UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

08/11

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USACE / NAVFAC / AFCEC / NASA	**UFGS-27 10 00 (August 2011)**

Preparing Activity: NAVFAC	**Superseding**
	UFGS-27 10 00 (January 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM
08/11

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NOTE: This guide specification covers requirements for building telecommunications cabling systems using a physical star network topology for transporting telecommunications signals within a building. Telecommunications cabling systems include the copper and optical fiber horizontal and interior building backbone systems and cable media, patch panels, connecting blocks, firestopping, grounding, cable support, hardware, communications outlets, connectors, and associated hardware; station wiring, work area station outlets (adapters); and distribution terminals. This specification covers telecommunication cabling systems supporting customer's voice, data, video, audio, security, digital imaging and environmental control for transporting information throughout modern buildings using twisted pair and optical fiber cables.

Telecommunications pathways are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Coordinate electrical, grounding, and HVAC requirements with the associated disciplines.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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NOTE: The designer shall provide single line schematic type diagrams of the telecommunications system, site plans, and floor plans showing overhead or underground service entrances, maintenance holes, handholes, conduit sizes, conductor size and type, number of pairs and fibers, and physical locations and layouts of telecommunication entrance facility, telecommunications equipment rooms, campus distributor, building distributors, floor distributors, and telecommunications outlets.

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NOTE: UFC 3-580-01, "Telecommunications Building Cabling Systems Planning and Design" provides requirements for interior telecommunications cabling systems for DoD. It is currently being revised to accommodate the USAISEC Technical Criteria for Installation Information Infrastructure Architecture (I3A) and the UFC 3-580-10, "Navy And Marine Corps Intranet (NMCI) Standard Construction Processes". When UFC 3-580-01 is complete, these documents will no longer be valid.

Until then, the Army ECB 2007-22, "Army Installation Information Infrastructure Architecture (I3A) Guide", available electronically at invokes the I3A, and the I3A provides the criteria for Army telecommunications cabling systems.

Similarly, UFC 3-580-01 and UFC 3-580-10, "Navy And Marine Corps Intranet (NMCI) Standard Construction Processes" provides design requirements for Navy sites.

****

PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile

references in the publish print process.
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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

ECIA EIA/ECA 310-E	(2005) Cabinets, Racks, Panels, and Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596	(2016) Indoor Optical Fiber Cables
ICEA S-90-661	(2012) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA/BICSI 568	(2006) Standard for Installing Building Telecommunications Cabling

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66	(2019) Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-21	(1988a; R 2012) FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices
TIA-526-7	(2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-526-14	(2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-568-C.0	(2009; Add 1 2010; Add 2 2012) Generic Telecommunications Cabling for Customer Premises
TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-568-C.2	(2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568-C.3	(2008; Add 1 2011) Optical Fiber Cabling Components Standard
TIA-569	(2015d) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-570	(2012c) Residential Telecommunications Infrastructure Standard
TIA-606	(2017c) Administration Standard for the Telecommunications Infrastructure
TIA-607	(2015c; Addendum 1 2017) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-1152	(2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding
TIA/EIA-604-2	(2004b; R 2014) FOCIS 2 Fiber Optic Connector Intermateability Standard
TIA/EIA-604-3	(2004b; R 2014) Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3
TIA/EIA-604-10	(2002a) FOCIS 10 Fiber Optic Connector Intermateability Standard - Type LC
TIA/EIA-604-12	(2000) FOCIS 12 Fiber Optic Connector Intermateability Standard Type MT-RJ

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

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

UNDERWRITERS LABORATORIES (UL)

UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 444	(2008; Reprint Apr 2015) Communications Cables
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 969	(2017; Reprint Mar 2018) UL Standard for Safety Marking and Labeling Systems
UL 1286	(2008; Reprint Jan 2018) UL Standard for Safety Office Furnishings
UL 1666	(2007; Reprint Jun 2012) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1863	(2004; Reprint Oct 2019) UL Standard for Safety Communication Circuit Accessories

1.2 RELATED REQUIREMENTS

****

NOTE: Ensure that design provides for adequate telecommunications spaces using TIA/EIA-569-A as a minimum requirement.

Network type, size and configuration must be coordinated with the user's representative, if known. The same cable pathways and spaces are normally used for both telephone and data (including local area network) systems.

For Military Construction projects, telephone instruments and other equipment are procured and installed using procurement funding outside of the construction contract. Other types of projects, such as Army and Navy Reserve, DoD and work for others, may require that telephone instruments and other specified equipment be added to this section detailing what must be procured and installed as part of the construction contract.

****

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and Section 33 82 00

TELECOMMUNICATIONS, OUTSIDE PLANT (OSP), apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

****

NOTE: Use Definitions from HEADQUARTERS AIR FORCE MEDICAL SUPPORT AGENCY DESIGN AND IMPLEMENTATION GUIDELINES MEDICAL SYSTEMS INFRASTRUCTURE MODERNIZATION PROGRAM (2001) for Air Force Medical projects. In this section the terms cover plate, device plate and faceplate refer to the same item and are used interchangeably. In this section the terms outlet/connector and adapter are used to designate the "jack" or female portion of intermateable interconnection components and connectors are used to designate the "plug" or male portion of intermateable interconnection components.

****

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, TIA-606 and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

1.3.6 Equipment Room (ER) (Telecommunications)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.3.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

****

NOTE: Use Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT (OSP) to specify exterior distribution and interbuilding cables and include bracketed sentence.

For the Navy: Coordinate with the Base Communications Officer (BCO) for the Navy and with the G6 for the Marine Corps and edit the last bracketed sentences appropriately. The Navy and Marine Corps Intranet (NMCI) contract has been replaced by a "continuation of Services Contract (COSC)". This will eventually be replaced by "next Generation" (NGEN) Contract. These contracts are being handled differently for the Navy and the Marine Corps.

