
USACE / NAVFAC / AFCEC UFGS-27 10 00 (May 2025)

Preparing Activity: NAVFAC Superseding
UFGS-27 10 00 (August 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2026

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SECTION 27 10 00

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03/26

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SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM 03/26

NOTE: This guide specification covers requirements for building telecommunications cabling systems using a physical hierarchical star or hierarchical star with redundancy levels 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 and service outlets; pathways; and distribution terminals. This specification covers telecommunication cabling systems supporting customer's voice, data, video, audio, security, digital imaging, facility related control system distribution, and environmental control for transporting information throughout modern buildings using twisted pair and optical fiber cables.

Coordinate telecommunications requirements with electrical, grounding, security, fire alarm, and HVAC requirements. Coordinate all requirements with the proponent Technical Authority.

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 a 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 \(CCR\)](#).

NOTE: The designer must provide TIA-606 compliant T-Drawings 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.

The design package is to include but is not limited to the following drawings:

T0 Site drawings, T1 Interior Drawings showing all ICT elements on floor plans, T2 Drawings showing serving zones and pathways, T3 Drawings for all telecommunication spaces, T4 Drawings for details including labeling scheme and cabinet elevations, T5 Drawings showing schedules for cable plant including cutovers, and T6 Drawings including network diagrams, riser diagrams, and boundary diagrams in accordance with ANSI/TIA 606.

NOTE: UFC 3-580-01, "Information and Communications Technology Infrastructure Planning and Design," provides requirements for interior and outside plant (OSP) telecommunications cabling systems for DoD.

PART 1 GENERAL

1.1 REFERENCES

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.

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. Use the most current version at the time of contract award.

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2017) Standard Specification for Laminated Thermosetting Materials

BICSI International Standards Program (BICSI)

ANSI/BICSI N1 (2019) Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure

ANSI/BICSI N3 (2020) Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure

BICSI TDMM (2024; 15th Edition) Telecommunications Distribution Methods Manual

ANSI/BICSI 008 (2024) Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices

BICSI ITISMM (2025) Information Technology Systems Installation Methods Manual (8th Edition)

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

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

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA 61196-1-100 (2022) Coaxial Communications Cables-Part 1-100:Electrical test methods General Requirements

ICEA S-83-596 (2021) Indoor Optical Cable

ICEA S-90-661 (2021) Category 3 and 5E Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in General Purpose and LAN Communications Wiring Systems

UNITED FACILITIES GUIDE SPECIFICATIONS

26 05 48 (2023) Seismic Protection for Electrical Equipment

26 20 00 (2025) Interior Distribution System

27 05 26 (2025) Grounding and Bonding for Communication Systems

27 05 29.00 10 (2025) Protected Distribution System (PDS) for SIPRNET Communication Systems

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO/IEC 11801 (2017) Information technology - Part 1-General Requirements-Generic cabling for customer premises

ISO/IEC 14763-2 (2019) Information technology - Part 1 -Implementation and operation of customer premises cabling

ISO/IEC 14763-3 (2024) Information technology - Implementation and operation of customer premises cabling; Part 3: Testing of optical fiber cabling

INTERNATIONAL TELECOMMUNICATION UNION (ITU)

ITU-T G.652 (2024) Characteristics of a single-mode optical fiber and cable

ITU-T G.655 (2009) Characteristics of a non-zero dispersion-shifted single-mode optical fiber and cable

ITU-T G.657 (2024) Characteristics of a bending-loss insensitive single-mode optical fiber and cable

ITU-T G.984.1 (2012) Gigabit-capable passive optical networks (GPON): General characteristics

ITU-T G.987.1 (2016; 2020 Corrigendum 1) 10-Gigabit-capable passive optical networks (XG-PON): General requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66 (2024) Standard for Category 6 and 6A, 100 Ohm, Individually Unshielded Twisted Pairs, Indoor Cables (With Or Without An Overall Shield) for Use in LAN Communication Wiring Systems

NEMA BI-50026/VE 2	(2024) Cable Tray Installation Guidelines
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(2026; TIA 26-1; ERTA 26-1; TIA 26-2; TIA 26-3; TIA 26-4; TIA 26-5; TIA 26-6; TIA 26-7; ERTA 26-2; ERTA 26-3) National Electrical Code
TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)	
ANSI/TIA-526-7	(2015a; R 2022) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures - Part 4-2: Installed Cable Plant - Single-Mode Attenuation and Optical Return Loss Measurement
ANSI/TIA-526-14	(2023d) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
ANSI/TIA-568 Series	(2023) Building Telecommunications Cabling Standards, includes ANSI/TIA-568.0 (2020e), ANSI/TIA-568.1 (2024e), ANSI/TIA-568.2 (2024e), ANSI/TIA-568.3 (2022e), ANSI/TIA-568.4 (2022), ANSI/TIA-568.5 (2022)
ANSI/TIA-568.1	(2020e) Commercial Building Telecommunications Infrastructure Standard
ANSI/TIA-568.2	(2024e) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
ANSI/TIA-568.3	(2022e) Optical Fiber Cabling Components Standard
ANSI/TIA-568.4	(2022e) Broadband Coaxial Cabling and Components Standard
ANSI/TIA-568.5	(2022; 2024 Am 1) Balanced Single Twisted-pair Telecommunications Cabling and Components Standard
ANSI/TIA-569	(2019e; Add 1 2022) Telecommunications Pathways and Spaces
ANSI/TIA-606	(2021d) Administration Standard for Telecommunications Infrastructure
ANSI/TIA-607	(2024e) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
ANSI/TIA-942	(2024) Telecommunications Infrastructure Standard for Data Centers

ANSI/TIA-1152	(2016; R 2021) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
TIA TSB-162	(2021) Telecommunications Cabling Guidelines for Wireless Access Points
TIA-455-21	(1988a; R 2012) FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices
ANSI/TIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding
TIA-604-2	(2004b; R 2014) FOCIS 2 Fiber Optic Connector Intermateability Standard
TIA-604-3	(2004b; R 2014) Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3
ANSI/TIA-604-10	(2021c) FOCIS 10 Fiber Optic Connector Intermateability Standard - Type LC
TIA/EIA-604-12	(2000) FOCIS 12 Fiber Optic Connector Intermateability Standard Type MT-RJ

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-580-01	(2024) Information and Communications Technology 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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UL SOLUTIONS (UL)

UL 50	(2024) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 444	(2023) UL Standard for Safety Communications Cables
UL 467	(2022) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2025) UL Standard for Safety Wire Connectors
UL 514C	(2014; Reprint Apr 2024) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 723	(2018; Reprint Jun 2025) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials

UL 969	(2025) UL Standard for Safety Marking and Labeling Systems
UL 1286	(2022; Reprint Mar 2024) UL Standard for Safety Office Furnishings
UL 1666	(2007; Reprint Sep 2021) UL Standard for Safety Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1863	(2004; Reprint Apr 2025) UL Standard for Safety Communication Circuit Accessories
UL 2043	(2023) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces

1.2 RELATED REQUIREMENTS

NOTE: Ensure that design provides for adequate telecommunications spaces using UFC 3-580-01 as a minimum requirement.

Network type, size and configuration must be coordinated with the technical manager. The horizontal and backbone structured cabling must support the Information Technology (IT) and Operational Technology (OT) requirements of the end user.

For Military Construction projects the proponent property (non-permanent) items are procured from a distinct funding source separate from MILCON money and may or may not be included in a MILCON project construction contract. The infrastructure that supports those items is real property and is to be included in the design. The ICT designer must verify the items that are being procured outside of the MILCON project construction contract and must document these items in writing.

Select bracketed Section 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP), and Section 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS] apply to this section with additions and modifications specified herein. Building telecommunications infrastructure and cabling shall be installed in accordance with UFC 3-580-01 and NECA/BICSI 568-2006, Standard for Installing Commercial Building telecommunications Cabling. Workmanship shall conform to the practices described in the BICSI Information Transport System Installation Methods Manual (ITSIMM) and UFC 3-580-01.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in [ANSI/TIA-568.1](#), [ANSI/TIA-568.2](#), [ANSI/TIA-568.3](#), [ANSI/TIA-569](#), [ANSI/TIA-606](#), Federal Communications Commission (FCC), [BICSI TDMM](#), [IEEE 100](#), UFC 3-580-01, ANSI/TIA-607 and herein.

1.3.1 Distributor C / Campus Distributor (CD)

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

1.3.2 Distributor B / 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 Distributor A / 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)

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

1.3.6 Equipment Room (ER)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity. It is not necessary for the TR or ER to be positively charged relative to air flow unless it is adjacent to an outside space, storage, warehouse, or an unconditioned space such as a mechanical room.

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.

