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DEPARTMENT OF THE ARMY AR-27 10 00.00 48 (April 2020)  
U.S. ARMY CORPS OF ENGINEERS -----  
Preparing Activity: LRL USACE

ARMY RESERVE GUIDE SPECIFICATIONS

SECTION 27 10 00.00 48

BUILDING TELECOMMUNICATIONS CABLING SYSTEM  
04/20

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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 directed to the mailbox [SpecsIntact@usace.army.mil](mailto:SpecsIntact@usace.army.mil).

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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 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.

ARMY RESERVE NETWORK ENTERPRISE CENTER (ARNEC)

ARNEC Army Reserve Network Enterprise  
Center Infrastructure Technical Criteria

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

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

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 MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66 (2013) Performance Standard for Category 6  
and Category 7 100 Ohm Shielded and  
Unshielded Twisted Pairs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA  
17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA  
17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA  
17-11; TIA 17-12; TIA 17-13; TIA 17-14;  
TIA 17-15; TIA 17-16; TIA 17-17) National  
Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-21 (1988a; R 2012) FOTP-21 - Mating  
Durability of Fiber Optic Interconnecting  
Devices

TIA-455-46A (1990) FOTP-46 Spectral Attenuation  
Measurement for Long-Length, Graded-Index  
Optical Fibers

TIA-455-78-B (2002) FOTP-78 Optical Fibres - Part  
1-40: Measurement Methods and Test  
Procedures - Attenuation

TIA-526-7 OFSTP-7 Measurement of Optical Power Loss  
of Installed Single-Mode Fiber Cable Plant

TIA-526-14 OFSTP-14A Optical Power Loss Measurements  
of Installed Multimode Fiber Cable Plant

TIA-568.0 Generic Telecommunications Cabling for

Customer Premises

TIA-568.1	(Commercial Building Telecommunications Cabling Standard
TIA-568.2	Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568.3	Optical Fiber Cabling Components Standard
TIA-568.4	Broadband Coaxial Cabling and Components Standard
TIA-569	Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-598	Optical Fiber Cable Color Coding
TIA-606	Administration Standard for the Telecommunications Infrastructure
TIA-607	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA/EIA-455	(1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
TIA/EIA-604-3	(2004b; R 2014) Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-580-01	Telecommunications Interior Infrastructure Planning and Design
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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 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 Nov 2018) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

- 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 Sep 2016) UL Standard for Safety Communication Circuit Accessories

1.2 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00.00 06 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 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.

The "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29.00 06 SUSTAINABILITY REPORTING. Locate the "S" submittal under the SD number that best describes the submittal item.

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USARC G-6 is to be provided submittals under this section to review. USARC G6 has no contractual authority over the contract, and this must be annotated in the Engineering Considerations and Instruction to Field Personnel (ECIFP). Adding them

as a reviewer directly in the contract could  
potential create a condition where USARC G6 could  
obligate the Government.

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Government approval is required for submittals with a "G" designation;  
submittals not having a "G" designation are for information only. Submit  
the following in accordance with Section 01 33 00.00 06 SUBMITTAL  
PROCEDURES:

SD-02 Shop Drawings

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

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

SD-03 Product Data

Submit manufacturer's name, trade name, place of manufacture, and  
catalog model or number. Include performance and characteristic  
curves; applicable federal, military, industry, and technical  
society publication references. Should manufacturer's data require  
supplemental information for clarification, submit the  
supplemental information as specified in paragraph "Regulatory  
Requirements." All product submissions must have the exact product  
that is intended to be used specifically highlighted or called out.

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

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

Telecommunications Outlet/Connector Assemblies; G[, [\_\_\_\_\_]]

Equipment Support Frame; G[, [\_\_\_\_\_]]

Cable Support; G[, [\_\_\_\_\_]]

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

Grounding and Bonding Products; G[, [\_\_\_\_\_]]

T5 Drawings; G[, [\_\_\_\_\_]]

SD-06 Test Reports

Telecommunications Cabling Testing; G[, [\_\_\_\_\_]]

SD-07 Certificates

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

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

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

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

Certificate; G[, [\_\_\_\_\_]]

### 1.3 GENERAL DESIGN REQUIREMENTS

Telecommunication products, product quality, and product execution in accordance with ARNEC and UFC 3-580-01. If a difference arises between these specification or the drawings, or both, then adherence to these criteria documents will take precedence for such products.

