

DIVISION 27
COMMUNICATIONS

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PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Workstation outlets.
2. Copper cabling.
3. Cross connect blocks.
4. Patch panels.
5. Patch cables.
6. UPS
7. Innerduct.
8. Fiber optic cables.
9. Fiber optic terminations.
10. Fiber optic termination/cross connect panels.
11. Fiber optic patch cables.
12. Equipment racks.
13. Equipment backboards.
14. Lightning protectors.
15. Cable terminations and labeling.
16. Cable training and management.
17. Testing & documentation of installation.

- B. Owner's vendor to provide patch cords, PBX equipment, cross connections file servers, multiplexers, routers, fiber interface panels, handsets, etc.

C. Related Sections: The following sections contain requirements that relate to this Section:

1. Section "Common Work Results for Electrical" for general requirements, submittal requirements, coordination, project conditions, fire stopping, equipment supports, installation and construction requirements, quality control, identification, and all other applicable paragraphs.
2. Section "Grounding & Bonding for Electrical Systems" for bus bars, grounding, bonding, and other requirements.
3. Section "Raceways & Boxes for Electrical Systems" for conduit, cable tray and mounting box interface requirements.

D. Permits and Fees:

1. Apply, pay for and secure all permits, required by the Authorities Having Jurisdiction and necessary for specified work of this section, prior to start of work, in accordance with contract General Conditions and Division 01.
2. Deliver all certificates to the Owner prior to final acceptance of work.

1.3 SYSTEM DESCRIPTION

A. General Description:

1. Voice and data communication cabling system including workstation outlets, device jacks, cabling, terminations, patch panels, punch blocks, equipment racks, fiber optic and copper riser and backbone cables, testing, etc. as shown on drawings.

B. System Design Requirements: Installer shall meet the entire intent of these specifications and associated drawings. Deviations from specified equipment and/or operation of the system shall be at Installer's risk.

C. Performance Requirements: This is a performance specification. It is the full responsibility of the installer to insure that the design and installation conforms with all applicable standards and Codes and provides the specified performance.

1. General Requirements: Categories per EIA/TIA 568-B standards:
 - a. VoIP: Cat 6
 - b. Ethernet connectivity of all workstations.
 - c. Star topology.
 - d. All systems shall be backward compatible with lower performing category components.
 - e. Support of Owner's choice of vendor software/hardware.
2. Category 6 Systems: Verified gigabit Ethernet performance at up to 250MHz per IEEE 802.3ab, 1000 BASE-T specifications. All components shall meet Cat 6 ANSI/TIA/EIA-568-B.2-1 and all addenda.
3. Fiber Optic Systems: Verified performance at 1000 BASE-T SX/LX per IEEE 802.3z. All components shall meet ANSI/TIA/EIA-568-B.3 and all addenda.

1.4 REFERENCES

A. Telecommunications Industry Association (TIA):

1. ANSI/EIA/TIA-568-B.1 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements

2. ANSI/EIA/TIA-568-B.1-1 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements - Addendum 1 - Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend Radius
3. ANSI/EIA/TIA-568-B.1-2 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements - Addendum 2 - Grounding and Bonding Requirements for Screened Balanced Twisted-Pair Horizontal Cabling
4. ANSI/EIA/TIA-568-B.1-3 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements - Addendum 3 - Supportable Distances and Channel Attenuation for Optical Fiber Applications by Fiber Type
5. ANSI/EIA/TIA-568-B.1-4 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements - Addendum 4 - Recognition of Category 6 and 850 nm Laser-Optimized 50/125 μm Multimode Optical Fiber Cabling
6. ANSI/EIA/TIA-568-B.2 Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components
7. ANSI/EIA/TIA-568-B.2-1 Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Components - Addendum 1 - Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling
8. ANSI/EIA/TIA-568-B.2-2 Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair Cabling Components - Addendum 2
9. ANSI/EIA/TIA-568-B.2-3 Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair Cabling - Addendum 3 - Additional Considerations for Insertion Loss and Return Loss Pass/Fail Determination
10. ANSI/EIA/TIA-568-B.2-4 Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Components - Addendum 4 - Solderless Connection Reliability Requirements for Copper Connecting Hardware
11. ANSI/EIA/TIA-568-B.2-5 Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair Cabling Components - Addendum 5 - Corrections to TIA/EIA-568-B.2

