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USACE / NAVFAC / AFCEA / NASA UFGS-27 10 00 (January 2008)  
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Preparing Activity: NAVFAC Superseding  
UFGS-27 10 00 (July 2007)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2011

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### SECTION TABLE OF CONTENTS

#### DIVISION 27 - COMMUNICATIONS

#### SECTION 27 10 00

#### BUILDING TELECOMMUNICATIONS CABLING SYSTEM

01/08

#### PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
  - 1.3.1 Campus Distributor (CD)
  - 1.3.2 Building Distributor (BD)
  - 1.3.3 Floor Distributor (FD)
  - 1.3.4 Telecommunications Room (TR)
  - 1.3.5 Entrance Facility (EF) (Telecommunications)
  - 1.3.6 Entrance Room (ER) (Telecommunications)
  - 1.3.7 Open Cable
  - 1.3.8 Open Office
  - 1.3.9 Pathway
- 1.4 SYSTEM DESCRIPTION
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
  - 1.6.1 Shop Drawings
    - 1.6.1.1 Telecommunications Drawings
    - 1.6.1.2 Telecommunications Space Drawings
  - 1.6.2 Telecommunications Qualifications
    - 1.6.2.1 Telecommunications Contractor
    - 1.6.2.2 Key Personnel
    - 1.6.2.3 Minimum Manufacturer Qualifications
  - 1.6.3 Test Plan
  - 1.6.4 Regulatory Requirements
  - 1.6.5 Standard Products
    - 1.6.5.1 Alternative Qualifications
    - 1.6.5.2 Material and Equipment Manufacturing Date
- 1.7 DELIVERY AND STORAGE
- 1.8 ENVIRONMENTAL REQUIREMENTS
- 1.9 WARRANTY
- 1.10 MAINTENANCE
  - 1.10.1 Operation and Maintenance Manuals
  - 1.10.2 Record Documentation
  - 1.10.3 Spare Parts

## PART 2 PRODUCTS

- 2.1 COMPONENTS
- 2.2 TELECOMMUNICATIONS PATHWAY
- 2.3 TELECOMMUNICATIONS CABLING
  - 2.3.1 Backbone Cabling
    - 2.3.1.1 Backbone Copper
    - 2.3.1.2 Backbone Optical Fiber
  - 2.3.2 Horizontal Cabling
    - 2.3.2.1 Horizontal Copper
    - 2.3.2.2 Horizontal Optical Fiber
  - 2.3.3 Work Area Cabling
    - 2.3.3.1 Work Area Copper
    - 2.3.3.2 Work Area Optical Fiber
- 2.4 TELECOMMUNICATIONS SPACES
  - 2.4.1 Backboards
  - 2.4.2 Equipment Support Frame
  - 2.4.3 Connector Blocks
  - 2.4.4 Cable Guides
  - 2.4.5 Patch Panels
    - 2.4.5.1 Modular to 110 Block Patch Panel
    - 2.4.5.2 Fiber Optic Patch Panel
  - 2.4.6 Optical Fiber Distribution Panel
- 2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES
  - 2.5.1 Outlet/Connector Copper
  - 2.5.2 Optical Fiber Adapters
  - 2.5.3 Optical Fiber Connectors
  - 2.5.4 Cover Plates
- 2.6 MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)
- 2.7 TERMINAL CABINETS
- 2.8 GROUNDING AND BONDING PRODUCTS
- 2.9 FIRESTOPPING MATERIAL
- 2.10 MANUFACTURER'S NAMEPLATE
- 2.11 FIELD FABRICATED NAMEPLATES
- 2.12 TESTS, INSPECTIONS, AND VERIFICATIONS
  - 2.12.1 Factory Reel Tests