### 1.4 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification are as defined in the ARNEC, TIA-568.0, TIA-568.1 TIA-568.2 TIA-568.3 TIA-568.4 TIA-569, TIA-606, TIA-607 and as stated.

#### 1.4.1 Entrance Facility (EF) (Telecommunications)

An environmentally controlled centralized space that serves as an entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall.

#### 1.4.2 Telecommunications Equipment Room (TER) (Telecommunications Equipment Room)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. The space will also house all backbone cable terminations that serve all other telecommunications spaces on an Army Reserve site. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity. The room is the recognized cross-connect between the backbone cable and the horizontal cabling for the area served.

#### 1.4.3 Telecommunications Room (TR)

An environmentally controlled 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 for the area served.

#### 1.4.4 Main Telecommunications Room (MTR)

An environmentally controlled space for housing telecommunications equipment, cable, terminations, and cross-connects. This room will be utilized when a new building or buildings with more than one TR within the new building(s) is being constructed on an existing site where the site already has an existing TER in an existing building. This room will serve as space where all backbone cable from other TRs within the building will terminate. This will also be the room where outside plant conduit will terminate. The room is the recognized cross-connect between the backbone cable and the horizontal cabling for the area served.

#### 1.4.5 Telecommunications Enclosure(TE)

An environmentally controlled space for housing telecommunications equipment, cable, terminations, and cross-connects. This is a non-dedicated telecommunications space. This enclosure will only be utilized when there is no available opportunity to build out a dedicated telecommunications room. A lockable floor or wall mounted telecommunications cabinet will be required in the room and will house all of the telecommunications terminations and network equipment. The

enclosure is the recognized cross-connect between the backbone cable and the horizontal cabling for the area served.

#### 1.4.6 Open Cable

Cabling that is not run in a raceway as defined by [NFPA 70](#), [ARNEC](#). 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.

#### 1.4.7 Open Office

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

#### 1.4.8 Pathway

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

### 1.5 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system to 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. Wire the horizontal system in a star topology from the telecommunications outlets in the serving area to TER/TR that is serving that area. All intra-building backbone cable shall connect from the TRs within the building to the TER the center or hub of the star. For projects where a new building or buildings are being built on an existing site with an existing TER in an existing building, the main TR of the new building(s) shall serve as the center of the star for that building. The main TR of the new building shall have new backbone cable that connects to the site's existing TER. The backbone cabling and pathway system includes intra-building and inter-building interconnecting cabling, pathway, and terminal hardware. The intra-building and inter-building backbone provides connectivity from all TRs on an Army Reserve site to the TER as required. Wire the backbone system in a star topology with the TER for the site at the center or hub of the star. Provide telecommunications pathway systems referenced as stated.

### 1.6 QUALITY ASSURANCE

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items to be shown to ensure a coordinated installation. Wiring diagrams to identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings to indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include the nameplate data, size, and capacity; and all applicable federal, military, industry, and technical society publication references.

#### 1.6.1 Telecommunications

Provide drawings in accordance with [ARNEC](#) and [TIA-606](#). Show the identifier

for each termination and cable; depict final telecommunications installed wiring system infrastructure in accordance with TIA-606. Provide details required to prove that the distribution system will properly support connectivity from the EF and TER telecommunications, TRs, TEs, to the telecommunications work area outlets. Submit the following 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. Detailed drawings of symbols and typical such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.
- d. Where this design conflicts with the Contract Drawings, request clarification and direction from the Contracting Officer prior to proceeding.

#### 1.6.2 Telecommunications Space

Provide T3 drawings in accordance with ARNEC and TIA-606 that includes telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. 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. 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. Where this design conflicts with the Contract Drawings, request clarification and direction from the Contracting Officer prior to proceeding.

#### 1.6.3 Telecommunications Qualifications

Perform work by the approved telecommunications contractor and key personnel. A minimum of 30 days prior to installation, submit qualifications for the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer) and key personnel.

##### 1.6.3.1 Telecommunications Contractor

Provide 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 to demonstrate experience in providing successful

telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of 3 and a maximum of 5 successful telecommunication system installations for the telecommunications contractor.

#### 1.6.3.2 Key Personnel Qualifications

Provide professional personnel 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 proposed depending upon how many of the key roles each has successfully provided. Each of the key personnel to 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 to be in accordance with qualified in accordance with [ARNEC](#). Submit documentation of current BICSI certification for each of the key personnel.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work by the date of Award of Contract. Only the key personnel approved will work on the telecommunications system. Any substitutions for the telecommunications contractor's key personnel requires approval from the Contracting Officer.