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| 12. | ANSI/EIA/TIA-568-B.3 | Optical Fiber Cabling Components Standard |
| 13. | ANSI/EIA/TIA-568-B.3-1 | Optical Fiber Cabling Components Standard
- Addendum 1 - Additional Transmission
Performance Specifications for 50/125 um
Optical Fiber Cables |
| 14. | ANSI/EIA/TIA-569-A | Commercial Building Standard for
Telecommunications Pathways and Spaces |
| 15. | ANSI/EIA/TIA-569-A-1 | Commercial Building Standard for
Telecommunications Pathways and Spaces,
Addendum 1 |
| 16. | ANSI/EIA/TIA-569-A-2 | Commercial Building Standard for
Telecommunications Pathways and Spaces,
Addendum 2 |
| 17. | ANSI/EIA/TIA-569-A-3 | Commercial Building Standard for
Telecommunications Pathways and Spaces,
Addendum 3 |
| 18. | ANSI/EIA/TIA-569-A-4 | Commercial Building Standard for
Telecommunications Pathways and Spaces,
Addendum 4 |
| 19. | ANSI/EIA/TIA-569-A-6 | Commercial Building Standard for
Telecommunications Pathways and Spaces -
Addendum 6 - Multi-Tenant Pathways and
Spaces |
| 20. | ANSI/EIA/TIA-569-A-7 | Commercial Building Standard for
Telecommunications Pathways and Spaces -
Addendum 7 - Cable Trays and Wirelines |
| 21. | ANSI/EIA/TIA-570-A | Residential Telecommunications Cabling
Standard |
| 22. | ANSI/EIA/TIA-606-A | Administration Standard for the
Telecommunications Infrastructure of
Commercial Buildings |
| 23. | ANSI/EIA/TIA-607 | Commercial Building, Grounding and
Bonding Requirements for
Telecommunications |

1.5 SUBMITTALS

- A. General: Submit each item in this Section according to the conditions of the contract and Division 01 Specification Sections.
- B. Submittals shall also comply with the submittal procedures and requirements of electrical Specification Sections.
- C. Submittal Requirements of this section:

1. Workstation outlet faceplates and jacks.
2. Horizontal station cabling.
3. Cross connect blocks.
4. Patch panels.
5. Patch cables.
6. Innerduct.
7. Fiber optic cables & terminations.
8. Fiber optic termination/cross connect panels.
9. Fiber optic patch cables.
10. Equipment racks, wire management devices.
11. Lightning protectors.
12. Emergency Telephone Units.
13. Cable labeling scheme.
14. Post-installation testing & documentation.

D. Descriptive Data for Each Product:

1. To verify specifications have been met/exceeded.
2. Clearly indicate or state all options, etc.:
 - a. Manufacturer/cat. number.
 - b. Manufacturer's options.
 - c. Accessories.
 - d. Indicate point of connections with other equipment or systems.
3. Manufacturer's data on all proposed equipment.
 - a. Highlight or clearly indicate all items to be provided.
4. UL Listing.

E. Wiring Diagrams:

1. Riser diagrams showing all riser cables, backbone cables, MDF and/or IDF connections, etc.
2. Schematic wiring diagram for entire system, showing all cable types, cable sizes, pair quantities, etc.

F. Drawings:

1. Elevation drawings of each proposed equipment room and/or equipment rack showing scaled layout of all components, cable management devices, etc.

G. For Emergency Phones, submit the following:

1. Wiring diagrams showing all cables, interconnections, etc. of emergency phones, phone cables, remote strobe lights, power supply transformers, etc.

2. Schematic wiring diagram for entire system, showing all cable types, cable sizes, pair quantities, etc.
 3. Elevation drawings of each proposed emergency phone cabinet, showing scaled layout of all components, etc.
- H. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, and Section “Common Work Results for Electrical,” and as follows:
1. As-Built Drawings: Provide three (3) full-size copies of all plans, drawings and schematics to the owner after final acceptance testing. The drawings shall be revised to show all terminal designations, location of all cabinets, devices, wiring and conduit routings. Drawings, etc. shall be delivered as part of the O&M Manual package.

1.6 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.
 2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.
- B. Single-Source Responsibility:
1. Installer of the telecomm system shall assume responsibility for compatibility and inter-operation of all system components and performance of the entire system.
- C. Manufacturer’s Requirements: Proposed equipment manufacturer must meet the following:
1. Engaged in manufacturing of voice and data systems components for at least 5 years.
 2. All components of the proposed system shall have been tested by the manufacturer to assure that the system meets specified performance requirements.
 3. System shall be of latest design. No obsolete or pending obsolete parts shall be used.
 4. Maintain current stock of all spare parts at local service organization.
 5. Provide local maintenance and service with location less than 50 miles from project site.
 6. Provide list of technical support staff, project experience, training, etc. as

requested. Staff must be factory trained or have received on-site training from manufacturer.

7. Provide technical support to installer.
8. Make all final connections, adjustments, and supervision for system testing.
9. Provide references upon request:
 - a. Names of (6) similar projects in size and scope.
 - b. Contact person and phone number for each project.

D. Installer Qualifications: Engage an experienced factory-authorized Installer to perform work of this Section.

1. System planning, design and installation shall be supervised by a BICSI-Certified Registered Communications Distribution Designer (RCDD) on staff.
2. Installing contractor must meet the following:
 - a. Factory trained and authorized to design, engineer, install and maintain the proposed manufacturer's system.
 - b. Has installed a minimum of 6 comparable systems within local area.
 - c. Staff must be factory trained or have received on-site training from component manufacturer.
 - d. Maintain current stock of all spare parts.
3. Provide references upon request:
 - a. Names of (6) similar projects in size and scope.
 - b. Contact person and phone number for each project.