1.3.10 Telecommunications Cable

All copper and fiber cables utilized for the application of transmitting data on a network. Supports all equipment outlets whether indicated as work areas, service, or equipment type.

1.3.11 Activity Specific Telecommunications Manager/Authority

Throughout this document, the term "telecommunications manager" or "technical authority" refers to the following:

For Army, the Network Enterprise Center (NEC)

For Navy, the Base Communications Officer (BCO)

For Marine Corps, the Installation Communications G6

For Air Force, the Base/Installation

Communications Squadron, Commander's

Representative.

1.4 SYSTEM DESCRIPTION

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

Provide telecommunications pathway systems referenced herein and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. The telecommunications contractor shall coordinate with Joint Base Lewis McChord (JBLM) personnel (such as COE, DPW, JBLM NEC, YTC NEC, and 627CS) concerning access to and configuration of telecommunications spaces. JBLM NEC controls access to telecommunications spaces on JBLM (Lewis). YTC NEC controls access to telecommunications spaces at YTC. The 627CS controls access to telecommunications spaces on JBLM (McChord). The building telecommunications cabling, and pathway system must include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications and service outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport the Information Technology (IT) and Operational Technology (OT) (including LAN) between equipment items in a building. The horizontal system must 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 must be wired in a star topology with the campus distributor at the center or hub of the star. The interbuilding backbone system provides connectivity between the campus distributors and is specified in Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

1.5 SUBMITTALS

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

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

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

Government approval is required for submittals with a "G" or "S" classification. The JBLM NEC project team shall perform a technical review of all telecommunications submittals and requests for information (RFI) for each project and provide review comments to the Government project team. Prior to the government's approval of telecommunications cable cut-over plan submittal, the government project team shall have the JBLM NEC project team's technical review comments and approval. This is necessary because of the coordination required for outside agency approval processes and scheduling of service interruptions to minimize the impact on the services JBLM NEC provides to its customers. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submittals must include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals must also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information must be submitted as specified in paragraph REGULATORY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

T1-T6 Telecommunications Drawings; G, [_____]

SD-03 Product Data

Telecommunications Cabling (Backbone and Horizontal); G, [_____]

Cable Trays; G, [_____]

Non-continuous Cable Supports; G, [_____]

Patch Panels; G, [_____]

Telecommunications Outlet/Connector Assemblies; G, [_____]

Equipment Support Frames; G, [_____]

Connector Blocks; G, [_____]

Multi-User Telecommunications Outlet Assembly; G, [_____]

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

Spare Parts; G, [_____]

Floor Outlet And Poke-Thru Boxes; G

Plywood Backboards; G

Consolidation Point; G

SD-05 Design Data

Fiber Link Loss Budget; G, [_____]

SD-06 Test Reports

Telecommunications Cabling Testing; G, [NEC_]

SD-07 Certificates

Telecommunications Contractor Qualifications; G, [_____]

Key Personnel Qualifications; G, [_____]

Manufacturer Qualifications; G, [_____]

Test Plan; G, [NEC_]

SD-09 Manufacturer's Field Reports

Factory Reel Tests; G, [_____]

SD-10 Operation and Maintenance Data

Telecommunications Cabling and Pathway System Data Package 5; G, [_____]

SD-11 Closeout Submittals

Record Documentation; G, [_____]

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings must be in electronic format, both native and PDF and be a minimum of 279 by 432 mm 11 by 17 in in size using a minimum scale of 1 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 must identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings must indicate required clearance for operation, maintenance, and replacement of operating equipment devices. Submittals must include the nameplate data, size, and capacity. Submittals must also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 T1-T6 Telecommunications Drawings

NOTE: Registered Communications Distribution Designer (RCDD) approved drawings for all projects.

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

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

Activity Specific Telecommunications Manager/Authority:

Throughout this document, the term "telecommunications manager" or "technical authority" refers to the following:

- For Army, the Network Enterprise Center (NEC)
- For Navy, the Base Communications Officer (BCO)
- For Marine Corps, Installation Communications G6
- For Air Force, the Base/Installation Communications Squadron, Commander's Representative.

It is expected, per UFC 3-580-01, that these drawings will be provided during design. UFC 3-580-01, Tables 2-1 and 2-2, list expected T-drawing submissions and when they are typically provided in the design process. When the project requires design after award, include the below requirements. All drawings must be required as-builts.

NOTE: There are six types of drawings in the TIA-606-A backward-compatible drawing scheme that apply to Information and Communications Technology (ICT) systems. They are: (T0, T1, T2, T3, T4, T5, and T6).

Provide Registered Communications Distribution Designer (RCDD) approved drawings in accordance with ANSI/TIA-606 and UFC 3-580-01. The identifier for each cabinet, rack, termination, and cable must appear on the drawings. Drawings must depict final telecommunications installed wiring system infrastructure in accordance with ANSI/TIA-606. The drawings should provide details required to prove that the distribution system will properly support connectivity from the EF telecommunications rooms and ER telecommunications rooms, Campus Distributor's (CD), Building Distributor's (BD), Floor Distributor's (FD), and 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 architectural wayfinding room number. Mount the laminated schematic in the EF telecommunications space as directed by the Contracting Officer.

The following drawings must be provided as a minimum:

- a. T1 - 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. T3 - Telecommunications Space Drawings in accordance with ANSI/TIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, ladder racks, and conduit), mechanical/electrical layout, and cabinet, rack, backboard, and wall elevations. Drawings must 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 must include a complete list of equipment and material, equipment rack details, to include conduit and cable tray fill data, 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 and T2 drawings.
- d. T4 - Typical Detail Drawings to include Faceplate Labeling, Firestopping Assemblies, Americans with Disabilities Act (ADA) requirements, etc. Detailed drawings of symbols and typical details such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways. Outlets must

be laid out in a logical manner, moving left to right starting from the telecommunications space served.

- e. T5 - Schedules to include schedules to show information for cutovers and cable plant management administrative details.
- f. T6 - Drawings to include network, riser, and boundary diagrams.

1.6.2 Telecommunications Qualifications

NOTE: BICSI Copper and Fiber Cabling Installer, Technician Level certification is preferred for supervisors and installers in lieu of documentation of 3 years' experience. Contractors have the option to submit either BICSI certification or experience documentation. Equivalent training and 3 years of verifiable experience in lieu of the certification may be adjudicated by the COR.

Work and equipment installation under this section must be performed by and provided by approved telecommunications contractor(s) and key personnel. Qualifications must be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer), the Building Industry Consulting Service, International (BICSI), Inc., Registered Communications Distribution Designer (RCDD), and the cable testing technicians. A minimum of 30 days prior to installation, submit documentation of the experience, and certifications, of the telecommunications contractor and all key personnel.

1.6.2.1 Telecommunications Contractor

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

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of providing implementation, 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 must demonstrate experience in providing successful telecommunications systems within the past 5 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the submitted key personnel. Supervisors, installers, and testers assigned to the installation of this system or any of its components must be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level for both copper and fiber. Submit documentation of current BICSI certification for each of the key personnel. In lieu of BICSI certification, supervisors and installers assigned to the installation and testing of this system or any of its components must have a minimum of 5 years' experience in the

installation of the specified copper and fiber optic cable and components and training that is deemed equivalent by the COR. These must include factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the products provided. Documentation for each key person must 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 the existing telecommunications system installations offered by the key persons as successful experience must 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. Note that only the key personnel identified in the approved submittals of the successful proposal, and approved by the Contracting Officer are permitted to do work on this solicitation's telecommunications system. Key personnel must 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 the resubmission of the qualifications and new approval from The Contracting Officers Representative (COR).

1.6.2.3 Minimum [Manufacturer Qualifications](#)

Cabling, equipment, and hardware manufacturers must have a minimum of 3 years' experience in the manufacturing, assembly, and factory testing of components which comply with [ANSI/TIA-568 Series](#).

1.6.3 [Test Plan](#)

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 60 days prior to the proposed test date. Include procedures for certification, validation, [fiber link loss budget](#) and testing. Provide calibration data for equipment and all appurtenances and accessories to be used including but not limited to launch cables. Provide test technician qualifications. A Registered Communications Distribution Designer (RCDD) shall review, stamp and approve both the test plan and test report (UFC 3-580-01).

1.6.4 Test Reports

Provide test reports, in native and PDF format, for each coax, copper and fiber cable installed. In addition to cable test data, each report must indicate the project name, date and time of test, personnel performing the test, software version of cable limits and equipment, and calibration dates of all equipment. Results must include equipment reference testing required when changing equipment locations, when reference cords are removed from equipment, and the start of new testing shifts. Cable ID's on each test result must match those provided in T4 approved submittals. A BICSI Registered Communications Distribution Designer (RCDD) shall review,

stamp and approve both the test plan and test report. Test reports shall be provided in accordance with UFC 3-580-01 and TIA-526-7.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" or "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 must be in accordance with the mandatory and advisory provisions of NFPA 70 and UFC 3-580-01 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 must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must 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 must 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.