#### 1.6.3.3 Manufacturer Qualifications

Cabling, equipment, and hardware manufacturers to have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components in accordance with [TIA-568.0](#), [TIA-568.1](#) [TIA-568.2](#) [TIA-568.3](#) [TIA-568.4](#).

#### 1.6.4 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 calendar days prior to the proposed test date. Include procedures for certification, validation, and testing. Test plan in accordance with [ARNEC](#).

#### 1.6.5 Regulatory Requirements

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 in accordance with [NFPA 70](#), unless more stringent requirements are specified or indicated.

#### 1.6.6 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 to have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period to include applications of equipment and materials under similar circumstances and of similar size. The product to have been 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 to be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless otherwise specified.

#### 1.6.6.1 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.

#### 1.6.6.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site are prohibited for use.

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

### 1.9 WARRANTY

The equipment items to 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. Submit warranty information in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS.

### 1.10 MAINTENANCE

#### 1.10.1 Record Documentation

Submit T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings to 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. Provide the following T5 drawing documentation as a minimum:

- a. Cables - Provide a record of installed cable in accordance with TIA-606. The cable records to include only the required data fields 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 in accordance with TIA-606. Documentation to include the required data fields as a minimum in accordance with TIA-606.

## PART 2 PRODUCTS

### 2.1 COMPONENTS

Cabling and interconnecting hardware and components for telecommunications systems to be UL listed or third party independent testing laboratory certified, and in accordance with [NFPA 70](#) and requirements as specified. 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 to 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.

### 2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with [ARNEC](#), [UFC 3-580-01](#), and [TIA-569](#). Provide system furniture pathways in accordance with [UL 1286](#).

### 2.3 TELECOMMUNICATIONS CABLING

Provide UL listed cable for the application in accordance with [TIA-568.0](#), [TIA-568.1](#) [TIA-568.2](#) [TIA-568.3](#) [TIA-568.4](#) and [NFPA 70](#). Provide a labeling system for cabling in accordance with [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.

Cabling manufactured more than 12 months prior to date of installation is prohibited for use.

#### 2.3.1 Backbone Cabling

##### 2.3.1.1 Backbone Copper

Provide solid conductor, 24 AWG, 100 ohm, Category 3, UTP, in accordance with [ICEA S-90-661](#), [TIA-568.2](#), and [UL 444](#) formed into 25 pair binder groups covered with a thermoplastic jacket. Cable to 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 is permitted in accordance with [NFPA 70](#). Cables installed in conduit within and under slabs to be UL listed and labeled for wet locations in accordance with [NFPA 70](#).

##### 2.3.1.2 Backbone Optical Fiber

Provide in accordance with [ICEA S-83-596](#), [TIA-568.3](#), [UL 1666](#), and [NFPA 70](#). Cable to be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches.

Provide the number of strands indicated of single-mode (OS2), tight buffered fiber optic cable.

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 to be permitted in accordance with NFPA 70. The cable cordage jacket, fiber, unit, and group color to be in accordance with TIA-598. Cables installed in conduit within and under slabs to be UL listed and labeled for wet locations in accordance with NFPA 70.

### 2.3.2 Horizontal Cabling and Copper

Provide horizontal cable in accordance with NFPA 70 and performance characteristics in accordance with TIA-568.0, TIA-568.1 TIA-568.2.

Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568.2, UL 444, ANSI/NEMA WC 66, and ICEA S-90-661. Provide 4 each individually twisted pair, minimum size 24 AWG conductors, Category 6a, with a thermoplastic jacket for each connector (8P8C). Category 6a cable selected must have an outside diameter no larger than .29 inches. Cable to 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. Cables installed in conduit within and under slabs to be UL listed and labeled for wet locations in accordance with NFPA 70.

## 2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility and telecommunication equipment room(s) to facilitate installation as shown 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 3/4 inch thick. Backboards to be fire rated by manufacturing process. The wood facing out to be fire stamped and clearly visible. Paint each sheet of plywood with fire-retardant paint. Paint color of plywood to match the paint color of the wall the plywood is being installed onto. Provide backboards on a minimum of two adjacent walls in the telecommunication spaces.

### 2.4.2 Equipment Support Frame

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

- a. 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. Rack to be compatible with 19 inch panel mounting.
- b. Cabinets, wall or floor mounted modular type, 16 gauge steel or 11 gauge aluminum construction, minimum, treated to resist corrosion.