E. Installation Quality: In accordance with recognized trade organizations and standards.

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| 1. | ANSI | American National Standards Institute |
| 2. | EIA | Electronics Industry Alliance |
| 3. | FCC | Federal Communications Commission |
| 4. | FIPS | Federal Information Processing Standards |
| 5. | IEEE | Institute of Electrical and Electronics Engineers |
| 6. | IEEE C2 | “National Electrical Safety Code” |
| 7. | NEC | National Electrical Code |
| 8. | NECA | National Electrical Contractor’s Association “Standards of Installation.” |
| 9. | NEMA | National Equipment Manufacturers Association |
| 10. | NETA | National Electrical Testing Association |
| 11. | NFPA | National Fire Protection Association |
| 12. | TIA | Telecommunications Industry Association |
| 13. | UL | Underwriter’s Laboratories |

F. Certifications:

1. Manufacturer shall have tested the proposed mix of system components to verify performance of the installed components as a system.
2. All hardware comprising the voice and/or data cabling system(s) shall be certified as a system for compliance with EIA/TIA performance category stated.
3. Only products of a single manufacturer shall be submitted for approval. Exceptions shall only be considered in cases where a manufacturer does not manufacture a particular component. In such cases, all equipment must be documented as having been tested to stated performance as a system.
4. Submit written certification of testing and performance of all proposed systems (i.e. proposed cables, outlets, patch panels, etc. Manufacturer shall provide independent test data verifying compatibility and performance of all proposed components as a single system.

1.7 DELIVERY, STORAGE AND PROTECTION OF EQUIPMENT

A. Storage and Protection:

1. Store wires and cables out of rain.
2. Protect from physical damage.
3. Guard against nicks and scratches.

1.8 SEQUENCING

A. General Sequencing:

1. Sequence installation of devices and equipment of this section such that damage to installed equipment is minimized.
2. Do not install outlets, patch panels or other termination components prior to all sanding, painting or other construction activities, which could result in dust/debris entering outlets, jacks, etc.

B. Sequencing, Coordination, and Integration:

1. Provide installation of outlets and faceplates after supporting raceways and boxes are permanently installed.
2. Coordinate installation in cable trays. Do not install in trays until properly supported and equipped with all tray fittings, turndowns, etc.

1.9 WARRANTY

- ##### A. Special Warranty: Extended product warranty over and above that required by General Conditions of this contract.

1. Provide a twenty-five (25) year passive product warranty, backed by manufacturer, and a twenty-five (25) year application assurance warranty on applications described in these specifications.
2. Warranty shall cover the entire system, all components, performance, and installation integrity.
3. System shall provide specified performance for channel transmission and application assurance.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Available Manufacturers: Subject to compliance with requirements, provide a system by the named "Basis of Design" manufacturer, or a comparable product of one of the other following named manufacturers:
1. Workstation Outlets, faceplates, jacks:
 - a. Hubbell Premise Wiring (basis of design)
 - b. Avaya (Lucent Technologies)
 - c. The Siemon Company
 - d. Ortronics
 2. Patch Panels, Punchblocks, Termination Panels:
 - a. Hubbell Premise Wiring (basis of design)
 - b. Avaya (Lucent Technologies)
 - c. The Siemon Company
 - d. Ortronics
 3. Copper Workstation Cabling:
 - a. General Cable (basis of design)
 - b. Lucent Technologies
 - c. Belden
 - d. WestPenn
 - e. Mohawk
 4. Copper Backbone and Riser Cabling:
 - a. Mohawk (basis of design)
 - b. Lucent Technologies
 - c. Belden
 - d. WestPenn
 - e. Anixter
 5. Fiber Optic Cabling:
 - a. Optical Cable Corporation (basis of design)
 - b. Belden
 - c. Lucent Technologies
 - d. WestPenn
 - e. General Cable

2.2 WORKSTATION OUTLETS

A. Backboxes:

1. As specified in Section "Raceways & Boxes For Electrical Systems."

B. Stainless Steel Faceplates:

1. Single gang plate (unless noted otherwise).
2. Brushed stainless steel.
3. Minimum of six (6) vertically oriented insert ports.
4. Accepts UTP RJ-45, BNC, RCA, S-video, Fiber SC, Type F coax, etc.
5. Quantity of voice and/or data jack inserts per drawings.
6. Jack number indicated.
7. Blank insert covers for all unused ports.
8. Hubbell SSF Series or comparable product by previously named manufacturers.

C. Wall Phone Faceplates:

1. Single gang plate (unless noted otherwise).
2. Brushed stainless steel.
3. Single insert ports, centered in plate.
4. Two steel phone-mounting studs.
5. Jack inserts, as specified elsewhere, to match Owner phone system.
6. Hubbell 630 Series, or comparable product by previously named manufacturers.