## PART 3 EXECUTION

- 3.1 INSTALLATION
  - 3.1.1 Cabling
    - 3.1.1.1 Open Cable
    - 3.1.1.2 Backbone Cable
    - 3.1.1.3 Horizontal Cabling
  - 3.1.2 Pathway Installations
  - 3.1.3 Service Entrance Conduit, Overhead
  - 3.1.4 Service Entrance Conduit, Underground
  - 3.1.5 Cable Tray Installation
  - 3.1.6 Work Area Outlets
    - 3.1.6.1 Terminations
    - 3.1.6.2 Cover Plates
    - 3.1.6.3 Cables
    - 3.1.6.4 Pull Cords
    - 3.1.6.5 Multi-User Telecommunications Outlet Assembly (MUTOA)
  - 3.1.7 Telecommunications Space Termination
    - 3.1.7.1 Connector Blocks
    - 3.1.7.2 Patch Panels
    - 3.1.7.3 Equipment Support Frames

- 3.1.8 Electrical Penetrations
- 3.1.9 Grounding and Bonding
- 3.2 LABELING
  - 3.2.1 Labels
  - 3.2.2 Cable
  - 3.2.3 Termination Hardware
- 3.3 FIELD APPLIED PAINTING
- 3.4 FIELD FABRICATED NAMEPLATE MOUNTING
- 3.5 TESTING
  - 3.5.1 Telecommunications Cabling Testing
    - 3.5.1.1 Inspection
    - 3.5.1.2 Verification Tests
    - 3.5.1.3 Performance Tests
    - 3.5.1.4 Final Verification Tests

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEA / NASA UFGS-27 10 00 (January 2008)  
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### SECTION 27 10 00

#### BUILDING TELECOMMUNICATIONS CABLING SYSTEM 01/08

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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 items(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. UFC 3-580-01, "Telecommunications Building Cabling Systems Planning and Design" provides general guidance for interior telecommunications cabling systems. USAISEC Technical Guide for Installation Information Infrastructure Architecture (I3A) provides guidance for Army telecommunications cabling systems. Army ECB 2007-22 is available electronically at [http://www.wbdg.org/ccb/ARMYCOE/COEECB/ecb\\_2007\\_22.pdf](http://www.wbdg.org/ccb/ARMYCOE/COEECB/ecb_2007_22.pdf). UFC 3-580-10, "Navy And Marine Corps Intranet (NMCI) Standard Construction Processes" provides design guidance for Navy sites. Confirm specific system requirements with the using Activity.

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## 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 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 D 709

(2001; R 2007) Laminated Thermosetting

## Materials

### ELECTRONIC COMPONENTS ASSOCIATION (ECA)

ECA EIA/ECA 310 (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 (2001) Optical Fiber Premises Distribution Cable

ICEA S-90-661 (2008) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements

### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66 (2001; Errata 2003) Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs

NEMA WC 63.1 (2005) Twisted Pair Premise Voice and Data Communications Cables

### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

### TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607 (2002a) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA-455-21 (1988a; R 2002) FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices

TIA-492AAAA (2009b) 62.5-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers

TIA-492AAAB (2009a) 50-Um Core Diameter/125-Um Cladding Diameter Class 1A Graded-Index Multimode Optical Fibers

TIA-492CAAA (1998; R 2002) Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers

TIA-526-14 (2010b) OFSTP-14A Optical Power Loss

Measurements of Installed Multimode Fiber  
Cable Plant

TIA-526-7	(2002; R 2008) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA-568-2	(2009c; Errata 2010) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cable Components
TIA-568-C.1	(2009) Commercial Building Telecommunications Cabling Standard
TIA-568-C.3	(2008; Corrections 2008) Optical Fiber Cabling Components Standard
TIA-569	(2004b; Add 1 2009) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-570	(2004b; Adm 1 2009; R 2010) Residential Telecommunications Infrastructure Standard
TIA/EIA-598	(2005c) Optical Fiber Cable Color Coding
TIA/EIA-604-12	(2000) FOCIS 12 Fiber Optic Connector Intermateability Standard Type MT-RJ
TIA/EIA-604-2	(2004b) FOCIS 2 Fiber Optic Connector Intermateability Standard
TIA/EIA-604-3	(2000b) Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3
TIA/EIA-606	(2002a; Errata 2007; R 2007; Adm 1 2008) Administration Standard for the Telecommunications Infrastructure

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

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

UL 1286	(2008; Reprint Jan 2011) Office Furnishings
UL 1666	(2007) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1863	(2004; Reprint Aug 2008) Communication Circuit Accessories
UL 444	(2008; Reprint Apr 2010) Communications Cables

UL 467	(2007) Grounding and Bonding Equipment
UL 50	(2007) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 514C	(1996; Reprint Sep 2009) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 910	(1998) Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
UL 969	(1995; Reprint Nov 2008) Standard for Marking and Labeling Systems

## 1.2 RELATED REQUIREMENTS

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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.