1.6.6.1 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 must not be used, unless specified otherwise. Products must not be delivered to site earlier than 6 months prior to installation.

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. Visual inspection, for damage, of all material must be performed prior to installation.

1.8 ENVIRONMENTAL REQUIREMENTS

Telecommunication spaces must comply with UFC 3-580-01 paragraph 2-3.1.3.3 and as indicated in Division 23 specifications. Connecting hardware must 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 unless more stringent criteria are called out by the designer.

1.9 WARRANTY

The equipment items must 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 and as required in Section 01 78 00 CLOSEOUT SUBMITTALS.

1.10 SEISMIC REQUIREMENTS

**NOTE: Do not use this paragraph for Navy projects.
Edit Sections 13 48 73 SEISMIC CONTROL FOR
NONSTRUCTURAL COMPONENTS and 26 05 48 SEISMIC
PROTECTION FOR ELECTRICAL EQUIPMENT to suit the
project and include in the contract documents. Edit
the following paragraph and include it in the
project specification. When a government designer
is the Engineer of Record, provide seismic
requirements on the drawings.**

Provide seismic details conforming to Section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS and to Section 26 05 48 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT as indicated.

1.11 MAINTENANCE

1.11.1 Operation and Maintenance Manuals

Commercial off-the-shelf manuals must be furnished for operation, installation, configuration, and maintenance of products provided as a part of the Telecommunications Cabling and Pathway System, Data Package 5. Submit draft operations and maintenance data, drawings, and record documentation prior to the start of final acceptance testing and commissioning. Submit final operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

1.11.2 Record Documentation

NOTE: ANSI/TIA-606 describes the necessary data fields and reports for hard copy, spreadsheet, and electronic media as well as cable management software requirements. Check with activity technology manager 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 in the coordinated/approved/proper format.

Provide T5 drawings including documentation on cables and termination hardware in accordance with ANSI/TIA-606. T5 drawings must 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 must be provided in hard copy format and on electronic media using

Windows based computer cable management software. A licensed copy of the cable management software including documentation, must be provided. Provide the following T5 drawing documentation as a minimum:

- a. Cables - A record of installed cable must be provided in accordance with ANSI/TIA-606. The cable records must 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 ANSI/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 must be provided in accordance with ANSI/TIA-606. Documentation must include the required data fields as a minimum in accordance with ANSI/TIA-606.

1.11.3 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: Pathway requirements are included in UFC 3-580-01. Refer to paragraph TELECOMMUNICATIONS PATHWAYS in this section for open cable systems including cable tray. Refer to SECTION 26 20 00 INTERIOR DISTRIBUTION SYSTEM for conduit requirements. SECTION 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP) provides requirements for campus backbone cable systems.

For specialized circuits such as classified networks, coordination is required with the Technical Authority. Provide electrical and telephone outlets installed per the ADA to accommodate TTD's and other devices.

Components must be UL, or third party certified by a nationally recognized testing laboratory (NRTL). 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 must 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 for the intra building backbone and the horizontal cabling. When redundancy is required by the mission utilize appropriate level of redundancy to ensure reliability. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks.

Cabling and interconnecting hardware and components for telecommunications systems must be UL listed, or third-party independent testing laboratory certified and must comply with NFPA 70, ANSI/TIA-569, and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS SPACES

NOTE: For projects that do not include SECTION 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP) for termination of interbuilding cables, copy paragraph BUILDING PROTECTOR ASSEMBLIES and PROTECTOR MODULES from SECTION 33 82 00 and paste the paragraphs into this section as part of the telecommunications spaces. Include these for projects that include OT cabling to endpoint devices, non-person entities, that are outside of the NFPA 780 protection zone for the building and served by copper cabling. Provide protected entrance terminals (PET) in accordance with ANSI/TIA-758. Equip PETs with modules to protect the inside plant cabling and equipment from power surges. Furnish solid state or gas tube modules adequate for all used pairs plus 25 percent, but not to exceed the total pair count. Provide 110-type insulation displacement connector (IDC) terminal blocks or cable stubs. Provide 710-type connector for legacy only applications.

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

Cross-Connect Field Color Codes	
Color	Identifies
Orange	Demarcation point (e.g., central office terminations).
Green	Network connections (e.g., network and auxiliary equipment).
Purple	Common equipment, private branch exchange (PBX), local area network (LANs), multiplexers (e.g., switching and data equipment).
White	First-level backbone (e.g., CD (MC) to an FD (HC) or to a BD (IC)).
Gray	Second-level backbone (e.g., BD (IC) to an FD (HC)).
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[data center ANSI/TIA-942 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 ANSI/TIA-606 and as approved by the technical authority.

2.2.1 Plywood Backboards

Provide void-free fire-retardant treated A/C interior grade plywood. Plywood must comply with International Building Code, Section 2303.2; 19 mm 3/4 in thick [1200 by 2400 mm] 4 by 8 ft as indicated. Backboards must be fire rated by manufacturing process. Fire stamp must be clearly visible. Backboards shall not be painted. Backboards must be provided on all walls in the telecommunication spaces to support wall mounted equipment.

2.2.2 Equipment Support Frames

NOTE: Provide lockable cabinets in locations where additional security is required.

Provide adequate space in telecommunications spaces to facilitate tenant owned telecommunications system support equipment requirements. Coordinate with the Information Communications Technical Authority to determine the space and weight requirements for the USG-provided active equipment.

DoR must coordinate power requirements with Using Agency and tailor requirements accordingly.

Provide in accordance with ECIA EIA/ECA 310-E and UL 50, UFC 3-580-01, and seismically rated or braced in accordance with the ICC IBC.

- a. Bracket, wall mounted, 8-gauge aluminum. Provide hinged bracket compatible with [482.6 mm] 19 in panel mounting.
- b. Racks, wall floor mounted 2-post modular type, 42U 16-gauge steel construction, minimum, treated to resist corrosion. Provide rack with vertical and 6-inch-wide double-sided horizontal cable management and horizontal or 42U vertical ground bar. Provide 1 vertical surge protected Power Distribution Units (PDU) per rack with 42U, duplex 24 C13's and 18 flexible C39's, which accepts C14 and C20 plugs power receptacles. PDU must have indicator lights, but no integral on/off switch and be capable of monitoring. Rack must be compatible with [482.6 mm] 19 in panel mounting.
- c. Channel Racks, (Not used on JBLM)
- d. Racks, floor mounted 4-post, 16-gauge steel construction, minimum, treated to resist corrosion, seismically rated in accordance with the

ICC IBC, and painted black. Provide rack with vertical and 6-inch-wide double-sided horizontal cable management and vertical or horizontal ground bar. Provide 2 42U vertical rear mounted surge protected Power Distribution Units (PDU) with duplex 24 C13's and 18 flexible C39's, which accepts C14 and C20 plugs. PDU must have indicator lights, but no integral on/off switch and be capable of monitoring. Rack must be compatible with [482.6 mm] 19 in panel mounting.

- e. Cabinets, freestanding modular type, 16-gauge steel construction, minimum, treated to resist corrosion, seismically rated in accordance with the ICC IBC, and painted black. Cabinets with 63 percent mesh doors with blanks and baffling to ensure front-to-rear air flow and avoid intra-cabinet air circulation unless another cooling method is designed. In instances where other air flow is needed, use manufacturer-approved penetrations and sealing to maintain airflow. For hot and cold aisles, use an airflow scheme engineered for the solution. Cabinet must have removable and lockable side panels, front and rear doors with at least 63 percent mesh, and have adjustable feet for leveling. Cabinet must have cable access in the roof and base and be compatible with [482.6 mm] 19 in panel mounting.
Provide cabinet with vertical or horizontal grounding bar, rack or roof mounted 15 cu., 550 CFM fan with filter and two vertical rear mounted surge protected Power Distribution Units with duplex 24 C13's and 18 flexible C39's, which accepts C14 and C20 plugs. All cabinets must be keyed alike to local activity's key requirement unless specified otherwise as required for differing security levels.
- f. Cabinets, wall-mounted modular type, 16 gauge steel construction, minimum, treated to resist corrosion, seismically rated in accordance with the ICC IBC, and painted black. Cabinet must have lockable front and rear doors, louvered side panels, 7 cu. m 250 CFM roof rack mounted fan, ground lug, and top and bottom cable access. Cabinet must be compatible with [482.6 mm] 19 in panel mounting.
Provide a duplex AC outlet and a 1U vertical mounted surge protected Power Distribution Unit that supports C13's and flexible C39's which accepts C14 and C20 plugs. All cabinets must be keyed alike to local activity's key requirement unless specified otherwise as required for differing security levels.