For the Air Force: Project development and design requires coordination with the Installation Communications Squadron, regardless of the planned design method or the execution method (DB, DBB, other). The Installation Communications Squadron shall be one of the approving organizations for project development, design, and construction.

****

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system

shall be wired in a star topology with the campus distributor at the center or hub of the star.[The interbuilding backbone system provides connectivity between the campus distributors and is specified in Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).] Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.[The telecommunications contractor must coordinate with the NMCI/COSC/NGEN contractor concerning access to and configuration of telecommunications spaces. The telecommunications contractor may be required to coordinate work effort within the telecommunications spaces with the NMCI/COSC/NGEN contractor.]

1.5 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings; G[, [_____]]

Telecommunications Space Drawings; G[, [_____]]

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G[, [_____]]

Patch panels; G[, [_____]]

Telecommunications outlet/connector assemblies; G[, [_____]]

Equipment support frame; G[, [_____]]

[Connector blocks; G[, [_____]]]

****
NOTE: Delete submittal for spare parts on Navy projects. Spare parts requirements are provided in Section 01 78 23 OPERATION AND MAINTENANCE DATA on Navy projects.
****

[Spare Parts; G[, [_____]]]

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G[, [_____]]

SD-07 Certificates

Telecommunications Contractor Qualifications; G[, [_____]]

Key Personnel Qualifications; G[, [_____]]

Manufacturer Qualifications; G[, [_____]]

Test plan; G[, [_____]]

SD-09 Manufacturer's Field Reports

Factory reel tests; G[, [_____]]

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G[,

[_____]]

SD-11 Closeout Submittals

Record Documentation; G[, [_____]]

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 279 by 432 mm 11 by 17 inches in size using a minimum scale of one mm per 100 mm 1/8 inch per foot[, except as specified otherwise]. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

****

NOTE: The Army and Navy require RCDD approved drawings for all A/E designed projects.

On government designed (in-house design) projects, the government designer shall make sure that the bid documents require an RCDD stamp on the contractor's telecommunications drawings submitted for approval.

For small scale projects, limited to adding drops to existing telecommunications rooms, an RCDD stamp is not required provided the work is being accomplished under the technical authority of an RCDD or the government telecommunications manager.

Activity Specific Telecomunications Manager: Throughout this document, the term "telecommunications manager " refers to the following:
" For Army, the Network Enterprise Center (NEC).
" For Navy, the Base Communications Officer (BCO)
" For Marine Corps, the G6
" For Air Force, the Base/Installation Communications Squadron, Commander's Representative.

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Provide[registered communications distribution designer (RCDD) approved,] drawings in accordance with TIA-606. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF

telecommunications and ER telecommunications, CD's[, BD's], and FD's to the telecommunications work area outlets.[Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, CD's, BD's, FD's, and the EF and ER for telecommunications keyed to floor plans by room number. Mount the laminated schematic in the EF telecommunications space as directed by the Contracting Officer.] The following drawings shall be provided as a minimum:

a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.

c. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

1.6.1.2 Telecommunications Space Drawings

Provide T3 drawings in accordance with TIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and [cabinet][, rack][, backboard][and] wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

1.6.2 Telecommunications Qualifications

****

NOTE: BICSI Cabling Installer, Technician Level certification is preferred for supervisors and installers in lieu of documentation of three years experience. Contractors have the option to submit either BICSI certification or experience documentation.

****

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to

installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of [3][_____] years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using [optical fiber and]copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the

telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of [3] [_____] years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3.

1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, [60][_____] days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.10 MAINTENANCE

1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than [2] [_____] months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

1.10.2 Record Documentation

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NOTE: TIA-606 describes the necessary data fields and reports for hard copy, spreadsheet and electronic media as well as cable management software requirements. Check with activity to determine if cable management software is currently employed at the activity and provide necessary data input to the existing system to include information associated with project installation.

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Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided[in hard copy format][on electronic media using Windows based computer cable management software.][A licensed copy of the cable management

software including documentation, shall be provided.] Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall [include only the required data fields][include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility]in accordance with TIA-606. Include manufacture date of cable with submittal.

b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA-606. Documentation shall include the required data fields[as a minimum][only] in accordance with TIA-606.

[1.10.3 Spare Parts

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NOTE: Delete this paragraph for Navy projects.
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In addition to the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

]PART 2 PRODUCTS

2.1 COMPONENTS

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NOTE: Service entrance and pathway requirements are provided in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP) provides requirements for campus backbone cable systems.

For specialized circuits, such as pay phones, coordinate with the local telephone company. Provide electrical and telephone outlets installed per the ADA to accommodate TTD's and other devices.

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Components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications

systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA-569 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide system furniture pathways in accordance with UL 1286.

2.3 TELECOMMUNICATIONS CABLING

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NOTE: Cables shall be terminated within telecommunications rooms, telecommunications equipment rooms, and work areas. Cross-connect jumpers may be provided as part of the contract if required to provide the customer a complete and usable facility. Optical fiber and copper patch cords shall be provided by the Contractor when patch panels are installed. Optical fiber media may be single-mode, multimode, or hybrid combination. For information on optical fiber local area network system, visit www.fols.org.

Air Force Medical Facilities are installed and labeled in accordance with HEADQUARTERS AIR FORCE MEDICAL SUPPORT AGENCY DESIGN AND IMPLEMENTATION GUIDELINES MEDICAL SYSTEMS INFRASTRUCTURE MODERNIZATION PROGRAM (2001) for Air Force medical projects. All other projects are labeled in accordance with TIA-606.