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Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT, apply to this section with additions and modifications specified herein.

## 1.3 DEFINITIONS

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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.**

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Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in [TIA-568-C.1](#), [TIA-568-2](#), [TIA-568-C.3](#), [TIA-569](#), [TIA/EIA-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 antennae) including the entrance point at the building wall and continuing to the entrance room or space.

**1.3.6 Entrance Room (ER) (Telecommunications)**

A 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

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NOTE: Use Section 33 82 00, TELECOMMUNICATIONS, OUTSIDE PLANT to specify exterior distribution and interbuilding cables and include bracketed sentence. Choose the last bracketed sentences for Navy and Marine Corps projects only.  
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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.] Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.[ The telecommunications contractor must coordinate with the NMCI 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 contractor.]

#### 1.5 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

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

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Telecommunications drawings[; G][; G, [\_\_\_\_]]

Telecommunications Space Drawings[; G][; 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][; G, [\_\_\_\_]]

Patch panels[; G][; G, [\_\_\_\_]]

Telecommunications outlet/connector assemblies[; G][; G, [\_\_\_\_]]

Equipment support frame[; G][; G, [\_\_\_\_]]

[Connector blocks[; G][; G, [\_\_\_\_]]]

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**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.

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[Spare Parts[; G][; 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][; G, [\_\_\_\_]]

## SD-07 Certificates

Telecommunications Contractor Qualifications[; G][; G, [\_\_\_\_]]

Key Personnel Qualifications[; G][; G, [\_\_\_\_]]

Manufacturer Qualifications[; G][; G, [\_\_\_\_]]

Test plan[; G][; G, [\_\_\_\_]]

## SD-09 Manufacturer's Field Reports

Factory reel tests[; G][; G, [\_\_\_\_]]

## SD-10 Operation and Maintenance Data

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

## SD-11 Closeout Submittals

Record Documentation[; G][; G, [\_\_\_\_]]

## 1.6 QUALITY ASSURANCE

### 1.6.1 Shop Drawings

In exception to Section 01 33 00, SUBMITTAL PROCEDURES, submit shop drawings a minimum of 355 by 510 mm 14 by 20 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

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NOTE: The Navy requires RCDD approved drawings for  
designs with multiple telecommunications spaces or  
designs that have multiple voice and data systems.  
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Provide[ registered communications distribution designer (RCDD) approved,] drawings in accordance with TIA/EIA-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/EIA-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/EIA-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

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**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.**  
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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. 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-568-2](#) 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[ UTP] [ and] [ optical fiber] components and accessories [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 3 years 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. 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.

##### 1.10.2 Record Documentation

\*\*\*\*\*

NOTE: EIA TIA/EIA-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.

\*\*\*\*\*

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA/EIA-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/EIA-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/EIA-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/EIA-606. Documentation shall include the required data fields[ as a minimum][ only] in accordance with TIA/EIA-606.

### [1.10.3 Spare Parts

\*\*\*\*\*  
**NOTE: Delete this paragraph for Navy projects.**  
 \*\*\*\*\*

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

\*\*\*\*\*  
**NOTE: Service entrance and pathway requirements are provided in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM for Navy projects and Section 26 20 00, ELECTRICAL WORK, INTERIOR for Army projects. Choose 2 years and 6000 hours for Navy projects and 1 year and 3000 hours for Army projects. Section 33 82 00, TELECOMMUNICATIONS OUTSIDE PLANT 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.**

\*\*\*\*\*

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

\*\*\*\*\*  
NOTE: Refer to Section 16130, UNDERFLOOR RACEWAY SYSTEM for underfloor duct systems. Choose Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM for telecommunications pathway requirements.