D. Modular jack inserts:

1. Insert ports to accept UTP RJ-45 connectors.
2. Connectors to terminate specified 4-pair UTP cable.
3. Each connector insert as follows:
 - a. Keystone jack, listed per UL 1863, "Standard for Communications-Circuit Accessories."
 - b. RJ-45, non-keyed, 4-pair UTP.
 - c. Standard EIA wired.
 - d. EIA/TIA 568-B Category:
 - e. VoIP - Cat 6.
 - f. 110 IDC terminations with retention caps.
 - g. Paired punch down sequence.
 - h. Gold plated, beryllium copper contacts.

- i. Printed circuit board design.
- j. Imprinted Category reference on front of jack.
- k. Color coded for appropriate connection type:
- l. Data insert - red icon depicting PC terminal.
- m. Voice insert - blue icon depicting phone handset.
- 4. Manufacturer: Basis of design is noted below. Provide the following “basis of design” product or comparable product by previously named manufacturers.
 - a. Cat 6: Hubbell Xcelerator XJ series.

2.3 WORKSTATION CABLING

A. Horizontal workstation cable:

- 1. One continuous run to each voice or data jack.
- 2. #24 AWG, solid copper.
- 3. Unshielded twisted pair (UTP).
- 4. Compliant with EIA/TIA 568-B and 569-A, including all subsections and addenda.
- 5. UL CMP rated.
- 6. Plenum rated.
 - a. Color coded fluorinated ethylene FEP insulation.
 - b. Low smoke PVC (LSPVC) outer sheath.

B. VoIP Cables:

- 1. EIA/TIA 568-B Category 5e (enhanced), TIA Draft 11.
- 2. Compliant with EIA/TIA 568-B and 569-A, including all subsections and addenda.
- 3. Blue outer jacket.
- 4. Manufacturer: Basis of design is noted below. Provide the following “basis of design” product or comparable product by previously named manufacturers.
 - a. Cat 6: General Cable Command LINX7 6 Cable

2.4 COPPER RISER AND BACKBONE CABLES

A. Provide multi-pair riser cable from each telecomm closet or room of each floor to main Telecomm equipment room.

B. Multiple pair, UL Listed riser cable between communication rooms on different floors.

- 1. Install through sleeves between floors.
- 2. #24 AWG, solid copper.
- 3. Unshielded twisted pair (UTP).
- 4. Pair quantity per drawings.

5. Corrugated aluminum sheath.
6. Plenum rated.
 - a. Color-coded fluorinated ethylene FEP insulation.
 - b. Flame retardant FR-PVC outer sheath.
7. Compliant with EIA/TIA 568-B and 569-A, including all subsections and addenda.
8. UL ARMM rated, NEC compliant.
9. Minimum technical specifications (Cat 5):
 - a. Gauge: 24 AWG
 - b. Insulation: Teflon (FEP)
 - c. Maximum DC Resistance: 9.38Ohms/100 m
 - d. Nom. Mutual Capacitance: 5.6 nF/100 m @ 1kHz
 - e. Characteristic Imped: 100 Ohms +/- 15% @ 1-100 MHz
 - f. The attenuation of any pair shall not exceed the following values:

Frequency (MHz)	Maximum Attenuation (dB per 100 m @ 20 deg. C.)
1	2.0
4	4.1
10	6.5
16	8.2
20	9.3
25	10.4
31.25	11.7
62.5	17.0
100	24.0

- g. The Near-End Cross Talk (NEXT) loss for worst pair shall be equal or greater than the following values:

Frequency (MHz)	NEXT (dB per 100 m @ 20 deg. C.)
1	62
4	53
10	47
16	44
20	42
25	41
31.25	39
62.5	35
100	30.1

TIA Enhanced Cat 5e minimum performance specifications (dB @100MHz):
 Attenuation: 24.0

NEXT	30.1
ELFEXT	17.4
PS-ELFEXT	14.4
Return Loss	10.0
ACR	6.1
(PS-ACR	3.1

2.5 MODULAR 66 CROSS CONNECT BLOCKS

A. For termination of phone cable homeruns at backboards:

1. 66 style modular blocks.
2. EIA/TIA 568-B Category 3.
3. UL Listed.
4. Backboard mounted.
5. Cable connections:
 - a. Paired punch down sequence.
 - b. Cable twist maintained to within 1/2" of connector.
 - c. 66 terminations, tin lead plated IDC with caps.
 - d. Gold plated, beryllium copper contacts.
6. 12 cable ports per panel, quantity as required.
7. Port quantity to connect all workstation cables.
8. Spare ports 20% per patch panel.
9. Insertion loss 0.03 dB nominal.
10. Hubbell BR25 Series, or comparable product by previously named manufacturers.