When systems furniture is provided as part of the construction contract, ensure that systems furniture specifications require compliance with TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, and TIA-568-C.3 cabling standards as applicable.

NFPA 70 provides detailed information for optical fiber cables and communications circuits in various spaces and locations. Article 770, table 770-154(a), provides application of optical fiber cables and article 800, Table 800.154(a), provides application for communications circuits (copper).

Table 770.179 provides the following definitions for optical fiber cable:

OFNP Nonconductive optical fiber plenum cable
OFCP Conductive optical fiber plenum cable
OFNR Nonconductive optical fiber riser cable
OFCR Conductive optical fiber riser cable
OFNG Nonconductive optical fiber general-purpose cable
OFCG Conductive optical fiber general-purpose cable
OFN Nonconductive optical fiber general-purpose cable
OFC Conductive optical fiber general-purpose cable

Table 800.179 provides the following definitions for communications circuits:

CMP Communications plenum cable
CMR Communications riser cable
CMG Communications general-purpose cable
CM Communications general-purpose cable
CMX Communications cable, limited use
CMUC Undercarpet communications wire and cable

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NOTE: In passive optical network (PON) topologies, specify single mode fiber since it is currently the only viable cabling solution. PON technology is not supported by all current networks and must be coordinated with the agency specific telecommunications manager (NEC, BCO, G6) and additionally for the Navy, with the NMCI/COSC/NGEN Contractor.

****

Cabling shall be UL listed for the application and shall comply with TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3 and NFPA 70. Provide a labeling system for cabling as required by TIA-606 and UL 969. Ship cable on reels or in boxes bearing manufacture date for for unshielded twisted pair (UTP) in accordance with ICEA S-90-661[and optical fiber cables in accordance with ICEA S-83-596] for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

[2.3.1 Backbone Cabling

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NOTE: 150 ohm shielded twisted pair (STP)is not allowed for new construction. Backbone cable lengths shall not exceed guidelines of TIA-568-C.1, TIA-568-C.2, and TIA-568-C.3. STP 100 ohm backbone and horizontal cable may be required for EMI isolation in complex buildings.

Use fiber optic cable for backbone data service, unless expanding an existing site where other backbone cable types are required or requested by user.

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[2.3.1.1 Backbone Copper

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NOTE: TIA-568-C.1 recognizes Category 3 rated cable as the minimum backbone transmission media. Use of cables rated higher than Category 3 are not required since the copper backbone cable is only used for voice systems. Choose the first bracketed jacket

color for the preferred color code for cable jackets. Coordinate with activity and choose the second bracketed jacket color option to specify an activity preferred color. Color coding for conductors within the 25 pair bundles is covered by the reference to industry standards.

ICEA S-90-661 specifies a different cable marking interval for copper cables when marked in SI versus empirical units. This standard requires: "Length marking shall appear at intervals not to exceed 1 meter 3.3 feet and the word "METER" shall appear after each length marking. If specified by the user, length marking shall be provided in feet and shall appear at intervals not to exceed 0.6 meters 2 ft. The word "FEET" shall appear after each length marking".

****

Copper backbone cable shall be solid conductor, 24 AWG, 100 ohm, [100] [_____]-pair, Category 3, UTP, in accordance with ICEA S-90-661, TIA-568-C.1, TIA-568-C.2 and UL 444, formed into 25 pair binder groups covered with a[gray][____] thermoplastic jacket[and overall metallic shield]. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular length marking intervals in accordance with ICEA S-90-661 . Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG)communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70.

][2.3.1.2 Backbone Optical Fiber

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NOTE: In a fiber optic communication cable a buffer is one type of component used to encapsulate one or more optical fibers for the purpose of providing such functions as mechanical isolation, protection from physical damage and fiber identification. The buffer may take the form of a miniature conduit, contained within the cable and called a loose buffer, or loose buffer tube, in which one or more fibers may be enclosed, often with a lubricating gel. A loose buffer is typically used in outside plant applications. A tight buffer consists of a polymer coating in intimate contact with the primary coating applied to the fiber during the manufacturing process. A tight buffer is typically used for interior distribution.

Indicate the proper color coding of optical fiber cabling on design drawings. TIA/EIA-598 color coding scheme for cordage jackets used on military projects is as follows:

Fiber type and class	Fiber diameter m	Jacket color
Multimode	50/125 Laser Optimized (OM3)	Aqua
	50/125 (OM2)	Orange
	62.5/125 (OM1)	Slate
Single-mode	OS1 (ranges between 8 and 10)	Yellow

****

NOTE: The Army Installation and Campus Area Network (ICAN) Guide standard dictates the use of single mode fiber cables for building backbones on Army projects.

For Navy projects provide single mode fiber cables (OS1) for building backbones on all new projects to future proof the network and standardize the backbone. Additionally, this permits the option of flattening the network via direct connection to switches in TRs other than the main TR.

In existing facilities with multimode cables and switches, coordinate with the activity and the NMCI/COSC/NGEN contractor to determine whether the switch optics will be changed to utilize the single mode backbone, or if multimode cable must also be provided in addition to the single mode. If using multimode, OM3 (which permits data rates up to 10 Gig) is first choice. OM2 and OM1 should only be used to supplement existing systems

For Air Force projects, coordinate fiber cable requirements with the Installation Communications Squadron.

****

Provide in accordance with ICEA S-83-596, TIA-568-C.3, UL 1666 and NFPA 70. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 1 meter 40 inches.

Provide the number of strands indicated, (but not less than 12 strands between the main telecommunication room and each of the other telecommunication rooms), of single-mode(OS1), tight buffered fiber optic cable.