Ensure that the maximum allowable raceway fill is not exceeded.

\*\*\*\*\*

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

\*\*\*\*\*  
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 additional technical information on optical fiber cabling, contact [www.corningfiber.com](http://www.corningfiber.com). For information on optical fiber local area network system, visit [www.techsavvy.com/](http://www.techsavvy.com/).

For medical (including Navy medical projects) and Army projects use Category 6 cable. NMCI is currently limited to supporting Category 5e cabling for Navy projects. Requiring use of Category 6 cable on Navy projects will add additional cost to the project, is not supported by MCON funding, and should not be done unless specifically approved by the EFD/EFA.

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/EIA-606.

When systems furniture is provided as part of the construction contract, ensure that systems furniture specifications require compliance with EIA TIA/EIA-568-B.1, EIA TIA/EIA-568-B.2, and EIA

TIA/EIA-568-B.3 cabling standards as applicable.

Communications general purpose (CM or CMG) and nonconductive optical fiber general purpose cable (OFN or OFNG) are general purpose cables for use in spaces other than plenums and risers. Communications plenum (CMP) and nonconductive optical fiber plenum cable (OFNP) are plenum rated cables. Provide type CMP and OFNP, plenum rated cabling in ducts, plenums and other air-handling spaces. Communications riser (CMR) and nonconductive optical fiber riser cable (OFNR) are riser rated cables. Provide type CMR and OFNR, in vertical shafts that pass through a floor penetration.

\*\*\*\*\*

Cabling shall be UL listed for the application and shall comply with TIA-568-C.1[, TIA-568-2][, TIA-568-C.3] and NFPA 70. Provide a labeling system for cabling as required by TIA/EIA-606 and UL 969. Ship cable[ on reels][ in boxes] bearing manufacture date for 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

\*\*\*\*\*

NOTE: 150 ohm shielded twisted pair (STP) is not allowed for new construction. Backbone cable lengths shall not exceed guidelines of EIA TIA/EIA-568-B.1, EIA TIA/EIA-568-B.2, and EIA TIA/EIA-568-B.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.

\*\*\*\*\*

##### [2.3.1.1 Backbone Copper

\*\*\*\*\*

NOTE: Category rated cable is not required for backbone copper cabling. Choose NEMA WC 66 for Category 6 cable and NEMA 63.1 for other copper conductor cables. 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.

ICEA S-90-661 specifies a different cable marking interval for copper cables when marked in SI versus empirical units. This standard requires that the

cable be marked at regular intervals not to exceed 1 meter for SI units and 2 feet for empirical units.

\*\*\*\*\*

ICEA S-90-661, TIA-568-C.1, TIA-568-2, [ NEMA WC 63.1] [ ANSI/NEMA WC 66] and UL 444, copper backbone cable shall be solid conductor, [24][22] AWG, 100 ohm, [100] [\_\_\_\_]-pair UTP (Unshielded twisted pair), 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 intervals not to exceed 1 meter 3.3 feet. The word "METER" "FEET" or the abbreviation "M" "FT" shall appear after each length marking. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70. Color coding shall comply with industry standards for 25 pair cables.

] [2.3.1.2 Backbone Optical Fiber

\*\*\*\*\*

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 tight buffer consists of a polymer coating in intimate contact with the primary coating applied to the fiber during manufacture. Tight buffer is the buffering type for interior distribution.

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

<u>Fiber type and class (Note 1)</u>	<u>Fiber diameter <math>\mu</math>m (Note 1)</u>	<u>Jacket color (Note 2)</u>
Multimode Ia	50/125	Orange
	62.5/125	Slate
	100/140	Green
Single-mode IVa	All	Yellow
Single-mode IVb	All	Yellow

Notes: 1) From EIA TIA/EIA-492A000

2) Natural jackets with colored tracers may be used instead of solid-color jackets.

\*\*\*\*\*

NOTE: The Army Common User Information Transport Network (CUITN) standard dictates the use of single mode fiber cables for building backbones on Army

projects.