2.6 RACK MOUNTED 110 PATCH PANELS

A. For termination of workstation data and voice UTP cable homeruns:

1. Voice and data patch panels installed in separate equipment racks.
2. EIA/TIA 568-B Category:
 - a. VoIP: Cat 6.
3. UL 1863 Listed.
4. 19" Rack mounted, anodized black aluminum.
5. Rear horizontal cable connections:
 - a. Paired punch down sequence.
 - b. Cable twist maintained to within 1/2" of connector.
 - c. 110 terminations, tin lead plated IDC with caps.
6. Front patch cord connections:
 - a. RJ-45, non-keyed, interchangeable inserts.
 - b. Gold plated, beryllium copper contacts.
7. Combinations of 24, 48 or 96 ports, as required.
8. Port quantity to connect all workstation cables.

9. Spare ports 20% per patch panel.
10. Insertion loss 0.03 dB nominal.
11. PC board construction.
12. Cable retention bars and clips front and rear.
13. Characteristic impedance of 100 ohms $\pm 15\%$.
14. Label slot for changeable, typed jack numbers.
15. Manufacturer: Basis of design is noted below. Provide the following "basis of design" product or comparable product by previously named manufacturers.
 - a. Cat 6: Hubbell Nextspeed 670 Cat 6 Patch Panels

2.7 PATCH CORDS

- A. Patch cords for interconnections between concentrators, patch panels, etc.
 1. Factory assembled modular cord of proper lengths.
 2. ANSI/EIA/TIA 568-B, Category 5e or 6 UTP, to match specified system.
 3. UL Listed 1863.
 4. #24 AWG stranded copper wire.
 5. FCC part 68 subpart F compliant.
 6. Gold over nickel contacts.
 7. Flame retardant plastic modular connectors, double ended.
 8. Flame retardant FR-PVC jacket.
 9. Manufacturer: Basis of design is noted below. Provide the following "basis of design" product or comparable product by previously named manufacturers.
 - a. Cat 6: Hubbell PC670, "Nextspeed."

2.8 FIBER OPTIC INNERDUCT

- A. Provide innerduct for FO cables in cable tray or free air.
 1. Minimum 1" size.
 2. Orange identifying color.
 3. Rated for plenum installation.
 4. Continuous along entire FO cable route.

2.9 INTERIOR FIBER OPTIC DISTRIBUTION CABLE

- A. Backbone cable system between wire closets.
 1. UL Listed fiber optic cable.
 2. Multi-core, FDDI grade 62.5/125um, multi-mode type.
 3. 12 strand cables.
 4. Color-coded low smoke PVC buffer.
 5. Plenum rated inner materials and outer sheath.
 6. The maximum attenuation in DB per kilometer at 850 nm shall be 3.5 dB and

- at 1300 nm it shall be 1.0 dB.
7. The minimum bandwidth at 850 nm shall be 160 MHz and at 1300 nm it shall be 500 MHz.
 8. NEC compliant for OFNR or OFNP.
 9. All fibers terminated in interconnect panels at each end.
 10. EIA/TIA 568, CSA FT6, and ICEA standards.
 11. Optical Cable Corp. DX-Series Distribution Cables, or comparable product by previously named manufacturers.

2.10 FIBER OPTIC TERMINATIONS

- A. Connectors for all installed fibers.
 1. SC style 2.5mm bayonet connector.
 2. Multimode to match installed fibers.
 3. Ceramic ferrule.
 4. Low insertion loss, 0.6 dB nominal.
 5. Single crimp termination.
 6. With strain relief for cable.
 7. Hubbell 2Quick connectors, Avaya P6200 series or comparable product by Amp or Siemon.

2.11 FIBER OPTIC TERMINATION/CROSS CONNECT PANEL

- A. Panel shall provide FO cross connect, inter connect or splicing capabilities.
 1. Modular rack mounted enclosure in 19" equipment rack.
 2. Internal retainer rings to limit fiber bending radius.
 3. Sliding drawer for access to fibers and connectors.
 4. Angled (left or right) SC style connectors.
 5. Terminations for up to (16) fibers per panel.
 6. Hubbell FCR Series, Avaya LST1U, or comparable product by Ortronics, Siemon.

2.12 FIBER OPTIC (FO) PATCH CABLES

- A. FO patch cables for cross connection and interconnection of terminating blocks and lightguide interconnect units in wire closets.
 1. Compatible with installed patch panels or LIU's.
 2. (1) or (2) single buffered graded-index fibers.
 3. 62.5um core/125um cladding.
 4. Cladding covered by aramid yarn.
 5. Flame retardant FR-PVC jacket.
 6. SC -II style terminations with ceramic plug on both ends.

7. Performance parameters:
 - a. Minimum bend radius: 1.25"
 - b. Operating temperature: -20 to 70 Deg. C
 - c. Loss: 0.4 dB/mated connector (ceramic) 0.5 dB/mated connector (plastic)
 - d. Minimum bandwidth: 160MHz km at 850 nm 500MHz km at 1300 nm
8. Hubbell or comparable product by Avaya, Lucent, or Siemon.