[Provide tight buffered fiber optic multimode, [50/125-um diameter laser optimized(OM3)][50/125-um diameter(OM2)][62.5/125-um diameter(OM1)] cable as indicated.]

Provide plenum (OFNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. The cable cordage jacket, fiber, unit, and group color shall be

in accordance with TIA/EIA-598.

Provide plenum (OFNP) riser (OFNR) , or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. The cable cordage jacket, fiber, unit, and group color shall be in accordance with TIA/EIA-598.

]]2.3.2 Horizontal Cabling

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NOTE: Coordinate project requirements and use of fiber optic cable for horizontal cabling.

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Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA-568-C.1.

2.3.2.1 Horizontal Copper

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NOTE:
Choose the first bracketed jacket color for the preferred color code for cable jackets. Coordinate with activity and choose the second bracketed jacket color option to specify an activity preferred color.

ICEA S-90-661 specifies a different cable marking interval for copper cables when marked in SI versus empirical units. This standard requires "Length marking shall appear at intervals not to exceed 1 meter 3.3 feet and the word "METER" shall appear after each length marking. If specified by the user, length marking shall be provided in feet and shall appear at intervals not to exceed 0.6 meters 2 feet. The word "FEET" shall appear after each length marking."

Screened twisted pair cable (ScTP) may be required OCONUS. Coordinate with Activity for specific requirements and applicable reference standards.

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Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568-C.2, UL 444, ANSI/NEMA WC 66, ICEA S-90-661 . Provide four each individually twisted pair, minimum size 24 AWG conductors, Category 6, with a[blue][_____] thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs shall be UL listed and labeled for wet locations in accordance with NFPA 70. [Provide residential Category 6 cabling in accordance with TIA-570.]

[2.3.2.2 Horizontal Optical Fiber

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NOTE: When using fiber to the work area outlet, the most common method is to use the multimode fiber for horizontal cabling. If using multimode, OM3 (which permits data rates up to 10 Gig) is first choice. OM2 and OM1 should only be used to supplement existing systems.

Centralized cabling provides connection from the work areas to the centralized cross connect by allowing the use of pull through cable, an interconnect, or a splice in the TR or ER. Although this is using the same cable as horizontal, the industry standard permits runs up to 300 meters. In this topology, longer distances corresponds to a lower date rate.

In passive optical network (PON) topologies, specify single mode fiber since it is currently the only viable cabling solution. PON technology is not supported by all current networks and must be coordinated with the agency specific telecommunications manager (NEC, BCO, G6) and additionally for the Navy, with the NMCI/COSC/NGEN Contractor.

- **For horizontal cabling, 62.5/125 µm or 50/125 µm multimode optical fiber is recommended for:**
  - **Distances up to 90 m 295 ft.**
  - **Data rates up to 2.5 Gb/s.**
- **For centralized cabling, 62.5/125 µm or 50/125 µm multimode optical fiber is recommended for:**
  - **Distances up to 300 m 984 ft.**
  - **Data rates up to 1.25 Gb/s.**

****

Provide optical fiber horizontal cable in accordance with ICEA S-83-596and TIA-568-C.3. Cable shall be tight buffered, [multimode, 50/125-um diameter laser optimized, OM3][,][multimode, 50/125-um diameter, OM2][multimode, 62.5.125-um diameter, OM1][single-mode, 8/125-um diameter, OS1]. Cable shall be imprinted with manufacturer, flammability rating and fiber count at regular intervals not to exceed 1 meter 40 inches.

Provide plenum (OFNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70.Cables installed in conduit within and under slabs be UL listed and labeled for wet locations in accordance with NFPA 70. The cable jacket shall be of single jacket construction with color coding of cordage jacket, fiber, unit, and group in accordance with TIA/EIA-598.

][2.3.3 Work Area Cabling

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NOTE: This type cabling is seldom provided on projects and is normally the responsibility of the activity. Coordinate with the activity and local

design agency for requirements concerning work area cabling.
****

2.3.3.1 Work Area Copper

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NOTE: Choose the first bracketed jacket color for the preferred color code for cable jackets. Coordinate with activity for alternate color coding and choose the second bracketed jacket color option to enumerate activity preferred color code. Coordinate work area cabling color code with work area adapter color code.
****

Provide work area copper cable in accordance with TIA-568-C.2, with a[blue,][_____] thermoplastic jacket.

[2.3.3.2 Work Area Optical Fiber

Provide optical work area cable in accordance with TIA-568-C.3.

]]2.4 TELECOMMUNICATIONS SPACES

****
NOTE: For projects that do not include Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT (OSP) for termination of interbuilding cables, copy paragraph BUILDING PROTECTOR ASSEMBLIES and PROTECTOR MODULES from Section 33 82 00 and paste the paragraphs into this section as part of the telecommunications spaces.

Navy projects adhere to color coding standards in accordance with the following colors from TIA-606.

Cross-Connect Field Color Codes	
Color	**Identifies**
Orange	**Demarcation point (e.g., central office terminations).**
Green	**Network connections (e.g., network and auxiliary equipment).**
Purple	**Common equipment, private branch exchange (PBX), local area network (LANs),multiplexers (e.g., switching and data equipment).**
White	**First-level backbone (e.g., CD (MC) to an FD (HC) or to a BD (IC)).**
Gray	**Second-level backbone (e.g., BD (IC) to an FD (HC)).**

Cross-Connect Field Color Codes	
Color	**Identifies**
Blue	**Horizontal cable (e.g., horizontal connections to telecommunications outlets).**
Brown	**Interbuilding backbone (campus cable terminations).**
Yellow	**Miscellaneous (e.g., auxiliary, alarms, security).**
Red	**Reserved for future use (also, key telephone systems).**
NOTE: Brown takes precedence over white or gray for interbuilding runs.	