For Navy projects a general guideline in premises applications for backbone cabling is as follows:

- 62.5/125  $\mu\text{m}$  or 50/125  $\mu\text{m}$  multimode optical fiber is recommended for:
  - Distances under 2 km (1.2 mi).
  - Data rates up to 155 Mb/s.
- Single-mode fiber is recommended for greater distances or higher data rates:
  - Distances under 3 km (1.9 mi)
  - Data rates up to 10 Gb/s

Often, a backbone comprised of both multimode and single-mode fiber is recommended to satisfy present and future needs in the backbone. Hybrid cables provide combinations of multimode and single-mode fiber optic cables bundled together in the same overall jacket. Hybrid cables require standards for both cable types to be included in the specification.

\*\*\*\*\*

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. [ Hybrid fiber optic cable marking shall comply with TIA/EIA-598.]

[TIA-492AAAA, multimode, 62.5/125-um diameter, 0.275 numerical aperture][, ] [TIA-492AAAB, multimode, 50/125-um diameter, 0.275 numerical aperture][ and ] [TIA-492CAAA, single-mode, 8/125-um diameter, 0.10 numerical aperture], tight buffered fiber optic cable. Provide a [24] [\_\_\_\_\_] -fiber [ hybrid cable bundled with [12] [\_\_\_\_\_] multimode and [12] [\_\_\_\_\_] single-mode fiber optic units] fiber optic cable. Provide nonconductive optical fiber general purpose cable (OFN or OFNG), nonconductive optical fiber plenum cable (OFNP), and nonconductive optical fiber riser cable (OFNR) rated cable in accordance with NFPA 70 and UL 910. Type OFNP or OFNR may be substituted for type OFN or OFNG and type OFNP may be substituted for type OFNR 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

\*\*\*\*\*

NOTE: Medical facility projects may require the use of fiber optic cable for horizontal cabling. Check with regional medical Information Technology staff for exact cabling requirements.

\*\*\*\*\*

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

#### 2.3.2.1 Horizontal Copper

\*\*\*\*\*

NOTE: For medical (including Navy medical projects) and Army projects use Category 6 cable. NMCI is

currently limited to supporting Category 5e cabling for Navy projects. Requiring use of Category 6 cable on Navy projects will add additional cost to the project, is not supported by MCON funding, and should not be done unless specifically approved by the EFD/EFA.

Choose NEMA WC 66 for Category 6 cable and NEMA 63.1 for other copper conductor cables. Use the last bracketed sentence for horizontal copper cabling in residential applications.

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.

\*\*\*\*\*

Provide horizontal copper cable in accordance with TIA-568-2, UL 444, [NEMA WC 63.1] [ANSI/NEMA WC 66], ICEA S-90-661 UTP (unshielded twisted pair), 100 ohm. Provide four each individually twisted pair, [24 AWG] [22 AWG] conductors, [Category 5e] [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) at regular intervals not to exceed 1 meter 3.3 feet. The word "METER" "FEET" or the abbreviation "M" "FT" shall appear after each length marking. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70. [ Provide residential [Category 5e] [Category 6] cabling in accordance with TIA-570.]

#### [2.3.2.2 Horizontal Optical Fiber

\*\*\*\*\*

##### NOTE:

- 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-83-596, ] TIA-568-C.3 and [TIA-492AAAA, multimode, 62.5/125-um diameter, 0.275 numerical aperture] [, ] [TIA-492AAAB, multimode, 50/125-um diameter, 0.275 numerical aperture] [TIA-492CAAA, single-mode, 8/125-um diameter, 0.10 numerical aperture], tight buffered fiber optic cables. Cable shall be imprinted with manufacturer, flammability rating and fiber count at regular intervals not to exceed 1 meter 40 inches. Provide nonconductive optical fiber general purpose cable (OFN or OFNG), nonconductive optical fiber riser cable (OFNR) or nonconductive optical fiber plenum cable (OFNP) in accordance with NFPA 70. Type OFNP or OFNR may be substituted for type OFN

or OFNG and type OFNP may be substituted for type OFNR 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

\*\*\*\*\*  
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

\*\*\*\*\*  
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-568-2, 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 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 EIA TIA/EIA-606.