Cabinet to have lockable hinged cover, ground lug, and top and bottom cable access.

#### 2.4.3 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Category 3 copper backbone systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 10 percent spare.

#### 2.4.4 Cable Support

Provide cable support specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inch equipment racks and telecommunications backboards. Cable guides or rings or bracket type devices backboard for horizontal cable management and individually mounted for vertical cable management. Mount ladder style cable tray for vertical cable management on telecommunication backboards. 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 10 percent spare. Provide fiber optic patch panel for maintenance and cross-connecting of optical fiber cables. Panel to be constructed of 16 gauge steel or 11 gauge aluminum minimum and be rack or wall mounted in accordance with design and ARNEC requirements and in accordance with ECIA EIA/ECA 310-E 19 inch equipment rack. Each panel to provide a minimum of 12 duplex single-mode adapters as SC in accordance with TIA/EIA-604-3 with zirconia ceramic alignment sleeves. Provide dust cover for unused adapters. The rear of each panel to have a cable management tray a minimum of 8 inches deep with removable cover, incoming cable strain-relief and routing guides. Panels to have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter.

### 2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

#### 2.5.1 Outlet or Connector Copper

Outlet or connectors in accordance with FCC Part 68 and TIA-568.0, TIA-568.1, TIA-568.2. UTP outlet or connectors in accordance with UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and be third party verified in accordance with TIA-568.0, TIA-568.1, TIA-568.2 Category 6a requirements. Outlet or connectors provided for UTP cabling to meet or exceed the requirements for the cable provided. Outlet or connectors to be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet or connector to be wired T568B. UTP outlet or connectors in accordance with TIA-568.0, TIA-568.1, TIA-568.2 for 200 mating cycles. Install outlet faceplates and or outlet assemblies in systems furniture.

#### 2.5.2 Optical Fiber Adapters (Couplers)

Provide optical fiber adapters suitable for duplex SC in accordance with TIA/EIA-604-3 with zirconia ceramic alignment sleeves. Provide dust cover for adapters. Optical fiber adapters in accordance with TIA-455-21 for 500 mating cycles.

### 2.5.3 Optical Fiber Connectors

Provide in accordance with ARNEC, UFC 3-580-01, TIA-455-21, TIA-568.3. Optical fiber connectors to be duplex SC in accordance with TIA/EIA-604-3 with zirconia ceramic alignment sleeves compatible with 8/125 single-mode fiber. The connectors to provide a maximum attenuation of 0.3 dB at 1300nm with less than a 0.2 dB change after 500 mating cycles. All FOC splices shall be fusion type to factory produced pigtail connectors. The use of angled polish connectors (APC) is not allowed.

### 2.5.4 Cover Plates

Provide in accordance with UL 514C and TIA-568.0, TIA-568.1; flush or oversized design constructed of high impact thermoplastic material to match color of receptacle/switch cover plates in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide labeling in accordance with paragraph "LABELING."

### 2.6 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA-607, NFPA 70, and ARNEC. Identify components in accordance with TIA-606.

### 2.7 FACTORY REEL TESTS

Provide documentation of the testing and verification actions taken by manufacturer in accordance with TIA-568.2 and TIA-526-7 for single mode optical fiber cables.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet or connector assemblies, and associated hardware in accordance with TIA-568.0, TIA-568.1, TIA-568.2, TIA-568.3, TIA-568.4, TIA-569 NFPA 70, ARNEC, UFC 3-580-01 and UL standards as applicable. Provide cabling in a star topology network. Install outlet boxes in accordance with 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 not to exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Run cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

Install cables required in workstation (cubicle) panel bases and conference room tables as indicated. Installation in workstation panel bases to include termination with appropriate outlets and outlet face plates.

Installation to be scheduled and coordinated with the furnishings contractor, through the Contracting Officer, to take place at the time workstation panels are erected and before workstation components are installed which could prohibit access to the panel bases. Quantity and location of telecommunications outlets in the workstation bases are as shown. There will be 2 meetings required prior to installation. The first meeting will be a coordination and clarification meeting with the

Contracting Officer and a US Army Corps of Engineers (USACE) project engineer prior to the Bid Opening Date. The second meeting will be held during the furniture installation kick-off meeting to include the representatives of the Contractor, the furniture installer, and the Contracting Officer.