2.2.3 Connector Blocks

**NOTE: Type 66 blocks are not permitted. Select
710-style for legacy installation only.**

Provide insulation displacement connector (IDC) Style 110 for Category systems aligned with cable type. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

2.2.4 Cable Guides

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

with screws, [and] [or] nuts and lock washers. Provide one horizontal cable manager for every [24 port appearances below or above] [48 port appearances below and above] each patch panel unless angled patch panels are specified.

2.2.5 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 equal to the number of installed horizontal cables. Provide patch cords, as complete assemblies, with matching connectors as specified. [Provide fiber optic patch cables with crossover orientation in accordance with ANSI/TIA-568.3]. Patch cords must meet minimum performance requirements specified in ANSI/TIA-568 Series for cables, cable length, and hardware specified.

2.2.5.1 Connector Block to Patch Panel

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

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

Provide in accordance with UFC 3-580-01, ANSI/TIA-568 Series, ANSI/TIA-569 standards. Panels must be third party verified. Panel must be constructed of 2.2 mm 0.09 in minimum aluminum and must be cabinet/rack or wall mounted and compatible with an ECIA EIA/ECA 310-E [482.6 mm] 19 in equipment cabinet rack. Panel must provide 48, Flat or Angled, non-keyed prts, 8p8c wired to T568A. Patch panels must terminate the building cabling on Type 110 IDCs and must utilize a printed circuit board interface. The rear of each panel must have incoming cable strain-relief and routing guides. Panels must have each port factory numbered.

2.2.5.2 Fiber Optic Backbone Patch Panel

NOTE: Provide rack/cabinet mount patch panels with either a vertical or horizontal orientation for the entire project. Provide quantities of LGX distribution panels to terminate all of the fiber being deployed plus 25 percent spare LGX space that must be covered with blanking panels. Provide space for fusion splice trays and cassettes in fiber patch panels.

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

Provide housing for maintenance and cross-connecting of optical fiber cables. Panel must be constructed of [16] [18] gauge steel [or] [

11-gauge aluminum] minimum and must be[cabinet][rack][wall] mounted and compatible with an ECIA EIA/ECA 310-E [482.6 mm] [19 in] equipment rack. Each panel must provide 12 [multimode] or [single-mode] adapters as[MPT-type 12 fiber connector cassettes broke out to six duplex LC UPC connectors,][duplex LC UPC in accordance with ANSI/TIA-604-10 with zirconia ceramic alignment sleeves,][duplex LC APC for RF applications including but not limited to DAS] in accordance with ANSI/TIA-604-10 with zirconia ceramic alignment sleeves[duplex SC in accordance with TIA-604-3 with zirconia ceramic]. Provide dust cover for all unused adapters. The rear of each panel must have a cable management tray a minimum of 203 mm 8 in deep with removable cover, incoming cable strain-relief and routing guides, and able to support 1 m 3 ft of cable slack. Panels must have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter. Must be equipped with factory bonding terminal. Patch panels must be sized to support all known connections plus 25 percent spare.

2.2.5.3 Fiber Optic Distribution Patch Panel

[Cabinet][Rack][Wall]mounted optical fiber distribution panel (OFDP) must be constructed in accordance with ECIA EIA/ECA 310-E utilizing[[16][18] gauge steel][or][11-gauge aluminum] minimum. Panel must be divided into two sections, distribution and user. Distribution section must have strain relief, routing guides, splice tray and must be lockable, user section must have a cover for patch cord protection[MPT-type 12 fiber connector cassettes multiplexed out to six duplex LC UPC connectors,][duplex LC UPC in accordance with ANSI/TIA-604-10 with zirconia ceramic alignment sleeves,][duplex LC APC for RF applications including but not limited to DAS in accordance with ANSI/TIA-604-10 with zirconia ceramic alignment sleeves,][duplex SC in accordance with TIA-604-3 with zirconia ceramic][MT-RJ in accordance with TIA/EIA-604-12 with thermoplastic][ST in accordance with TIA-604-2 with metallic] alignment sleeves. Provide dust covers for adapters. Provide patch cords as specified in the paragraph PATCH PANELS.

2.3 TELECOMMUNICATIONS PATHWAY

NOTE: Indicate cable tray layout on the drawings. When multiple types and sizes are used, indicate size and type of cable trays on the drawings. When using "as indicated" option, ensure information required is shown on the drawings. The RCDD must coordinate with structural engineer when designating the Span/Load Class category. This designation is found in NEMA BI-50016/VE 2. Provide designation on drawings and/or in this specification.

Provide telecommunications pathways in accordance with ANSI/TIA-569, UFC 3-580-01, BICSI TDM and BICSI ITSIMM. Where contradictions occur as they pertain to telecommunications, the criteria listed in UFC 3-580-01 take precedence. Provide conduit types specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, and as specified here. Provide system furniture pathways in accordance with UL 1286.

Provide the following: Submit cable trays design, including dimensional layout, load and seismic calculations, and fill calculations. Dimensional layout includes cable spacings, cable tray splices, and supports. Fill calculations include an index of cables for each section and identification of the lb/ft, cross sectional area, and insulation voltage

class for each cable.

- a. Cable trays: form a wireway system, with a nominal[75][100][150] mm [3][4][6] in][as indicated] depth. Cable tray is to have a span/load class designation of [____] per NEMA BI-50026/VE 2.
- b. Cable trays: constructed of steel that has been hot-dipped galvanized after fabrication.
- c. Cable trays: include splice and end plates, dropouts, and miscellaneous hardware.
- d. Edges, fittings, and hardware: finished free from burrs and sharp edges.
- e. Fittings: ensure not less than load-carrying ability of straight tray sections and have manufacturer's minimum standard radius.
- f. Radius of bends: [305][610][915] mm [12][24][36] in.][as indicated.]
- g. Accessories: ensure cable transitions required to proper support cable, bonding hardware, are indicated and provided.

2.3.1 Basket-Type Cable Trays

NOTE: Basket cable tray is a fabricated structure consisting of wire mesh bottom and side rails.

Provide[size as indicated][of nominal[50,][100,][150,][200,][300,][450,][and][600] mm[2,][4,][6,][8,][12,][18,][and][24] in width and[25,][50,][and][100] mm[1,][2,][and][4] in depth] with maximum wire mesh spacing of 50 by 100 mm 2 by 4 in.

2.3.2 Trough-Type Cable Trays

NOTE: Trough-type cable trays are not to be used for telecommunications applications on JBLM.

Provide[size as indicated][of nominal [150][305][455][610][760][915] mm [6][12][18][24][30][36] in width].[Cable tray must be suitable for use as an equipment grounding conductor.]

2.3.3 Ladder-Type Cable Trays

NOTE: Ladder cable tray is a fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs). Ladder cable tray is best suited for pathways in telecommunications spaces.

2.3.4 Channel-Type Cable Trays

NOTE: Channel-type cable trays are not to be used for telecommunications applications on JBLM.

2.3.5 Solid Bottom-Type Cable Trays

NOTE: Solid Bottom-type cable trays are not to be used for telecommunications applications on JBLM.

Center hung cable tray is not allowed for UMC projects and is not preferred for any other proponent.

2.3.6 Non-continuous Cable Supports

NOTE: Utilize non-continuous telecommunications cable supports (J-Hooks / J-Supports / D-rings) only as specifically permitted in UFC 3-580-01, Telecommunications Interior Infrastructure Planning and Design. Non-continuous supports shall not exceed 20 cables.

The use of cable tray mounted hooks mounted to the outside edge of cable tray is the preferred method for installation of Distributed Antenna System coax. The intent is to prevent the heavier cabling from having to transition thru BTP and fiber optic cabling.

Provide cable supports in accordance with UL 2043, UFC 3-580-01, BICSI TDMM, ANSI/BICSI N1. Provide[[galvanized][zinc-coated][stainless] steel] cable supports[as indicated]. Use cable trays for horizontal distribution to the maximum extent possible (maximum horizontal distance: 6 m 20 ft in open face hangers). The remaining pathway to the work area outlet may be implemented in a variety of ways combining conduit, non-continuous cable supports, and stub-ups/outs.

2.3.7 Sleeves and Conduit

Provide sleeves and conduit in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and as further required in ANSI/TIA-569. Conduit must be minimum 25.4 mm 1 in, runs must not exceed 30 m 100 ft without installation of appropriate type, and sized pull box. There must be no aggregated bends between pull boxes in excess of 180 degrees. Pull boxes must not be installed as a change in pathway direction.