2.13 J-HOOK CABLE SUPPORTS

- A. Cable supports attached to walls, bar joists, or other structural components above finished ceilings for support of all low voltage system wiring.
 1. J-hook with 2" wide support surface with radiused edges,
 2. 4" hook diameter.
 3. Aluminum construction.
 4. Minimum capacity of 220 Cat6 UTP cables.
 5. Hinged cable retainer clip.
 6. Maximum of 4' spacing.
 7. Erico Caddy CAT64HP, or equal.

2.14 EQUIPMENT RACKS & ACCESSORIES

- A. General construction of all racks, frames, etc.
 1. 19" Wide equipment mounting.
 2. Black urethane finish anodized aluminum.
 3. ANSI/EIA standard mounting.
 4. Bushings on all cable entry holes.
 5. Include wire management block with (5) rings between each installed patch panel, etc. Black aluminum.
 6. All racks grounded to telecomm room ground bus via #6 stranded, insulated copper conductor.
- B. Floor mounted, standoff racks for mounting patch panels, etc.
 1. 19"W x 6"D x 84"H, 8-gauge aluminum.
 2. Full height cable channels on both sides.
 3. Cable guides on channel surface, both sides, 8" O.C. max.
 4. Free standing mounted, but with (2) top support angles.
 5. Bushings on all cable entry holes.
 6. Wire management blocks with rings.
 7. Surge protected multi-outlet strip installed at base of each with 6 foot grounded cord/plug.
 8. Hubbell MCC84CMRR19, or comparable product by Homaca, Ortronics,

Siemon.

2.15 EQUIPMENT BACKBOARDS

- A. Equipment backboards for use in all wiring closets and behind all equipment racks.
1. 3/4" BC grade fire retardant treated plywood.
 2. Shall contain no urea-formaldehyde.
 3. Shall bear a "UL Classified" marking from the manufacturer.
 4. Minimum size of 48"W x 84"H, or as noted.
 5. Hoover *Pyro-Guard* treated wood, or equal.
 6. Paint with white, intumescent fire retardant paint.
 - a. Class A fire rated.
 - b. Low VOC, interior flat latex, fire retardant paint.
 - c. Intumescent when exposed to flame.
 - d. Flame Control Coatings, LLC. Intumescent Fire Retardant Paint, or equal.

2.16 UNINTERRUPTABLE POWER SUPPLY

- A. Provide one (1) UPS unit in each IDF data equipment rack, and any equipment rack not connected to the central UPS described below. The UPS System shall be line interactive design with a maximum transfer time of 4 milliseconds. The UPS shall be a single conversion modular UPS System with SNMP Management.
1. The UPS System shall provide a minimum of 2000 VA of output power with 120 Volt input. UPS shall connect to a NEMA L5-30 Receptacle.
 2. The UPS System shall provide a minimum battery runtime of 20 minutes at full load.
 3. The output waveform of UPS shall be true sine-wave.
 4. The UPS System shall be provided with a minimum of six NEMA 5-15R output receptacles.
 5. The system shall be covered by a two-year on-site warranty.
 6. The front panel display shall indicate load level, battery charge level, and replacement battery indication.
 7. The UPS System shall be rack-mounted in the bottom of each 19" equipment rack.
 8. The UPS shall be APC Smart UPS XL Series Model SU2200RMXLNET with SU48RMXLBP external battery pack, and SNMP Card AP9619 with

environmental monitoring, or approved equal.

9. Provide grounding per EIA/TIA 607 requirements.
- B. Provide one (1) central UPS unit in a UPS equipment rack in the MDF. Provide one APC Symmentra LX16KA N+1 UPS and 4 post UPS rack. Provide 90 minute battery at full load. Provide Network adapter with SNMP, remote web & SNMP UPS monitoring,
- C. Provide Factory assisted startup of all UPS units. Perform visual, mechanical and electrical inspections of UPS installation. Provide complete UPS on-site testing. Provide complete on-site operation training and demonstration of each UPS system, including providing and installing software setup, and operation.
- D. Provide manufacturer field services and maintenance services for a period of 2 years on all UPS units from date of final acceptance of UPS system.

PART 3 EXECUTION

3.1 GENERAL

- A. Install in star topology format, for 10BASE-T Ethernet system.
- B. All work shall conform to referenced standards.
- C. Provide all required tools, special equipment, etc. necessary to install, terminate, splice, test and complete the copper distribution system.
- D. Install all work in accordance with manufacturer's requirements to insure specified EIA/TIA Category performance.
- E. In general, install all workstation outlets at same height as power receptacles in the area. Coordinate box heights for above counter mounting locations.