### 3.1.1 Cabling

Install UTP and optical fiber telecommunications cabling system in accordance with [TIA-568.0](#), [TIA-568.1](#), [TIA-568.2](#), [TIA-568.3](#), [ARNEC](#), and [UFC 3-580-01](#). Screw terminals are prohibited for use except where specifically indicated. 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 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 not to be less than 4 times the cable diameter. Terminate cables; no cable to contain unterminated elements. Cables not to be spliced. Label cabling in accordance with paragraph "LABELING."

#### 3.1.1.1 Open Cable

Use only where specifically indicated for use in cable trays, or below raised floors. Install in accordance with [TIA-568.1](#), [UFC 3-580-01](#) and [ARNEC](#). Do not exceed cable pull tensions recommended by the manufacturer. Copper cable not in a wireway or pathway to be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Do not run cable through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors to be avoided, if possible; maintain a minimum separation of 12 inches to be maintained when such placement cannot be avoided.

Use plenum cable where open cables are routed through plenum areas.

#### 3.1.1.2 Backbone Cable

- a. Copper Backbone Cable. Install intra-building backbone copper cable, in indicated pathways, between the termination blocks in the TER and the termination blocks in the TR(s) and TE(s).
- b. Optical fiber Backbone Cable. Install intra-building backbone optical fiber in indicated pathways. Prepare cable for pulling by cutting outer jacket 10 inches leaving strength members exposed for approximately 10 inches. Twist strength members together and attach to pulling eye. Vertical cable support intervals in accordance with manufacturer's recommendations.

#### 3.1.1.3 Horizontal Cabling

Install horizontal cabling as indicated. Do not untwist Category 6a UTP cables more than more than what is allowed per [TIA-568.0](#), [TIA-568.1](#) and [TIA-568.2](#) from the point of termination to maintain cable geometry. Provide slack cable in accordance with [ARNEC](#).

### 3.1.2 Pathway Installations

Provide in accordance with [TIA-569](#), [NFPA 70](#), [ARNEC](#), [UFC 3-580-01](#) and

specifications 27 05 28.36 48. Provide building pathway as specified.

### 3.1.3 Work Area Outlets

#### 3.1.3.1 Terminations

Terminate UTP cable in accordance with ARNEC, UFC 3-580-01, TIA-568.0, TIA-568.1 and TIA-568.2 and wiring configuration as specified.

#### 3.1.3.2 Cover Plates

As a minimum, each outlet or connector to be labeled in accordance with ARNEC, and TIA-606.

#### 3.1.3.3 Pull Cords

Install pull cords in conduit serving telecommunications outlets that do not have cable installed.

### 3.1.4 Telecommunications Space Termination

Install termination hardware required for UTP and optical fiber system. Use an insulation displacement tool for terminating copper cable to insulation displacement connectors.

#### 3.1.4.1 Connector Blocks

Rack or wall mount installation as indicated in orderly rows and columns. Provide adequate vertical and horizontal wire routing areas between groups of blocks. Install in accordance with TIA-568.0, TIA-568.1, TIA-568.2, ARNEC, and UFC 3-580-01.

#### 3.1.4.2 Patch Panels

Mount in equipment racks with sufficient ports to accommodate the installed cable plant plus 10 percent spares.

- a. Copper Patch Panel. Secure copper cable entering a patch panel to the panel using manufacturer's cable strain relief bars. Install in accordance with TIA-568.0, TIA-568.1, TIA-568.2, ARNEC, UFC 3-580-01.
- b. Fiber Optic Patch Panel. Fiber optic cable loop to be 3 feet in length. Secure the outer jacket of each cable entering a patch panel to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

#### 3.1.4.3 Equipment Support Frames

Install in accordance with ARNEC, UFC 3-580-01, and TIA-569.

- a. Racks, and cabinet floor mounted modular type. Permanently anchor rack to the floor.
- b. Cabinets, wall-mounted modular type. Mount cabinet at a height of the highest panel not to exceed 78 inches above floor.

### 3.1.5 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated

wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

### 3.1.6 Grounding and Bonding

Provide in accordance with ARNEC, UFC 3-580-01, TIA-607, and NFPA 70. All Telecommunications bonding to originate at the PBB and be distributed to the SBBs.

#### 3.1.6.1 Telecommunications Bonding Backbone (TBB)

Telecommunication Bonding Backbone (TBB) is required between the primary bonding bus-bar (PBB) and all secondary bonding bus-bars (SBBs). A TBB is not required for installation with only a single PBB.