****

Provide connecting hardware and termination equipment in the telecommunications entrance facility[and telecommunication equipment room[s]] to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA-606.

2.4.1 Backboards

Provide void-free, interior grade A-C plywood 19 mm 3/4 inch thick[1200 by 2400 mm][4 by 8 feet] [as indicated]. Backboards shall be fire rated by manufacturing process. Fire stamp shall be clearly visible.[Paint applied over fire retardant backboard shall be UL 723 fire retardant paint. Provide label including paint manufacturer, date painted, UL listing and name of Installer. When painted, paint label and fire stamp shall be clearly visible.] Backboards shall be provided on a minimum of two adjacent walls in the telecommunication spaces.

[2.4.2 Equipment Support Frame

****

NOTE: Provide equipment support frames only when patch panels or cabinet/rack mounted interconnecting equipment are provided. In most applications, a rack in locked communications room is sufficient. Provide lockable cabinets in locations where additional security is required. Use wall-mounted brackets for small systems where only a few patch panels are required. Use 482.6 mm 19 inches equipment support frames for Navy projects.

Provide adequate space in telecommunications spaces to facilitate tenant owned telecommunications system support equipment requirements in tenant installed free standing cabinets or racks.

****

Provide in accordance with ECIA EIA/ECA 310-E and UL 50.

[a. Bracket, wall mounted, 8 gauge aluminum. Provide hinged bracket

compatible with [482.6 mm19 inches][584 mm23 inches] panel mounting.

][b. Racks, floor mounted modular type, [16 gauge steel][or][11 gauge aluminum] construction, minimum, treated to resist corrosion. Provide rack with vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug[and a surge protected power strip with 6 duplex 20 amp receptacles]. Rack shall be compatible with[482.6 mm 19 inches][584 mm 23 inches] panel mounting.

][c. Cabinets, freestanding modular type, [16 gauge steel][or][11 gauge aluminum] construction , minimum, treated to resist corrosion. Cabinet shall have removable and lockable side panels, front and rear doors, and have adjustable feet for leveling. Cabinet shall be vented in the roof and rear door. Cabinet shall have cable access in the roof and base and be compatible with[482.6 mm 19 inches][584 mm 23 inches] panel mounting. Provide cabinet with grounding bar[,][[rack][roof] mounted 15 cu. m 550 CFM fan with filter][and][a surge protected power strip with 6 duplex 20 amp receptacles].[All cabinets shall be keyed alike.]

][d. Cabinets, wall-mounted modular type, [16 gauge steel][or][11 gauge aluminum] construction , minimum, treated to resist corrosion. Cabinet shall have have lockable front[and rear] door[s], louvered side panels,[7 cu. m 250 CFM [roof][rack] mounted fan,] ground lug, and top and bottom cable access. Cabinet shall be compatible with[482.6 mm 19 inches][584 mm 23 inches] panel mounting.[All cabinets shall be keyed alike.][A [duplex AC outlet][surge protected power strip with 6 duplex 20 amp receptacles] shall be provided within the cabinet.]

]][2.4.3 Connector Blocks

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NOTE: Type 66 blocks are not permitted for new construction.
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Provide insulation displacement connector (IDC) Type 110 for Category 6 systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

][2.4.4 Cable Guides

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NOTE: Delete this paragraph for single family residential installations.
****

Provide cable guides specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on[[482.6][584] mm [19][23] inches equipment[racks][cabinets]][and][telecommunications backboards]. Cable guides of ring or bracket type devices[mounted on [rack][cabinet] panels][backboard] for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws,[and][or]nuts and lockwashers.

][2.4.5 Patch Panels

Provide ports for the number of horizontal and backbone cables terminated on the panel plus [25][_____] percent spare. Provide pre-connectorized [optical fiber][and][copper] patch cords for patch panels. Provide patch cords, as complete assemblies, with matching connectors as specified.[Provide fiber optic patch cables with crossover orientation in accordance with TIA-568-C.3]. Patch cords shall meet minimum performance requirements specified in TIA-568-C.1, TIA-568-C.2 [and TIA-568-C.3] for cables, cable length and hardware specified.

2.4.5.1 Modular to 110 Block Patch Panel

****

NOTE: Provide individual patch panels with a maximum of 48 adapter ports per patch panel for Navy projects. Larger patch panel cross-connect fields are more difficult for cable and administrative management. Army projects allow the use of 96 port adapter patch panels

Wire 8-pin modular ports to T568A configuration unless specifically requested and approved by the authority having jurisdiction.

****

Provide in accordance with TIA-568-C.1 and TIA-568-C.2. Panels shall be third party verified[and shall comply with EIA/TIACategory 6 requirements]. Panel shall be constructed of 2.2 mm 0.09 inches minimum aluminum and shall be [cabinet][rack][wall] mounted and compatible with an ECIA EIA/ECA 310-E [482.6 mm 19 inches][584 mm 23 inches] equipment[cabinet][rack]. Panel shall provide [48][_____] non-keyed, 8-pin modular ports, wired to [T568A][T568B]. Patch panels shall terminate the building cabling on Type 110 IDCs and shall utilize a printed circuit board interface. The rear of each panel shall have incoming cable strain-relief and routing guides. Panels shall have each port factory numbered and be equipped with laminated plastic nameplates above each port.

[2.4.5.2 Fiber Optic Patch Panel

****

NOTE: Provide individual patch panels and distribution panels with 12 duplex LC, SC or MT-RJ adapters or 24 ST adapters maximum. Larger patch panels are more difficult to manage

Sleeves are used in adapters to align the fibers and reduce insertion loss. Zirconia ceramic split sleeves are more expensive but provide higher durability than phosphor bronze split sleeves.