##### Cross-Connect Field Color Codes

<u>Color</u>	<u>Identifies</u>
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)).
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/EIA-606.

#### 2.4.1 Backboards

Provide void-free, interior grade plywood 19 mm 3/4 inch thick[ 1200 by 2400 mm][ 4 by 8 feet][as indicated]. Backboards shall be fire rated. Backboards shall be provided on a minimum of two walls in the telecommunication spaces. Do not cover the fire stamp on the backboard.

\*\*\*\*\*

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.

\*\*\*\*\*

#### [2.4.2 Equipment Support Frame

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

- [a. Bracket, wall mounted, 8 gauge aluminum. Provide hinged bracket compatible with[ 482.6 mm 19 inches][ 584 mm 23 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

Provide insulation displacement connector (IDC)[ Type 110 for Category 5e and higher][ Type 66 for Category 5e] systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus [25][\_\_\_\_\_] percent spare.

#### ] [2.4.4 Cable Guides

\*\*\*\*\*  
**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-568-2 [ 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.  
\*\*\*\*\*

Provide in accordance with TIA-568-C.1 and TIA-568-2. Panels shall be third party verified[ and shall comply with EIA/TIA[ Category 5e][ and][ Category 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 ECA EIA/ECA 310[ 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][ or ][T568B][as indicated]. 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 SC or MT-RJ adapters or 24 ST adapters maximum. Larger patch panels are more difficult to manage.  
\*\*\*\*\*

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 ECA EIA/ECA 310[ 482.6 mm 19 inches][ 584 mm 23 inches] equipment rack. Each panel shall provide [12][\_\_\_\_\_] [multimode][single-mode] adapters as [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 ECA EIA/ECA 310 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 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

\*\*\*\*\*

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 J-STD-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.

\*\*\*\*\*

### 2.5.1 Outlet/Connector Copper

\*\*\*\*\*

NOTE: Coordinate outlet/connector color with  
Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

\*\*\*\*\*

Outlet/connectors shall comply with FCC Part 68TIA-568-C.1, and TIA-568-2.  
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-568-2[ Category 5e][ 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-568-2  
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

\*\*\*\*\*

NOTE: Do not use ST style adapters for new  
construction unless specifically required for  
interface with existing equipment reused on  
installations. Check with activity for specific  
requirements for ST adapters.

MT-RJ fiber optic adapters are designed to insert into standard 8-pin modular adapter spaces in 8-pin modular adapter cover plates. MT-RJ connectors use plastic fiber guides and actuator keys for alignment and termination. MT-RJ connectors and adapters are epoxyless and have thermoplastic ferrules or alignment sleeves. They are held in place by a retaining clip type mechanism. This allows the connector and adapter to be reused for changes, moves, and additions.

\*\*\*\*\*

Provide optical fiber adapters suitable for [ 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 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

\*\*\*\*\*

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-568-2], [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 SYSTEMS]] [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)

\*\*\*\*\*

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/EIA-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/EIA-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 J-STD-607, and NFPA 70. Components shall be identified as required by TIA/EIA-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 D 709.** 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.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 TIA-568-C.1, TIA-568-2, [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.]

### 3.1.1.1 Cabling

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

Install [ Category 5e UTP, ] [ Category 6 UTP, ] [ and ] [ optical fiber ] telecommunications cabling system as detailed in TIA-568-C.1, [TIA-568-2, ] [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 untwist [Category 5e] [Category 6] UTP cables more than 12 mm one half inch from the point of termination to maintain cable geometry. Provide 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. 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-568-2 [ [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.]

- a. 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

\*\*\*\*\*

NOTE: Section 33 82 00, TELECOMMUNICATIONS OUTSIDE PLANT provides requirements for interbuilding backbone cabling . Intrabuilding backbone cabling consists of the cabling between the campus distributor, building distributors and floor distributors within a building.

