securely fastened to the sidewall of the TR on each floor.
- 7.7 Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- 7.8 Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method, to provide proper support for the weight of the cable.
- 7.9 Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

8 *Copper Termination Hardware*

- 8.1 Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's recommendations, and best industry practice.
- 8.2 Pair untwist at the termination shall not exceed 3.18mm (0.125 inch).
- 8.3 Bend radius of the cable in the termination area shall not exceed four (4) times the outside diameter of the cable.
- 8.4 Cables shall be dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle, separated, and dressed back to the point of cable entrance into the rack or frame.
- 8.5 The cable jacket shall be maintained to the termination point.
- 8.6 Each cable shall be clearly labeled on the cable jacket, behind the patch panel, at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view, shall not be acceptable.

9 *Racks*

- 9.1 Racks shall be securely attached to the concrete floor using minimum 3/8" hardware or as required by local codes.
- 9.2 Racks shall be placed with a 36-inch (minimum) clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.
- 9.3 All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 2.4 of this document.
- 9.4 Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

- 9.5 Wall mounted termination block fields shall be mounted on 4' x 8' x .75" void-free plywood. The plywood shall be mounted vertically, 12" above the finished floor. The plywood shall be painted with two coats of white, fire-retardant paint.
- 9.6 Wall-mounted termination block fields shall be installed with the lowest edge of the mounting frame 18" from the finished floor.

10 RF Cable Distribution System

- 10.1 All cabling must be home run. No taps, Splitters, or splices are to be used between the main closet distribution and the end users connection plate.
- 10.2 Each Cable length and cable type must be recorded and made available prior to the distribution system acceptance.
- 10.3 All cabling must be a minimum of RG-6 or better.
- 10.4 All cable runs to rooms up to 200' should be RG-6 or better
- 10.5 All cable runs to rooms 200'-300' should be RG-11 or better
- 10.6 All risers between floors should be RG-11 or better
- 10.7 All cabling should be Plenum where required by code.
- 10.8 All connectors should be industry standard moisture proof compression fittings NOT crimp style.
- 10.9 All cabling should be properly labeled with both to and from designations and a cable number.
- 10.10 Labels should be wrapping type or be heat shrunk over with clear covering.

11 Firestop System

- 11.1 All firestop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.

27170 TESTING, IDENTIFICATION AND ADMINISTRATION: BACKBONE CABLING

1 Testing and Acceptance

General

All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling-system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation, including, but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks, shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

All cables shall be tested in accordance with this document, the latest ANSI/TIA/EIA standards, and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

Fiber Testing

Fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in an RFP. Testing shall consist of an end-to-end power meter test performed per TIA/EIA-455-53A. The system loss measurements shall be provided at 850 and/or 1300 nanometers for multimode fibers and 1310 and/or 1550 nanometers for single mode fibers. These tests also include continuity checking of each fiber.

1. For a horizontal cabling system using multimode optical fiber, attenuation shall be measured in both directions at either 850 nanometer (nm) or 1300 nm using an LED light source and power meter.
2. Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for singlemode) in one direction.
3. Test set-up and performance shall be conducted in accordance with ANSI/TIA/EIA-526-14 Standard, Method B.
4. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. **ONLY A BASIC LINK TEST IS REQUIRED.** As an option, the Contractor can install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above. The values for calculating loss shall be those defined in the ANSI/TIA/EIA Standard.
5. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

OTDR TESTS

- 1.1.1.1 All OTDR testing requires the use of an access jumper (length determined by OTDR requirements) between the OTDR and the first connector and after the far end connector. The fiber used in the

access jumper shall have specifications that are identical to the fiber under test.