Do not use ST or MT-RJ fiber optic adapters and connectors for new construction unless specifically required for interface with existing equipment reused on installations. Check with activity for specific requirements for ST and MT-RJ adapters and connectors..

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Provide panel for maintenance and cross-connecting of optical fiber cables. Panel shall be constructed of[[16][18] gauge steel][or][11 gauge aluminum] minimum and shall be [cabinet][rack][wall] mounted and compatible with a ECIA EIA/ECA 310-E[482.6 mm 19 inches][584 mm 23 inches] equipment rack. Each panel shall provide [12][_____] [multimode][single-mode] adapters as [duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves,] [duplex SC in accordance with TIA/EIA-604-3 with zirconia ceramic][MT-RJ in accordance with TIA/EIA-604-12 with thermoplastic][ST in accordance with TIA/EIA-604-2 with metallic] alignment sleeves. Provide dust cover for unused adapters. The rear of each panel shall have a cable management tray a minimum of 203 mm 8 inches deep with removable cover, incoming cable strain-relief and routing guides. Panels shall have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter.

]][2.4.6 Optical Fiber Distribution Panel

[Cabinet][Rack][Wall] mounted optical fiber distribution panel (OFDP) shall be constructed in accordance with ECIA EIA/ECA 310-E utilizing[[16][18] gauge steel][or][11 gauge aluminum] minimum. Panel shall be divided into two sections, distribution and user. Distribution section shall have strain relief, routing guides, splice tray and shall be lockable, user section shall have a cover for patch cord protection. Each panel shall provide[[12][_____] multimode][and][[12][_____] single-mode] pigtails and adapters. Provide adapters as [duplex LC with zirconia ceramic] [duplex SC with zirconia ceramic][MT-RJ with thermoplastic][ST with metallic] alignment sleeves. Provide dust covers for adapters. Provide patch cords as specified in the paragraph PATCH PANELS.

]2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

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NOTE: When a building has elevators, a four-pair copper cable with an eight-position modular outlet adapter shall be installed for each elevator. The exact location of the outlet assembly should be verified with the elevator installer or Contractor.

Conduit bend radius shall be coordinated with cable bend radius. Conduit entries at outlet and junction boxes shall be arranged so that cables passing through the box shall enter and exit at opposite sides of the box. Provide grounding and bonding as required by TIA-607. Wire 8-pin modular outlet/connectors to T568A configuration unless specifically requested and approved by the authority having jurisdiction. The term RJ-45 refers to 8-pin modular adapters/connectors wired to T568A or T568B configurations. Ensure drawings indicate work area outlet adapter color code functionality if color coding of adapters is a requirement of the project.

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2.5.1 Outlet/Connector Copper

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NOTE: Coordinate outlet/connector color with

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Outlet/connectors shall comply with FCC Part 68, TIA-568-C.1, and TIA-568-C.2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified[and shall comply with TIA-568-C.2 Category 6 requirements.] Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired [T568A][or][T568B][as indicated]. UTP outlet/connectors shall comply with TIA-568-C.2 for [200] [_____] mating cycles.[UTP outlet/connectors installed in outdoor or marine environments shall be jell-filled type containing an anti-corrosive, memory retaining compound.]

2.5.2 Optical Fiber Adapters(Couplers)

****

NOTE: LC style adapters and connectors are the default standard for new construction due to smaller form factor (size) allowing higher density at both the patch panel and the outlets. However, SC style connectors/adapters are the minimum TIA-568-C.3 requirement.

Do not use ST or MT-RJ fiber optic adapters and connectors for new construction unless specifically required for interface with existing equipment reused on installations. Check with activity for specific requirements for ST and MT-RJ adapters and connectors.

Sleeves are used in adapters to align the fibers and reduce insertion loss. Zirconia ceramic split sleeves are more expensive but provide higher durability than phosphor bronze split sleeves.

****

Provide optical fiber adapters suitable for[duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves,][duplex SC in Accordance with TIA/EIA-604-3 with zirconia ceramic alignment sleeves,] [MT-RJ in accordance with TIA/EIA-604-12 with thermoplastic alignment sleeves,][and][ST in accordance with TIA/EIA-604-2 with metallic alignment sleeves] as indicated. Provide dust cover for adapters. Optical fiber adapters shall comply with TIA-455-21 for [500][_____] mating cycles.

2.5.3 Optical Fiber Connectors

****

NOTE: Do not use ST style connectors for new construction unless specifically required for interface with existing equipment reused on installations. Check with activity for specific requirements for ST connectors. Use bracketed option for crimp style ST type connectors. Select 850 or 1300 nm for multimode fiber optic cable and 1310 or 1550 nm for single-mode fiber optic cable

****

Provide in accordance with TIA-455-21.[Optical fiber connectors shall be[duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves,] [duplex SC in accordance with TIA/EIA-604-3 with zirconia ceramic][MT-RJ in accordance with TIA/EIA-604-12 with thermoplastic][ST in accordance with TIA/EIA-604-2 with metallic] ferrule, epoxyless[crimp style] compatible with[[62.5/125][50/125] multimode][8/125 single-mode] fiber. The connectors shall provide a maximum attenuation of 0.3 dB at[850][1300][1310][1550] nm with less than a 0.2 dB change after 500 mating cycles.]

2.5.4 Cover Plates

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NOTE: Coordinate cover plate color with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

****

Telecommunications cover plates shall comply with UL 514C, and TIA-568-C.1, [TIA-568-C.2], [TIA-568-C.3]; [flush][or][oversized] design constructed of [high impact thermoplastic material [[ivory][white][brown] in color][to match color of receptacle/switch cover plates specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM]][302 stainless material][or][brass material]. Provide labeling in accordance with the paragraph LABELING in this section.