2.3.8 Floor Outlet and Poke-Thru Boxes

Telecommunications floor outlets: consisting of recessed outlets flush with the finished floor[aluminum][stainless steel][brass] housing with receptacles as specified in[Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM][as indicated] and a minimum of [1][2][_____] 25 mm 1 in bushed side opening. Must be hinged type, not requiring a special tool to open, and provides latching style ports for cable egress protection when in use.

2.3.9 Outlet Boxes for Telecommunications System

NOTE: When using "as indicated" option, ensure information required is shown on the drawings.
Choose 100 mm 4 inch square boxes for single gang,

four outlet, copper telecommunications configurations that do not have provision for fiber optic cabling. Choose 120 mm 4 11/16 inch square boxes for 35 mm 1 1/4 inch conduit installations and for outlet boxes that have or may require fiber optic cabling. Larger boxes are required to meet bend radii requirements for fiber optic cable and for situations when conduit larger than 1 inch are required.

Provide the following:

- a. Standard type [100 mm square by 54 mm deep][120 mm square by 54 mm deep][130 mm square by 73 mm deep] [4 in square by 2 1/8 in deep][4 11/16 in square by 2 1/8 in deep][5 inches square by 2 7/8 in deep].
- b. Outlet boxes for wall-mounted telecommunications outlets: 100 by 54 by 54 mm 4 by 2 1/8 by 2 1/8 in deep.
- c. Depth of boxes: large enough to allow manufacturers' recommended conductor bend radii.
- d. Outlet boxes for fiber optic telecommunication outlets: include a minimum 10 mm 3/8 in deep single or two gang plaster ring as shown and installed using a minimum 27 mm 1 in conduit system.
- e. Outlet boxes for handicapped telecommunications station: [100 by 54 by 54 mm][130 mm square by 73 mm deep] [4 by 2 1/8 by 2 1/8 in][5 in square by 2 7/8 in] deep. Design outlet box for recess mounting with the faceplate flush with the wall surface, at the same height as the electrical outlets.
- f. Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

2.4 TELECOMMUNICATIONS CABLING (BACKBONE AND HORIZONTAL)

NOTE: Cables must 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 must be provided by the Contractor when patch panels are installed. Optical fiber media may be single-mode, multimode, or hybrid combination. For information on optical fiber local area network system, visit <https://www.tiafotc.org/>.

It is recommended that the labeling requirements be provided as a detail on drawings and approved by the technical authority/technology manager during design.

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 ANSI/TIA-606. Coordinate with the facility on labeling standards in place and include in the design.

When systems furniture is provided as part of the construction contract, ensure that systems furniture specifications require compliance with ANSI/TIA-568 Series cabling standards as applicable.

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

Table 770.179 provides the following definitions for optical fiber cable:

- OFNP Nonconductive optical fiber plenum cable
- OFCP Conductive optical fiber plenum cable
- OFNR Nonconductive optical fiber riser cable
- OFCR Conductive optical fiber riser cable
- OFNG Nonconductive optical fiber general-purpose cable
- OFCG Conductive optical fiber general-purpose cable
- OFN Nonconductive optical fiber general-purpose cable
- OFC Conductive optical fiber general-purpose cable
- CI Circuit Integrity, Fire Resistive Cable System, or Electrical Circuit Protective Systems

Table 800.179 provides the following definitions for communications circuits:

- CMP Communications plenum cable
- CMR Communications riser cable
- CMG Communications general-purpose cable CM, CATV, BM, and BL Communications general-purpose cable, Community Antenna coax, Network-powered Broadband medium power, and network-powered Broadband low power
- CI Circuit Integrity, Fire Resistive Cable System, or Electrical Circuit Protective Systems
- CMP-LP, CMR-LP, CMX Communications cable, limited use
- CMUC Under-carpet communications wire and cable

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

technology advancements IAW UFC 3-580-01. The designer will need to add the appropriate ITU references into the body of each section as appropriate.

Cabling shall be UL listed for the application and shall comply with ANSI/TIA-568 Series Standards ISO/IEC 11801 and NFPA 70. Provide a labeling system for cabling as required by UFC 3-580-01, the JBLM NEC Labeling Scheme, ANSI/TIA-606, and UL 969. Ship cable on reels or in boxes bearing manufacture date for balanced twisted pair (BTP) in accordance with ICEA S-90-661[and optical fiber cables in accordance with ICEA S-83-596][coax in accordance with ICEA 61196-1-100] for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation must not be used. Backbone Cabling

NOTE: 150 ohm shielded twisted pair (STP) is not allowed for new construction. Backbone cable lengths must not exceed guidelines of ANSI/TIA-568.1, ANSI/TIA-568.2, and ANSI/TIA-568.3. 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.

2.4.1.1 Backbone Copper

NOTE: ANSI/TIA-568.1 recognizes Category 5e rated cable as the minimum backbone transmission media. JBLM NEC uses CAT3 rated cable as a minimum for backbone copper cable. Use of cables rated higher than Category 5e are not required since the copper backbone cable is only used for voice systems. Choose the first bracketed jacket color for the preferred color code for cable jackets. Coordinate with activity and choose the second bracketed jacket color option to specify an activity preferred color. Color coding for conductors within the 25 pair bundles is covered by the reference to industry standards.

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

Copper backbone cable must be solid conductor, 24 AWG, 100 ohm, [25][_____] -pair, Category 3, UTP or greater, in accordance with

ANSI/TIA-568.1, ANSI/TIA-568.2, and UL 444, formed into 25 pair binder groups covered with a [gray][_____] thermoplastic jacket[and overall metallic shield]. Cable must 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 must be permitted in accordance with NFPA 70.

2.4.1.2 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 loose buffer is typically used in outside plant applications. A tight buffer consists of a polymer coating in intimate contact with the primary coating applied to the fiber during the manufacturing process. A tight buffer is typically used for interior distribution. If a transition under-slab or through an underground duct system is designed, the use of indoor/outdoor rated fiber optic cabling is recommended.

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

Fiber type	Fiber diameter in micrometer (um) and Class	Jacket color	
Multimode	50/125um Laser Optimized (OM5)	Lime green	
	50/125um Laser Optimized (OM4)	Violet or aqua	
	50/125um Laser Optimized (OM3)	Aqua	
	50/125um (OM2)	Orange	Legacy only to support extending existing installation OM2
	62.5/125um (OM1)	Slate	Legacy only to support extending existing installation OM1

Fiber type	Fiber diameter in micrometer (um) and Class	Jacket color	
Single-mode	OS1 (ranges between 8um and 10um)	Yellow	Legacy only to support extending existing Installation OS1
	OS1a (ranges between 8um and 10um)	Yellow	
	OS2 (ranges between 8um and 10um)	Yellow	

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

For Navy projects provide single mode fiber cables (OS1a) for building backbones on all new projects to future proof the network and standardize the backbone. Additionally, this permits the option of flattening the network via direct connection to switches in TRs other than the main TR.

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

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

Provide in accordance with ICEA S-83-596, ITU-T G.655, ANSI/TIA-568.3, UL 1666, and NFPA 70. Cable must be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 1 m 40 in. Provide the number of strands indicated, (but not less than 12 strands between the main telecommunication room and each of the other telecommunication rooms), of single-mode (OS1a), tight buffered fiber optic cable. Specify For premises applications deploying 10 Gigabit-Passive Optical Network (10G-PON) ITU-T G.987.1, ITU-T G.984.1, and ITU-T G.657. For longer reaches directly mating to OSP specify bend-insensitive fiber meeting ITU-T G.652.

Provide tight buffered fiber optic multimode, [50/125-µm diameter laser optimized (OM5)][50/125-µm diameter laser optimized (OM4)][50/125-µm

diameter laser optimized (OM3)][50/125-µm diameter (OM2)][62.5/125-µm diameter (OM1)] cable as indicated. Provide OM1 or OM2 only when mating to legacy installations. 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 must be permitted in accordance with NFPA 70. The cable cordage jacket, fiber, unit, and group color must be in accordance with TIA ANSI/TIA-598. Use of armored fiber optic cable on JBLM shall be approved by the telecommunications manager technical authority.

2.4.2 Horizontal Cabling

NOTE: Coordinate project requirements and use of fiber optic cable and coax for horizontal cabling with the technical authority.

Remove requirements for copper infrastructure for US Marine Corp projects unless specifically exempted.

Provide horizontal cable in compliance with NFPA 70, UFC 3-580-01, and performance characteristics and installation in accordance with ANSI/TIA-568 Series applicable for the type of horizontal media.

2.4.2.1 Horizontal Copper

NOTE: Choose the first bracketed jacket color for the preferred color code for cable jackets. Coordinate with activity and choose the second bracketed jacket color option to specify an activity preferred color. Cabling, patch panels, connector blocks, work area outlets, and cable connectors must be color-coded to distinguish their classification level. If color-coding is not possible, cabling must be clearly marked to indicate classification level. Provide detail sufficient for the security officer to submit and obtain approval from the certified TEMPEST technical authority. Design submittals must document RED/BLACK and checklist items from Intelligence Community Directive (ICD) Tech Spec, including the TEMPEST checklist items specific to telecommunications systems.