- 1.1.1.2 After terminations have been completed, each fiber shall have an OTDR trace made for the entire span, including the access jumpers as described above. The tests shall be performed in both directions using the OTDR and shall be stored on diskettes. Tests on Multimode fibers shall be performed at 1,300 (+/-) 20 nanometers. Tests on Singlemode fibers shall be performed at 1,550 (+/-) 20 nanometers.
- 1.1.1.3 As part of the test data submittal, the Contractor shall provide (with the diskettes) two copies of the necessary software that allows the traces to be displayed by a PC.
- 1.1.1.4 When viewed on the OTDR traces, the following test results shall be met:
 - 1.1.1.4.1 Connector losses -mated connector pairs shall exhibit an insertion loss, as measured by the OTDR, of no more than 0.8 dB per mated connector pair.
 - 1.1.1.4.2 Splice losses - fusion splices, where specified and allowed in the specifications, shall exhibit a bi-directional average splice loss as measured by the OTDR of no more than 0.2 dB per fusion splice.

1.1.2 Submittal of Test Results

- 1.1.2.1 Three copies of all test result data shall be submitted to the Owner for review. The installer shall maintain an accurate test record during all field tests. If installer-developed data sheets are used for recording test data, samples of the sheets shall be submitted for approval.
- 1.1.2.2 Along with the OTDR test data submittal, the Contractor shall provide with the diskettes, two licensed versions of the necessary software that allows the OTDR traces to be displayed by PC. This software shall be purchased from the OTDR manufacturer or retailer.

Coaxial Testing

A time domain reflectometry test shall be conducted on each newly installed cable section to determine shorts, opens, and other impedance discontinuities and their locations. Impedance discontinuities that would adversely affect the system's ability to meet the requirements of this specification shall be corrected.

Each trunk/feeder cable placed shall be sweep tested from 50-1000 MHz and tested with a Time Domain Reflectometer (TDR). Performance of the cable over the link shall meet or exceed manufacturer's published specifications. Documentation of performance testing shall be included.

2 System Documentation

Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Owner for approval.

Documentation shall include the items detailed in the sub-sections below.

Documentation shall be submitted within ten (10) working days of the completion of each testing phase. This is inclusive of all test results and draft as-built drawings.

Draft drawings may include annotations done by hand. Machine generated (final)

copies of all drawings shall be submitted within thirty (30) working days of the completion of each testing phase. At the request of the Owner, the

telecommunications contractor shall provide copies of the original test results.

The Owner may request a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Owner, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

Test Results documentation shall be provided on disk within three (3) weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation," the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B including applicable TSB's and amendments. The appropriate level III tester shall be used to verify Category 5e and 6 cabling systems.

Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the telecommunications contractor may furnish this information in electronic form (3.5" diskette or CD). These diskettes shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable using Microsoft Word.

When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented. The As-Built drawings are to include cable routes and outlet locations. Their sequential number, as defined elsewhere in this document, shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.

The Contractor shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form.

3 Identification and Labeling

The Contractor shall develop and submit for approval, a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels, and outlets. The labeling system shall designate the cable's origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel, and wiring block labels shall be installed on, or in, the space provided on the device.

Copper Cabling Specification

Label according to the Owner's specifications provided at start of work. This will include the products/materials, cable number, and cable pairs specified in the section "Specific Execution."

All labeling shall be accurate, visible, readable, and permanent.

All cables shall be labeled at building entrance and exit locations, on all termination frames, and at all splice locations where cables enter/exit the splice.

Fiber Optic Cabling Specification

Label at all locations according to the Owner's specifications provided at start of work. Each fiber optic patch panel (FOPP) and fiber distribution frames (FDF) shall be labeled as follows:

The fiber number shall include, in this order:

1. Lowest building number
2. Closet name/number
3. Highest building number
4. Closet name/number
5. S or M to indicate single mode or multimode
6. Physical cable number i.e. 1, 2, 3

Underneath this fiber number:

1. TO "WHATEVER THE OTHER END-POINT IS and THE CABLE SIZE"
2. If standing in 05-A581 and looking at the cable that goes to 09-1240, it would read "TO 09-1240-24"

A sample fiber number for a cable from 09-1240 to 05-A581, assuming the FOPP is in 05-A581, would read 05.N1.09.N1.S.1 TO 09-1240-24 (24 indicates cable size).

The Owner will provide details specific to the project at start of work. This will include the products/materials and fiber cable numbers specified in the section "Specific Execution."