[2.6 MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

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NOTE: Multi-User Telecommunications Outlet Assemblies (MUTOAs) are termination devices used for open office cabling. The use of multi-user telecommunications outlet assemblies allows horizontal cabling to remain intact when the open office plan is changed. Work area cables originating from the MUTOA should be routed through work area pathways (e.g., furniture pathways). The work area cables shall be connected directly to work station equipment without the use of any additional intermediate connections. MUTOAs should be located in an open office area so that each furniture cluster is served by at least one MUTOA. The MUTOA should be limited to serving a maximum of twelve work areas. Maximum work area cable length requirements shall also be taken into account. Spare capacity should also be considered when sizing the MUTOA.

****

Provide MUTOA(s) in accordance with TIA-568-C.1.

][2.7 TERMINAL CABINETS

****

NOTE: Install wiring and labeling in Air Force medical facilities in accordance with HEADQUARTERS AIR FORCE MEDICAL SUPPORT AGENCY DESIGN AND IMPLEMENTATION GUIDELINES MEDICAL SYSTEMS

INFRASTRUCTURE MODERNIZATION PROGRAM (2001) for Air Force Medical projects. Label other projects in accordance with TIA-606.
****

Construct of zinc-coated sheet steel,[915 by 610 by 150 mm 36 by 24 by 6 inches deep][as indicated]. Trim shall be fitted with hinged door and locking latch. Doors shall be maximum size openings to box interiors. Boxes shall be provided with 16 mm 5/8 inch backboard with two-coat varnish finish. Match trim, hardware, doors, and finishes with panelboards. Provide label and identification systems for telecommunications wiring and components consistent with TIA-606.

]2.8 GROUNDING AND BONDING PRODUCTS

****
NOTE: Indicate grounding and bonding components and conductor sizes on drawings. Use Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.
****

Provide in accordance with UL 467, TIA-607, and NFPA 70. Components shall be identified as required by TIA-606. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.9 FIRESTOPPING MATERIAL

****
NOTE: Firestopping material requirements are specified in Section 07 84 00 FIRESTOPPING.
****

Provide as specified in Section 07 84 00 FIRESTOPPING.

2.10 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.11 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm 0.125 inches thick, white with [black] [_____] center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm one by 2.5 inches. Lettering shall be a minimum of 6.35 mm 0.25 inches high normal block style.

2.12 TESTS, INSPECTIONS, AND VERIFICATIONS

2.12.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by

manufacturer to confirm compliance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3[, TIA-526-7 for single mode optical fiber][, and TIA-526-14 for multimode optical fiber] cables.

PART 3 EXECUTION

3.1 INSTALLATION

****
NOTE: Delete last sentence associated with cabling guides for single family residential installations.
****

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with NECA/BICSI 568, TIA-568-C.1, TIA-568-C.2, [TIA-568-C.3,]TIA-569, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network.[Provide residential cabling in a star wiring architecture from the distribution device as required by TIA-570.] Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling.[Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.]

3.1.1 Cabling

****
NOTE: Do not exceed cable manufacturer's specific minimum bend radius or manufacturer's maximum pull tension (tensile) rating.
****

Install [UTP,][and][optical fiber] telecommunications cabling system as detailed in TIA-568-C.1, [TIA-568-C.2,] [TIA-568-C.3][and TIA-570 for residential cabling]. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 110 N 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

[3.1.1.1 Open Cable

****
NOTE: Provide cabling in a wireway/raceway pathway system only for Navy projects. Delete bracketed sentences associated with cabling not in wireway and

pathway, structural member routing, cable placement and coiling of cables for Navy projects.
****

Use only where specifically indicated on plans for use in cable trays, or below raised floors. Install in accordance with TIA-568-C.1, TIA-568-C.2 [[and]TIA-568-C.3]. Do not exceed cable pull tensions recommended by the manufacturer.[Copper cable not in a wireway or pathway shall be suspended a minimum of [200][_____] mm [8][_____] inches above ceilings by cable supports no greater than [1.5][_____] m [60][_____] inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300 mm 12 inches shall be maintained when such placement cannot be avoided.]

Plenum cable shall be used where open cables are routed through plenum areas. Cable routed exposed under raised floors shall be plenum rated. Plenum cables shall comply with flammability plenum requirements of NFPA 70. Install cabling after the flooring system has been installed in raised floor areas.[Cable [1.8][_____] meters [6][_____] feet long shall be neatly coiled not less than [300][_____] mm [12][_____] inches in diameter below each feed point in raised floor areas.]

]3.1.1.2 Backbone Cable

a. Copper Backbone Cable. Install intrabuilding backbone copper cable, in indicated pathways, between the campus distributor, located in the telecommunications entrance facility or room, the building distributors and the floor distributors located in telecommunications rooms and telecommunications equipment rooms as indicated on drawings.

b. Optical fiber Backbone Cable. Install intrabuilding backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 250 mm 10 inches leaving strength members exposed for approximately 250 mm 10 inches. Twist strength members together and attach to pulling eye. Vertical cable support intervals shall be in accordance with manufacturer's recommendations.

3.1.1.3 Horizontal Cabling

Install horizontal cabling as indicated on drawings Do not untwist Category 6 UTP cables more than 12 mm one half inch from the point of termination to maintain cable geometry. Provide slack cable in the form of a figure eight (not a service loop) on each end of the cable, 3 m 10 feet in the telecommunications room, and 304 mm 12 inches in the work area outlet..