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

Screened twisted pair cable (ScTP) may be required OCONUS, in AV applications, or in secure areas, confirm with technical authority. Coordinate with Activity for specific requirements and applicable

reference standards.

The following are minimum cable Types for PoE System

Application Data minimum requirements:

Workstation and Service Outlets	Cat 6A
BAS	Cat 6
AV	Shielded Cat 6A
Lighting	Cat 6 23 AWG
WAPs	2 each Cat 6A
Elevator	2 each Cat 6A

Provide horizontal copper cable, UTP, 100-ohm in accordance with ANSI/TIA-568.2, UL 444, ANSI/NEMA WC 66. For Workstation Outlets provide four each individually twisted pair, minimum size 24 AWG conductors, Category 6A, with a blue thermoplastic jacket.

For Service Outlets and Facility Related Control Systems (FRCS) that do not require 10G horizontal capability, provide[four][one] each individually twisted pair, minimum size 24 AWG conductors, Category 6, with a green thermoplastic jacket. For AV that contain uncompressed HDMI signals, provide four each individually twisted pair, minimum size 24 AWG conductors, Shielded Category 6A, with a black thermoplastic jacket. (White is reserved for voice telephone CAT6/6A applications). For Wireless Access Points (WAP) provide 2 Category 6a cables to each outlet in accordance with TIA TSB-162. Cable must be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable must be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs must be UL listed and labeled for wet locations in accordance with NFPA 70.

2.4.2.2 Horizontal Optical Fiber

NOTE: When using fiber to the work area outlet, the design can use the multimode or single mode optical fiber for horizontal cabling. If using multimode, OM3 (which permits data rates up to 10 Gig) is first choice. OM2 and OM1 are legacy solutions and should only be used to supplement existing systems. Coordinate with Telecommunications Manager.

Centralized cabling provides connection from the work areas to the centralized cross connect by allowing the use of pull through cable, an interconnect, or a splice in the TR or ER. Although this is using the same cable as horizontal, the industry standard permits runs up to 300 m 984 ft for OM3 and 400 m 1,312 ft for OM4/OM5. These distances support 10GBASE-SR using MMF.

In passive optical network (PON) topologies, specify single mode fiber as it is currently the only viable cabling solution. PON technology is not supported

by all current networks and must be coordinated with the agency specific telecommunications manager approval from the technical authority. Best practice is when designing PON is to design with two fibers to support a differing infrastructure if the network architecture changes.

For horizontal cabling, OM3 or better multimode optical fiber is recommended for: - Distances up to **90 m 295 ft** in the horizontal.

Provide optical fiber horizontal cable in accordance with **ANSI/TIA-568.3**. Cable must be tight buffered, [multimode, 50/125-µm diameter laser optimized, OM3][,][single-mode, 8/125-µm diameter, OS1a with **ITU-T G.657** fiber][single-mode, 8/125-µm diameter, OS1a with **ITU-T G.652** fiber]. Cable must be imprinted with manufacturer, flammability rating and fiber count at regular intervals not to exceed **1 m 40 in**.

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 must be permitted in accordance with **NFPA 70**. Cables installed in conduit within and under slabs be UL listed and labeled for wet locations in accordance with **NFPA 70**. The cable jacket must be of single jacket construction with color coding of cordage jacket, fiber, unit, and group in accordance with **TIA ANSI/TIA-598**.

2.4.3 Work Area Cabling

**NOTE: Verify with Telecommunications
Manager/Technical Authority**

2.4.3.1 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. When selecting 2-pair UTP, verify component compatibility.

Provide work area copper cable in accordance with **ANSI/TIA-568.2**, with a blue thermoplastic jacket.

2.4.3.2 Work Area Optical Fiber

Provide optical work area cable in accordance with **ANSI/TIA-568.3**.

2.4.3.3 Service Outlets

Provide service outlet[single pair copper][4-pair copper][fiber optic] cabling to support all operational technology (OT) outlets as indicated in accordance with **ANSI/TIA-568 Series**.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

NOTE: When a building has elevators, all necessary four-pair copper cable with an eight-position modular outlet adapter location must be verified with the elevator installer or Contractor.

When a building has OT that requires structured cabling provide Service outlets with a four-pair copper cable with an eight-position modular outlet or 2-pair copper cabling if vendor equipment accepts this new connection type.

Conduit bend radius must be coordinated with cable bend radius. Conduit entries at outlet and junction boxes must be arranged so that cables passing through the box must enter and exit at opposite sides of the box. Provide grounding and bonding as required by ANSI/TIA-607.

Wire 8-pin modular outlet/connectors to T568A configuration unless specifically requested and approved by the Telecommunications Manager. The term RJ-45 refers to 8-pin modular adapters/connectors wired to T568A configurations. Ensure drawings indicate work area outlet adapter color code functionality if color coding of adapters is a requirement of the project.

Remove requirements for copper infrastructure for US Marine Corp projects unless specifically exempted.

[2.5.1 Outlet/Connector Copper

NOTE: Coordinate outlet/connector color with Telecommunications Manager/Technical Authority.

Outlet/connectors must comply with [FCC Part 68](#), [ANSI/TIA-568.1](#), and [ANSI/TIA-568.2](#) [[ANSI/TIA-568.5](#)]. UTP outlet/connectors must be [UL 1863](#) listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and must be third party verified by a nationally recognized testing laboratory. Outlet/connectors provided for UTP cabling must meet or exceed the requirements for the cable provided. Outlet/connectors must be terminated using a RJ45 type connections, color-coded for both T568A and T568B wiring. Each outlet/connector must be wired T568A. UTP outlet/connectors must comply with [ANSI/TIA-568.2](#) for [200][] mating cycles. UTP outlet/connectors installed in outdoor or marine environments must be jell-filled type containing an anti-corrosive, memory retaining compound.

]2.5.2 Optical Fiber Adapters (Couplers)

NOTE: LC style adapters and connectors are the

default standard for new construction due to smaller form factor (size) allowing higher density at both the patch panel and the outlets.

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

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

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

2.5.3 Optical Fiber Connectors

Provide in accordance with TIA-455-21. Crimp-style connectors are not authorized on JBLM. Use factory polished, fusion spliced connectors. Optical fiber connectors must be[duplex LC in accordance with ANSI/TIA-604-10 with zirconia ceramic alignment sleeves,][duplex SC in accordance with TIA-604-3 with zirconia ceramic][MT-RJ in accordance with TIA/EIA-604-12 with thermoplastic][ST in accordance with TIA-604-2 with metallic ferrule, epoxy less[crimp style] compatible with[[62.5/125][50/125] multimode][8/125 singlemode] fiber. The connectors must 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 must comply with UL 514C, and ANSI/TIA-568 Series;[flush][or][oversized][flat][angled] design constructed of[stainless steel][high impact thermoplastic material][ivory][white][brown] in color[to match color of receptacle/switch cover plates specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM]] [302 stainless material][or][brass material]. Provide 2-Post, stainless material cover plates for all wall mounted telephone locations. Provide labeling in accordance with the paragraph LABELING in this section.

2.6 ZONE CABLING ASSEMBLIES

**NOTE: Zone Cabling Assemblies such as MUTOA's and
CP's are termination devices used for open office**

cabling. The use of these assemblies allows horizontal cabling to change more easily when the open office plan is reconfigured. Work area cables originating from the MUTOA should be routed through work area pathways (e.g., furniture pathways). The work area cables must be connected directly to workstation equipment without the use of any additional intermediate connections. MUTOAs must be located in an open office area so that each furniture cluster is served by at least one MUTOA. The MUTOA must be limited to serving a maximum of twelve work areas. 90 meter 295 feet maximum permanent link requirements remain. Spare capacity must also be considered when sizing the MUTOA. MUTOA's are not allowed above ceiling spaces.

Passive consolidation points (with no provisions for active network components) can be designed to allow horizontal cabling to be changed more easily when the open office plan is reconfigured. This introduces another connection point in the cabling infrastructure and should be coordinated with the telecommunications manager/Technical authority prior to design.

2.6.1 Multi-User Telecommunications Outlet Assembly (MUTOA)

Provide MUTOA(s) in accordance with ANSI/TIA-569 and UFC 3-580-01.

2.6.2 Consolidation Point (CP)

Provide CP(s) in accordance with ANSI/TIA-569 and UFC 3-580-01.