NOTE: Number of copper cable pairs is requirement driven; when requirements are unknown, provide 1.5 cable pairs per 9 square meters 100 square feet of usable space. Gauge of cable shall depend on distance and gauge of existing base backbone cable. For U.S. Navy projects, installation of cable shall be in accordance with the Navy Base Communications Specifications, Section NCTC IOP90A, SCN 3. Install multipair copper cable to support voice, alarms, and miscellaneous low speed circuits.

Design shall provide multipair copper cable between each telecommunications room and the telecommunications equipment room. When the telecommunications equipment is not co-located with the FD, install a copper cable between the FD or BD and the equipment. The size of cable between the FD or BD in the telecommunications equipment room and the BD in the telecommunications rooms shall be based on four cable pair for every potential telephone instrument or every 9 square meters 100 square feet of usable space. The vertical building backbone shall have no more than two hierarchical levels of cross-connects. Bridged taps are not permitted. Vertical cables, as a minimum, shall meet parameters set forth in TIA/EIA-568-B.1, TIA/EIA-568-B.2, and TIA/EIA-568-B.3.

\*\*\*\*\*

- 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.

\*\*\*\*\*

NOTE: For Army projects follow guidelines set forth in USAISEC I3A or CUITN.

For Navy projects, single-mode or multimode optical fiber cable shall be the primary base intrabuilding backbone cable plant that transports existing and proposed telecommunications circuits. The following guides shall be used for planning and installation of optical fiber intrabuilding backbone cable:

A minimum of 24 strands of fiber media dispersion unshifted shall be installed in



each building. Strands shall be increased as necessary to support specific requirements (e.g., command and control facilities, ADP buildings, command post, etc.).

Optical fiber cables shall be terminated on patch panels, normally rack mounted.

\*\*\*\*\*

- 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

\*\*\*\*\*

NOTE: For Army projects, use guidance provided in USAISEC I3A for horizontal cabling.

For open office cabling on Navy projects, divide usable floor space into zones of 37 to 83 square meter 400 to 900 square feet for each furniture cluster. Furniture clusters may be serviced by either Consolidation Points (CP)s or Multi-User Telecommunications Outlet Assemblies (MUTOA)s. CPs must be made up of EIA TIA/EIA 568-B.1 compliant hardware and require an additional connection at an outlet assembly at the work area. MUTOAs do not require an additional connection at the work area.

Design of office spaces (e.g., permanent walls, open spaces, modular partitions, etc.) shall dictate the method of routing horizontal cable from the telecommunications room to the outlet/connector. There are four primary means of routing cable to the user: via conduit in permanent wall, floor ducts, open cable to utility columns and routed below raised floors.

No more than four, four-pair cables shall be in a conduit run for a single gang outlet box, and conduit shall be minimum of 27 mm one inch. For double gang outlet boxes, conduit shall be a minimum of 35 mm 1 1/4 inches with no more than eight four-pair cables in the conduit. Two single gang box, conduit, and cable configurations may be substituted for a double gang box to ensure conduit entry into standard depth outlet boxes. 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. Maximum length of horizontal UTP

cable to workstation outlet shall be 90 m 295 feet;  
this shall include the routing in the  
telecommunications room.

\*\*\*\*\*

Install horizontal cabling as indicated on drawings between the campus distributor[, building distributors][, floor distributors][, MUTOAs] and the telecommunications outlet assemblies at workstations.

### 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 SYSTEMS.

#### [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 SYSTEMS.

#### ] 3.1.5 Cable Tray Installation

Install cable tray as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS. 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-568-2 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/EIA-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 5e, ] [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 J-STD-607, NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

### 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 EIA TIA/EIA-606 using a mechanical device for printing.  
\*\*\*\*\*

Provide labeling in accordance with TIA/EIA-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/EIA-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/EIA-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.

### 3.4 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-568-2], [TIA-568-C.3]. 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-568-2, [TIA-568-C.3], [ and ][TIA-570 for residential cabling]. Visually confirm [Category 5e,][ and ][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 not 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 5e link tests in accordance with TIA-568-C.1 and TIA-568-2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay and delay skew.]
- [b. Perform Category 6 link tests in accordance with TIA-568-C.1 and TIA-568-2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.]
- [c. 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 --