3.2 ENGINEERING

- A. Attend required meeting with Owner/User personnel to:
 1. Confirm all requirements and operating parameters.
 2. Discuss proposed distribution methods, installation, etc.
 3. Contractor shall then prepare detailed engineering drawings consisting of riser diagrams, cross and interconnect diagrams, elevations of wiring closets, and proposed installation methods.
 4. Submit drawings in 24"x36" format for review and approval. Drawings shall indicate:

- a. Riser distribution plan.
- b. Layout of all distribution frames.
- c. Cable tray, conduit and raceway plans.
- d. Equipment room and closet plans.
- e. Cable records and assignments.

3.3 COORDINATION

- A. Coordinate installation of telephone outlets.
 1. Same height as power receptacles.
 2. Matching coverplates with receptacles.
 3. Coordinate above counter mounting locations.

3.4 RACEWAY PROVISIONS

- A. Provide the following for cabling installation:
 1. 1" EMT from workstation outlet to accessible point above finished ceiling.
- B. Terminate all conduit with nylon bushings.
- C. Provide with nylon pull strings, when empty.

3.5 CABLE INSTALLATION

- A. General installation requirements.
- B.
 1. Install so as to limit exposure to EMI/RFI sources.
 2. Cables shall be continuous from jacks to closets.
 3. Do not install cables closer than 12 inches to:
 - a. Fluorescent & HID ballasts/fixtures.
 - b. Dimming systems.
 - c. HVAC equipment and controls.
 - d. Variable frequency drive units, etc.
 - e. Digital or CPU controlled equipment.
 4. Do not exceed maximum cable pulling tensions.
 5. Maximum length per EIA/TIA.
 6. Terminate, label and test all cables installed under this contract.
- C. Install voice/data horizontal station cables as follows:
 1. Install cables in conduit from outlet box to ceiling, then free air to cable tray.
 2. Install cables in cable tray to telecomm closet, equipment rack, etc.

- D. Install backbone and riser cables as follows:
 - 1. Install riser cables in conduit.
 - 2. Install backbone cables in cable trays.
 - a. Secured backbone cables to cable tray every 36"-48."
 - b. Attach with nylon cable ties (tie wraps).

- E. Install fiber optic cables, cables as follows:
 - 1. Install FO riser cables in conduit.
 - 2. Install FO riser cables in innerduct only, no conduit.
 - 3. Install FO backbone cables in innerduct within cable trays.
 - a. Secured innerduct to cable tray every 36"-48."
 - b. Attach with nylon cable ties (tie wraps).

3.6 OUTLET INSTALLATION

- A. Mounting height for individual devices shall be as follows (all dimensions above finished floor):
 - 1. Std. telecomm jack: 18" AFF to center.
 - 2. Counter top jacks: 6" above counter to bottom of box.
 - 3. Wall phone jacks: 54" AFF to center.

- B. Wiring of jacks shall conform to ANSI/TIA/EIA-568A pin/pair assignments in workstation outlets and all associated patch panels.

3.7 EQUIPMENT BACKBOARD INSTALLATION

- A. Provide in all telephone, IDF, MDF, server, phone or similar closets, and elsewhere, as shown on drawings.

- B. Installation:
 - 1. Secure tightly to wall, with bottom 12" above finished floor.
 - 2. Paint with fire retardant paint specified.
 - 3. Leave one manufacturer's "UL Classified" mark visible for inspection. Do not paint over this one mark on each plywood sheet.
 - 4. Where power outlets are shown on backboards, surface mount receptacle boxes on the plywood backboard, at heights indicated.
 - 5. Provide grounding bus bar in lower corner for equipment grounding.

3.8 EQUIPMENT RACK INSTALLATION

- A. General installation requirements.

1. Permanently secure racks to prevent movement.
- B. Wall Mounted Racks & Cabinets:
1. Secured to wall on plywood backboard.
 2. Top of rack/cabinet at 78" AFF.
- C. Floor Mounted Racks:
1. Bolted to floor.
 2. Provide lateral braces from top of rack to nearest wall to prevent sway or movement.
 3. Install to permit adequate access behind racks for equipment service and cable terminations.

3.9 EXTERIOR CIRCUIT PROTECTION

- A. Provide standard Telco lightning surge protectors for all pairs of underground and overhead exterior cable runs.
- B. Ground the surge protection to the IDF or MDF ground bus bar.

3.10 COMMUNICATIONS EQUIPMENT ROOMS

- A. Cable must be installed so that station wire runs from the station outlet to the cross-connect point in the closet be no longer than 90 meters (295') of cable distance.
- B. All walls, ceilings and floors must be made non-porous with paint or sealant to minimize dust.
- C. Sleeves or conduit entering these spaces from telephone outlets shall penetrate the closet walls at a height above the plywood panels and extend only far enough to install bushings.
- D. Hardware shall be installed plumb and level on the wall backboards. Appropriate distribution rings shall be installed so that jumper and cross connect wires can be installed in a neat and orderly fashion.