All labeling shall be accurate, visible, readable, and permanent.

All cables shall be labeled at building entrance and exit locations, on all frames/panels, and at all splice locations where cables enter/exit the splice.

The Fiber Optic Patch Panel shall also be labeled with the cable number.

Coaxial Cabling Specification

Label with be similar to those on fiber optic cable. The exact type TBD by the Owner.

27170A TESTING, IDENTIFICATION, AND ADMINISTRATION: HORIZONTAL WIRING

1. *Testing and Identification/Labeling Specification for Copper Horizontal Cabling*

1.1 Copper Channel Testing

1.1.1 All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens, and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a level IIe or level III test unit for Category 5e or Category 6 performance compliance, respectively

1.1.1.1 Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs, and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

1.1.1.2 Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet, or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-A Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

1.1.1.3 Category 5e & 6 Performance

1.1.1.3.1 Follow the standards requirements established in ANSI/TIA/EIA-568-B

1.1.1.3.2 A level III test unit is required to verify Category 5e and Category 6 performances.

1.2 Labeling Of Horizontal Cables

1.2.1 Labeling of all wires and terminations shall be in a manner specified by the Owner at start of work.

1.2.2 Wired outlet assemblies shall be labeled as follows:

1.2.2.1 BB-CC-RRRR-J

1.2.2.1.1 B 2or 3digit building number

1.2.2.1.2 CC 2character BDF/IDF number

1.2.2.1.3 RRRR 4character room number

1.2.2.1.4 J 1-3-digit jack number

1.2.3 All labels shall be created using a CasioKL-7000 labeling machine. Labels shall consist of adhesive-backed labels under the plastic cover of the faceplate label field. Directions for setting up the printer labels are as follows:

1.2.3.1 Turn on the machine

- 1.2.3.2 Set font (Press font key, press down arrow, select sans??, press **set**)
- 1.2.3.3 Set format (Press format key, select the two horizontal lines, press **set**)
- 1.2.3.4 Type in jack info i.e. (10.N1.A385.47), press carriage return. This allows you to put the information for the second port on the same label.

2 Testing and Identification/Labeling Specification for Fiber Optic Horizontal Cabling

- 2.1 Labeling is the same as for copper horizontal wiring.
- 2.2 Testing is the same as for fiber optic backbone cable.

3 Testing and Identification/Labeling Specification for Coaxial Horizontal Cabling

- 3.1 Horizontal coaxial cabling from the BDF/IDF to the wired outlet shall be sweep tested from 50-1000 MHz from the patch panel connection to the wired outlet connection. Performance shall meet or exceed manufacturer's published specifications. Documentation of performance testing shall be included.

4 Documentation

- 4.1 The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document, shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.
- 4.2 The Contractor shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form.

27190 WARRANTY

1. The Contractor warrants that all services performed under this agreement shall be performed in a thorough and professional manner in conformance with the standards of the industry. The Contractor shall correct, at his expense, all defects or deficiencies in the work, which result from the material furnished by the Contractor, workmanship, or failure to follow the plans, drawings, or other specifications made part of this contract. Those defects or deficiencies discovered within five (5) years from the date of acceptance (acceptance of the work by the Owner shall not constitute a waiver of such defects or deficiencies) may be remedied by the Owner and the Contractor shall pay the Owner the cost of making such corrections.
2. All fiber optic materials and work shall be covered under the applicable manufacturer's warranty. A certificate of Project Registration shall be on file at start of work.
3. All horizontal copper wiring materials and work shall be covered under the Panduit Network Systems Certification Plus System Warranty Program. A certificate of Project Registration shall be on file at start of work.
4. The Owner will work with the successful bidder to obtain necessary warranty participation from the manufacturers.
5. All copper backbone materials and work shall be under warranty for five (5) full years from date of final acceptance.
6. All copper horizontal wire materials and work shall be under warranty for five (5) full years from date of final acceptance.
7. All other materials and work shall be under warranty for five (5) full years from date of final acceptance.