2.7 BONDING PRODUCTS

NOTE: Indicate bonding components and conductor sizes on drawings. Use the guidelines provided in Section 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

Provide in accordance with Section 27 05 26, UL 467, ANSI/TIA-607, UFC 3-580-01, and NFPA 70. Components must be labeled as required by ANSI/TIA-606 and as indicated.

2.8 FIRESTOPPING MATERIAL

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

Provide as specified in Section 07 84 00 FIRESTOPPING. Ends of conduit stubs must be treated as part of the overall assembly.

2.9 MANUFACTURER'S NAMEPLATE

Each item of equipment must 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.

2.10 UNIQUE IDENTIFICATION NAMEPLATES AND LABELS

Provide laminated plastic nameplates per [ASTM D709](#) thermal ink transfer process for each equipment rack, cabinet, wall mounted cabinet, patch panels, outlet and active equipment device; as specified in ANSI/TIA-606 and the JBLM NEC labeling scheme. Each nameplate inscription shall identify the function and, when applicable, the position. or as indicated on the drawings. Nameplates must be melamine plastic, [3 mm 0.125 in](#) thick, white with black center core. Surface must be matte finish. Corners must be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be [25 by 65 mm 1 by 2.5 in](#). Lettering must be a minimum of [6.35 mm 0.25 in](#) high normal block style, sized for the equipment, white with black text. Labels must be sized to fit the devices/equipment being labeled.

2.11 TESTS, INSPECTIONS, AND VERIFICATIONS

2.11.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with [ANSI/TIA-568.2](#) for BTP copper [ANSI/TIA-568.3](#) and [ANSI/TIA-526-7](#) for single mode optical fiber, and [ANSI/TIA-526-14](#) for multimode optical fiber cables.

PART 3 EXECUTION

3.1 INSTALLATION

NOTE: Cable installation logic must be approved by the proponents technical authority/telecommunications manager.

Install telecommunications telecommunication spaces, pathway systems, and cabling (including the horizontal and backbone cable), telecommunications outlet/connector assemblies, and associated hardware as detailed in [UFC 3-580-01](#), [ANSI/BICSI N1](#), [ANSI/BICSI N3](#), [ANSI/TIA-568.1](#), [ANSI/TIA-568.2](#), [ANSI/TIA-568.3](#), [ANSI/TIA-569](#), [NFPA 70](#), and UL standards as applicable. Building telecommunications infrastructure and cabling shall be installed in accordance with NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling. Workmanship shall conform to the practices described in the BICSI Information Transport Systems Installation Methods Manual (ITSIMM). Where contradictions occur as they pertain to telecommunications, the criteria listed in UFC 3-580-01 takes precedence. Seismic specifications for telecommunications infrastructure and related facilities shall accommodate applicable seismic requirements per the AHJ. Add these additional References: [ANSI/TIA-569](#), paragraph 6.3.6.1.9, seismic considerations, JBLM Design Standard Specification Section 13 48 00, SEISMIC BRACING FOR MISCELLANEOUS EQUIPMENT, [UFC 3-310-04](#), SEISMIC DESIGN FOR BUILDINGS, International Code Council (ICC), International Building Code (IBC). Pathways and outlet boxes must be types as specified in PART 2. Install cabling in a star topology network redundant star for C5ISR and other facilities with a mission that supports telecommunications infrastructure redundancy. 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 must not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling must be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment. To ensure a logical sequence of installation, and ease of maintenance, organize cables from top-to-bottom, left-to-right across the front of each patch panel. WAO must start from the serving telecommunications room working left-to-right around each room and left-to-right throughout the building. SO's may be included in sequence managed separately from WAO's as approved by the COR and technical authority.

3.2 TELECOMMUNICATION SPACE EQUIPMENT

Install all termination hardware necessary to support required Category [6a][_____] [and] [optical fiber] system[s] and network equipment as indicated on the drawings.

3.2.1 Plywood Backboards

Install void-free, fire-retardant treated A/C interior grade plywood backboards on all walls in telecommunications spaces as indicated on the drawings and in accordance with ANSI/TIA-569 and UFC 3-580-01. Mount plywood vertically, with the bottom of the plywood [150 mm] [203 mm] [6 in] [8 in] above the finished floor with the best side toward the room. The fire stamp must be clearly visible. Mounting anchors utilizing [galvanized] [zinc plated] [stainless steel] hardware with a flat head. Finished installation must be flush with countersunk screw head to prevent splitting. Drywall screws are not acceptable. Backboards shall not be painted.

3.2.2 Equipment Support Frames

Install equipment support frames, patch panels, cable management, and cable guides in accordance with ANSI/TIA-569 and UFC 3-580-01. Verify coordinated placement of all equipment and utilities. Maintain required clearances per PART 2 and approved shop drawing. Mount required PDU's along the sides of equipment frames per manufacturers recommendation [as indicated on the drawings].

- 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 in above floor.
- b. Racks, floor mounted modular type. Permanently anchor rack to the floor in accordance with manufacturer's recommendations. Anchor at the top in accordance with seismic requirement found elsewhere in design.
- c. Cabinets, freestanding modular type. Permanently anchor cabinets to the floor in accordance with manufacturer's recommendations and anchor at the top in accordance with seismic requirement found elsewhere in design. When cabinets are connected, remove adjoining side panels for cable routing between cabinets (unless needed to meet physical security requirements). Mount rack mounted fan in roof of cabinet.
- d. [Cabinets][Rack], wall-mounted modular type. Mount [cabinet][rack]

to plywood backboard in accordance with manufacturer's recommendations and to meet seismic requirements Mount cabinet so height of highest panel does not exceed 1980 mm 78 in above floor.

- e. Allow a minimum of 914 mm 36 in working clearance in[front and rear of floor mounted equipment frames][front of wall mounted equipment frames]. Clearance of 153 mm 6 in is required for equipment frames adjacent to a wall and a minimum of 762 mm 30 in is required at the end of each row.

3.2.3 Connector Blocks

Install wall mounted 110-Type connector blocks in orderly rows and columns. Adequate vertical and horizontal wire routing areas must be provided between groups of blocks. Install in accordance with industry standard wire routing guides per ANSI/TIA-569.

3.2.4 Patch Panels

Patch panels must 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 must have additional support and be secured to the panel as recommended by the manufacturer to prevent movement of the cable and reduce component strain. Land cabling left-to-right, top-to-bottom in the same logic as room's are identified.
- b. Fiber Optic Patch Panel. Fiber optic cable loop must be [900][_____] mm [3][_____] ft in length. The outer jacket of each cable entering a patch panel must be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.2.5 Cable Management

Install horizontal and vertical cable management in accordance with ANSI/TIA-569.

- a. Horizontal Cable Management: Install one rack unit (RU) horizontal manager for every one RU of patch panel or switch port appearances. Horizontal cable management must be installed to support ports without overlapping/crossing/impinging on other port appearances.

Vertical Cable Management: Install vertical cable management between racks[and at each end of each row]. Vertical cable management panels must be a minimum of 150 mm 6 in wide and deep and additionally sized based on total anticipated cable fill plus 50 percent. Allow space against wall for operation of management covers.

3.3 TELECOMMUNICATIONS PATHWAYS

NOTE: Do not use metal flex conduit for telecommunications wiring unless used to connect floor boxes under raised floors.

For guidelines on conduit sizing, see UFC 3-580-01,

**"Information and Communications Infrastructure
Planning and Design" and NFPA 70.**

Install in accordance with ANSI/TIA-569 and NFPA 70.

- a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications room: installed and cabling length requirements in accordance with ANSI/TIA-568 Series. Size conduits[wireways][and cable trays] in accordance with ANSI/TIA-569[and][as indicated]. Install a minimum of 25 mm 1 in conduit for telecommunications work area and service outlets. Conduit size must be increased if required by cable diameter and fill requirements.
- b. Backbone Pathway: Telecommunication pathways from the telecommunications entrance facility to telecommunications rooms, and, telecommunications equipment rooms (backbone cabling): installed in accordance with ANSI/TIA-569 and as indicated. Size conduits[, wireways][, and cable trays] for telecommunications risers in accordance with ANSI/TIA-569[and][as indicated].
- c. Service Entrance Conduit, Overhead: Install service entrance overhead as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.3.1 Interior Distribution System

Install conduit in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM PART 3 except as indicated below. Install wall mounted outlet boxes as specified in PART 2. Provide pull boxes for telecommunications systems in accordance with ANSI/TIA-569. No conduit runs must exceed 30 m 100 ft without a pull boxed placed. Pull boxes must not be used for a change in direction. Conduit bends must not exceed more than the equivalent of two 90 degree bends or 180 degrees total without the addition of a pull box in accordance with ANSI/TIA-569. Conduits must enter and exit pull boxes in accordance with ANSI/TIA-569. Install firestop penetrations in accordance with Section 07 84 00 FIRESTOPPING. Install conductors run through smoke and fire partitions in 103 mm 4 in rigid steel conduits with bond bushings, extending 305 mm 12 in beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of[partitions][listed fire barrier pathways].