Provide a copper conductor TBB in accordance with TIA-607, and NFPA 70. Provide insulated TBB, UL listed with the fire ratings of the pathway.

#### 3.1.6.2 Telecommunications Bonding Conductor

Provide a copper Telecommunications Bonding Conductor (TBC) between the primary bonding bus-bar (PBB) and the electrical service ground in accordance with TIA-607. Size the Telecommunications Bonding Conductor (TBC) so that it is no smaller than the Telecommunications Bonding Backbone (TBB).

### 3.2 LABELING

#### 3.2.1 Labels

Provide labeling in accordance with ARNEC and TIA-606. Handwritten labeling is prohibited.

#### 3.2.2 Cable

Label on both ends with identifiers in accordance with ARNEC, and TIA-606.

#### 3.2.3 Telecommunications and Signal System Pathway

Install in accordance with ARNEC and TIA-569.

- a. Horizontal Pathway: Install telecommunications pathways from the work area to the telecommunications room and cabling length requirements in accordance with ARNEC, TIA-568.0 AND TIA-568.1. Size of conduits and cable trays in accordance with ARNEC, TIA-569, and as indicated.
- b. Backbone Pathway: Install telecommunication pathways from the telecommunications entrance facility to telecommunications rooms, and, telecommunications equipment rooms (backbone cabling) in accordance with ARNEC and TIA-569. Size of conduits, and cable trays for telecommunications risers in accordance with ARNEC, TIA-569, and as indicated.
- c. Place pull boxes in conduit runs where continuous conduit length exceeds 100 feet or where more than two 90-degree bends occurs. Place pull boxes in straight runs and not to be used in lieu of a bend.

### 3.2.4 Termination Hardware

Label workstation outlets and patch panel connections with identifiers in accordance with ARNEC and TIA-606.

## 3.3 TESTING

### 3.3.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with ARNEC, TIA-568.0, TIA-568.2, TIA-568.3 and TIA-568.4. 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.

#### 3.3.1.1 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-568.0, TIA-568.2 and TIA-568.3. Visually confirm Category 6a, marking of outlets, cover plates, outlet or connectors, and patch panels.

#### 3.3.1.2 Performance/Acceptance Tests

Perform acceptance testing of all installed cabling in accordance with ARNEC, UFC 3-580-01, TIA-568.0, TIA-568.2, TIA-568.3 and TIA-568.4 and as specified. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing to be given to the Contracting Officer at least 14 days prior to any test unless specified otherwise. Testing not to proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans to define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans to define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans to identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements to be tabulated on a pair by pair or strand by strand basis.

##### 3.3.1.2.1 Horizontal Cable Tests

Perform Category 6a link tests in accordance with ARNEC, TIA-568.0 and TIA-568.2. Tests to include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.

##### 3.3.1.2.2 Backbone Copper Cable Tests

Perform the following acceptance tests in accordance with TIA-568.0 and TIA-568.0:

- a. Wire map (pin to pin continuity);
- b. Continuity to remote end;

- c. Crossed pairs;
- d. Reversed pairs;
- e. Split pairs;
- f. Shorts between two or more conductors

#### 3.3.1.2.3 Fiber Optic Cable Cable Tests

Test fiber optic cable in accordance with [ARNEC](#), [TIA-568.0](#), [TIA-568.3](#), [TIA-526-7](#), [TIA/EIA-455](#), and as specified. Perform 2 optical tests on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test and Attenuation Test. In addition, perform a width test on all multimode optical fibers. These tests to be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable.

- a. OTDR Test: Used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. A reference length of fiber, 150 feet minimum, used as the delay line to be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with [TIA-526-7](#) for single-mode fiber and [TIA-526-14](#) for multimode fiber. Splice losses not to exceed 0.3 db.
- b. Attenuation Test: End-to-end attenuation measurements to be made on all fibers, in both directions, using an 850 and 1300 (multimode fiber) or 1310 and 1550 (single-mode) nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with [TIA-455-46A](#) for multimode and [TIA-526-7](#) for single-mode fiber optic cables. The measurement method in accordance with [TIA-455-78-B](#). Attenuation losses not to exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber. Attenuation losses not to exceed 5.0 db/km at 850 nm and 1.5 db/km at 1300 nm for multimode fiber.

#### 3.3.1.3 Earth to Ground Tests

Perform Earth to Ground tests in accordance with [ARNEC](#).

-- End of Section --