3.1.2 Pathway Installations

****
NOTE: Do not use metal flex conduit for telecommunications wiring.
****

Provide in accordance with TIA-569 and NFPA 70. Provide building pathway as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

[3.1.3 Service Entrance Conduit, Overhead

Provide service entrance overhead as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

][3.1.4 Service Entrance Conduit, Underground

Provide service entrance underground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

]3.1.5 Cable Tray Installation

Install cable tray as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Only [CMP] [and] [OFNP] type cable shall be installed in a plenum.

3.1.6 Work Area Outlets

3.1.6.1 Terminations

Terminate UTP cable in accordance with TIA-568-C.1, TIA-568-C.2 and wiring configuration as specified.[Terminate fiber optic cables in accordance with TIA-568-C.3]

3.1.6.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.6.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 304 mm 12 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.6.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

[3.1.6.5 Multi-User Telecommunications Outlet Assembly (MUTOA)

Run horizontal cable in the ceiling or underneath the floor and terminate each cable on a MUTOA in each individual zone. MUTOAs shall not be located in ceiling spaces, or any obstructed area. MUTOAs shall not be installed in furniture unless that unit of furniture is permanently secured to the building structure. MUTOAs shall be located in an open work area so that each furniture cluster is served by at least one MUTOA. The MUTOA shall be limited to serving a maximum of twelve work areas. Maximum work area cable length requirements shall also be taken into account. MUTOAs must be labeled to include the maximum length of work area cables. MUTOA labeling is in addition to the labeling described in TIA-606, or other applicable cabling administration standards. Work area cables extending from the MUTOA to the work area device must also be uniquely identified and labeled.

]3.1.7 Telecommunications Space Termination

Install termination hardware required for [Category 6][and][optical fiber] system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

[3.1.7.1 Connector Blocks

Connector blocks shall be [cabinet][rack][wall] mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with TIA-569.

]3.1.7.2 Patch Panels

Patch panels shall be mounted [in equipment [cabinets]][racks][on the plywood backboard] with sufficient ports to accommodate the installed cable plant plus [25][_____] percent spares.

[a. Copper Patch Panel. Copper cable entering a patch panel shall be secured to the panel [with cable ties][as recommended by the manufacturer] to prevent movement of the cable.

][b. Fiber Optic Patch Panel. Fiber optic cable loop shall be [[900][_____] mm [3][_____] feet in length][provided as recommended by the manufacturer]. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

][3.1.7.3 Equipment Support Frames

Install in accordance with TIA-569:

[a. Bracket, wall mounted. Mount bracket to plywood backboard in accordance with manufacturer's recommendations. Mount rack so height of highest panel does not exceed 1980 mm 78 inches above floor.]

[b. Racks, floor mounted modular type. Permanently anchor rack to the floor in accordance with manufacturer's recommendations.]

[c. Cabinets, freestanding modular type. When cabinets are connected together, remove adjoining side panels for cable routing between cabinets.[Mount rack mounted fan in [roof][base] of cabinet.]]

[d. Cabinets, wall-mounted modular type. Mount cabinet to plywood backboard in accordance with manufacturer's recommendations. Mount cabinet so height of highest panel does not exceed 1980 mm 78 inches above floor.]

]3.1.8 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

3.1.9 Grounding and Bonding

Provide in accordance with TIA-607, NFPA 70 and as specified in Section

26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2 LABELING

3.2.1 Labels

****
NOTE: Install and label Air Force medical facilities in accordance with HEADQUARTERS AIR FORCE MEDICAL SUPPORT AGENCY DESIGN AND IMPLEMENTATION GUIDELINES MEDICAL SYSTEMS INFRASTRUCTURE MODERNIZATION PROGRAM (2001). Label other projects in accordance with TIA-606 using a mechanical device for printing.
****

Provide labeling in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using[thermal ink transfer process][laser printer] [_____].

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA-606.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

****
NOTE: Use and coordinate paint and coating requirements with Section 09 90 00 PAINTS AND COATINGS when provided in the job. When requirements are beyond what is specified in Section 09 90 00, specify the requirements in this paragraph.
****

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3.1 Painting Backboards

If backboards are required to be painted, then the manufactured fire retardant backboard must be painted with fire retardant paint, so as not to increase flame spread and smoke density and must be appropriately labeled. Label and fire rating stamp must be unpainted.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, [TIA-568-C.2], [TIA-568-C.3]. Test equipment shall conform to TIA-1152. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA-568-C.2, [TIA-568-C.3], [and][TIA-570 for residential cabling]. Visually confirm [Category 6,] marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but prior to being cross-connected.

****

NOTE: Two methods for measuring the installed optical fiber cable plant loss are described in EIA TIA/EIA-526-7 (single-mode cable). Method A uses optical power measurement equipment. Method B uses an Optical Time Domain Reflectometer (OTDR). Method B is not recommended for cable plants containing branching devices and/or isolators. EIA TIA/EIA-526-14A (multimode cable) does not recommend the use of an OTDR for testing. BICSI recommends using Method A for all testing and implementing Method B testing to isolate optical disparities in fiber links that fail Method A testing.

****

[[For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-14 using[Method A, Optical Power Meter and Light Source][Method B, OTDR] for multimode optical fiber.][For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-7 using[Method A, Optical Power Meter and Light Source][Method B, OTDR] for single-mode optical fiber.] Perform verification acceptance tests.]

3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

[a. Perform Category 6 link tests in accordance with TIA-568-C.1 and

TIA-568-C.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.

][. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568-C.3.

]3.5.1.4 Final Verification Tests

****
NOTE: Use bracketed options for Voice Tests and Data Tests on Navy projects only.
****

Perform verification tests for UTP[and optical fiber] systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

[a. Voice Tests. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.

][b. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

] -- End of Section --