3.11 WIRE MANAGEMENT & IDENTIFICATION

- A. Workstation Outlets:
1. Identify each workstation cable and outlet cover with a numbering system as follows (example V311-A):

- a. V V (voice) or D (data)
 - b. Room number
 - c. A A through Z indicating jack position in room, starting with A at the door and continuing clockwise.
2. Indicate jack number on faceplate and on cable at closet.
- B. Label all copper cables.
1. Label cables identically at each end.
 2. Typed self-adhesive labels wound around cable.
 3. Tape or paper tags are not acceptable.
 4. Provide wire number chart at every equipment frame.
 - a. Cable ID number.
 - b. Installed length.
 - c. Origin and destination locations.
 - d. Cable type.
 - e. Pair identity.
- C. Provide wire management in all closets.
1. Train cables neatly onto backboards, etc.
 2. Use cable rings and troughs for all cables where entering closets, trays or conduit.
 3. Do not exceed bending minimum radii of cables.
 4. Use cable ties to bundle cables every 6 inches.

3.12 SLACK

- A. In the work area, a minimum of 300 mm (12 in) should be left at outlets, while 1 m (3 ft) should be left at the backboard or rack, and 6 m (20 feet) in the closet area.
- B. In telecommunications rooms a minimum of 6 m (20 ft) of slack should be left for all cable types. This slack must be neatly managed on trays or other support types. "All cable types" includes all voice/data/video backbone cables and fiber optic backbone cables.
- C. All unused cables shall be properly terminated, as specified, with 10 m (33 feet) extra cable neatly coiled and tie-wrapped at the workstation end of cable in the ceiling space.
- D. Where wireless access point devices are installed, provide a minimum of 3 m (10 feet) of cable coiled, tie-wrapped, and supported in the ceiling space.

3.13 GROUNDING

- A. Provide ground at all MDF, IDF and equipment frame locations per ANSI EIA/TIA-607, as follows:
 - 1. Provide grounding system which bonds all remote equipment rooms and frames to a ground bar in the Main Distribution Frame (MDF) equipment room and each Intermediate Distribution Frame (IDF) room per ANSI and per section “Grounding & Bonding For Electrical Systems.
 - 2. Provide Telephone Main Grounding Busbar (TMGB) in MDF and Telephone Grounding Busbars (TGB) in all server rooms, server closets, IDF rooms, and other identified locations per section “Grounding & Bonding For Electrical Systems.

3.14 ACCEPTANCE TESTING

- A. All tests shall be post installation.
- B. Provide testing of all installed copper cables for:
 - 1. Open loop conductors.
 - 2. Grounded, shorted or crossed conductors.
 - 3. dB loss and split connections.
 - 4. Pair continuity.
 - 5. Presence of AC or DC voltages.
 - 6. Test all pairs, including spares.
 - 7. Test all cables, risers, backbones, including spares.
 - 8. Test with time domain reflectometer to measure exact lengths of installed cables. Record in cable ID chart.
- C. Provide testing of fiber optic cables.
 - 1. Continuity.
 - 2. Insertion loss.
 - 3. Fiber optic time domain reflectometer (OTDR), and bandwidth testing. Factory documentation for bandwidth shall be suitable in lieu of field testing.
 - 4. Connectorization testing for insertion loss for every terminated fiber including slices. Testing shall include losses of all connectors.
 - 5. Additional pre-installation tests all fibers:
 - a. Continuity to insure that cable has not been damaged during shipment.
 - b. OTDR using a bare fiber adapter operating at 850 nm. Provide written documentation from the installation technician to confirm tests have been performed and are acceptable.
 - 6. OTDR testing shall be performed on all fibers to provide the following

documentation:

- a. Evaluate fiber loss per unit distance.
 - b. Distance to localized attenuations, splices, connectors and fiber ends shall be measured.
 - c. Insure quality of installed connectors.
 - d. Bi-directional OTDR splice/connector losses.
 - e. Bare fiber OTDR testing for all unterminated fibers.
 - f. Post installation/connector testing shall be made at 850 and 1300 nm wavelengths.
 - g. Photographs or OTDR strip charts shall be provided for each tested fiber as performance proof. Label each fiber chart or photograph.
- D. Remove and replace any cables which fail any of the required tests. Repeat all required tests on the replacement cable. This applies to all cables, even if only one pair fails.

3.15 CLEANING AND ADJUSTING

A. Cleaning:

1. Remove paint splatters and other spots, dirt, and debris.
2. Touch up scratches and marred finishes to match original finish.
3. Clean all cabinets, racks, structures, outlets, etc. using methods and materials recommended by manufacturer.

3.16 AS-BUILT DOCUMENTATION

- A. Complete as-built drawings as per Section "Common Work Results for Electrical." Documentation shall include cable penetration details, locations and identification of all distribution closets and equipment, terminal information, jack numbering, pair count information, schematic drawings of risers, cable routing and termination plans.
- B. Cable assignment records for all pairs and fibers. Include test reports on all cables.
- C. Copies of all plans, etc. on reproducible mylar media, and a CD-ROM copy for all computer generated plans, risers, charts, etc.

END OF SECTION