3.3.2 Pull Cords

Pull cords must be installed in conduit serving telecommunications outlets that do not have cable installed. Pull cords must be labeled on each end and indicate the service in which they were installed to support, the location of all pull boxes, and room number of the far ends. Spare outlet locations must be included in record documentation.

3.3.3 Cable Tray

Install cable tray as specified in PART 2. Cable tray access and working clearances of 305 mm 12 in on one side and above the tray must be coordinated with other utilities. Side and top encroachment distance of less than 914 mm 3 ft in a 6 m 20 ft span is allowable provided it does not prohibit access to raceways or conduits that feed into the tray and is approved prior to cable installation. These encroachments must be approved by the Building Information Modeling (BIM) Coordination Team with final approval by the Information Communications Technical Authority.

Install cable tray using [wall mounted brackets] [ceiling hung brackets].
Do not install cable tray using a single center hanger.

Install and bond in accordance with NFPA 70, ANSI/TIA-569, and ANSI/TIA-607.
Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Cable tray and tray supports must not partially nor completely obstruct access to the room. Support [in accordance with NEMA BI-50026/VE 2 and with manufacturer recommendations but at not more than [1830][] mm [6][] ft intervals] [as indicated by the manufacturer]. Coat contact surfaces of aluminum connections with an antioxidant compound prior to assembly. Adjacent cable tray sections bonded together by connector plates of an identical type as the cable tray sections. Terminate cable trays 55 mm 10 in from both sides of smoke and fire partitions. Install cable tray supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction. Ensure edges, fittings, and hardware are finished free from burrs and sharp edges.

3.3.4 Non-Continuous Cable Supports

NOTE: Utilize non-continuous telecommunications cable supports (J-Hooks / J-Supports / Bridle rings/ D-rings) only as specifically permitted in UFC 3-580-01, Telecommunications Interior Infrastructure Planning and Design. If allowed, verify design notes are included on drawings.

For Navy projects, install cabling in a wireway/raceway pathway system only. Delete bracketed sentences associated with cabling not in wireway and pathway, structural member routing, cable placement and coiling of cables.

- [Install open top and closed ring cable supports on 1.2 m to 1.5 m 4 ft to 5 ft centers to adequately support and distribute the cable's weight. Use these types of supports to support a maximum of 20 6.4 mm 0.25 in diameter cables. Support cable not in a wireway or pathway minimum of [200][] mm [8][] in above ceilings and no greater than 1.2 m to 1.5 m 4 ft to 5 ft centers to adequately support and distribute the cable's weight. Open top and closed ring cable supports must be suspended from or attached to the structural ceiling or walls with hardware or other installation aids specifically designed to support their weight.
-] Cable must not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors must have a minimum separation of 300 mm 12 in. Cable routed exposed under raised floors must be plenum rated. Plenum cables must comply with flammability plenum requirements of NFPA 70. Install cabling after the flooring system has been installed in raised floor areas and arranged to not impede underfloor airflow. [Cable [1.8][] m [6][] ft long must be neatly coiled not less than [300][] mm [12][] in in diameter below each feed point in raised floor areas.]

3.3.5 Floor Outlet and Poke-Thru Boxes

Install floor outlet boxes in accordance [with manufacturer's instructions] [and] [as indicated]. Boxes must be flush with finished

floor surfaces. If electrical power is provided in the same box, the box must be fully partitioned.

3.3.6 Telecommunication Penetrations

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

3.4 TELECOMMUNICATIONS CABLE

3.4.1 Backbone Cable

- a. Copper Backbone Cable. Install intrabuilding backbone copper cable, in indicated pathways, between the campus distributor, located in the telecommunications entrance facility or room, the building distributors and the floor distributors located in telecommunications rooms and telecommunications equipment rooms as indicated on drawings.
- b. Optical fiber Backbone Cable. Install intrabuilding backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 250 mm 10 in leaving strength members exposed for approximately 250 mm 10 in. Twist strength members together and attach to pulling eye. Vertical cable support intervals must be in accordance with manufacturer's recommendations. Fusion-splice backbone fibers to factory produced pigtails.

3.4.2 Horizontal Cable

Install UTP[and][optical fiber] telecommunications cabling system as detailed in ANSI/TIA-568 Series and UFC 3-580-01 based on media type. Screw terminals must not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Terminate on a workstation outlet, service outlet, or MPTL on the field end and a patch panel in the TR. 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 lbs pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not use any support methods that allow over cinching of cables, or crush cables with staples. For UTP cable, bend radii must not be less than four times the cable diameter.

For fiber optic cables the bend radius must not be less than 20 times the diameter during pulling and must not be less than 10 times the diameter after installation. All cabling must be terminated; no cable must contain unterminated elements. Cables must not be spliced. Label cabling in accordance with paragraph LABELING in this section. Install cable rated for their listed environment.

- a. Install copper horizontal cabling as indicated on approved shop drawings. Do not untwist Category UTP cables more than 12 mm 1/2 in from the point of termination to maintain cable geometry. Install a slack cable a minimum of [3 m] [10 ft] [] along the longest pathway in the TR. Install 300 mm 12 in of cable slack above ceiling at the WOA or service outlet.
- b. Install fiber horizontal cabling as indicated on approved shop drawings and as detailed in UFC 3-580-01. Install a slack loop a minimum of [3 m] [10 ft] in the form of a service loop on the back

wall field of the telecommunications room. Install fiber optic cable in innerduct.

3.5 OUTLETS

3.5.1 Work Area Outlets

Terminate copper work area outlet cable in accordance with [ANSI/TIA-568.1](#), [ANSI/TIA-568.2](#), [ANSI/TIA-568.4](#), [ANSI/TIA-568.5](#), UFC 3-580-01, and wiring configuration T568A. [Terminate fiber optic cables in accordance with [ANSI/TIA-568.3](#).]

FOR EEDRS and DDC JACE connections:

To comply with physical security requirements for the metering networks, change from outlets on wall to CAT6 or 6A biscuit-style terminations inside each (EEDRS and DDC) JACE NEMA BOX with the jack numbers labeled on the biscuit inside the NEMA box (with a 1333 key) and on the NEMA box cover. NEC is responsible for the permanent link, CAT6 cable between the patch panel and the biscuit-style terminations inside each (EEDRS and DDC) JACE NEMA BOX.

3.5.2 Service Outlets (SO)

Terminate copper cable in accordance with [ANSI/TIA-568.1](#), [[ANSI/TIA-568.2](#)] [[ANSI/TIA-568.4](#)] [[ANSI/TIA-568.5](#)] [[TIA TSB-162](#)] and wiring configuration as specified. [Terminate fiber optic cables in accordance with [ANSI/TIA-568.3](#).] Male (MPTL) may be used in place of a SO in applications where a SO and patch cord are not accessible, or the OT equipment is not conducive to this type of installation.

3.5.3 Cover Plates

As a minimum, each outlet/connector must be labeled with the unique number to identify cable link in accordance with the paragraph LABELING in this section and as shown on the approved shop drawings.

3.6 ZONE CABLING ASSEMBLIES

3.6.1 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 must not be located in ceiling spaces, or any obstructed area. MUTOAs must not be installed in furniture unless that unit of furniture is permanently secured to the building structure. MUTOAs must be located in an open work area so that each furniture cluster is served by at least one MUTOA. The MUTOA must be limited to serving a maximum of twelve work areas. Maximum work area cable length requirements must also be considered. MUTOAs must be labeled to include the maximum length of work area cables. MUTOA labeling is in addition to the labeling described in [ANSI/TIA-606](#), or other applicable cabling administration standards. Work area cables extending from the MUTOA to the work area device must also be uniquely identified and labeled.

3.6.2 Consolidation Point (CP)

Run horizontal cable in the ceiling or underneath the floor and terminate each cable on a CP in each individual zone. CPs located in ceiling spaces must remain accessible and not installed in an obstructed area. CPs must be labeled to include the maximum length of work area cables. CP labeling is in addition to the labeling in accordance with [ANSI/TIA-606](#), section

LABELING, and as designed. Work area cables and service outlet cables extending from the CP to the work area device must also be uniquely identified and labeled.

3.7 TELECOMMUNICATIONS BONDING

NOTE: Refer to Section 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

3.8 LABELING

3.8.1 Labels

NOTE: Install and label medical facilities in accordance with Defense Health Agency LAN/WLAN Installation Manual. Label other projects in accordance with ANSI/TIA-606 using a mechanical device for printing. Labeling schemes are required to be detailed in design drawings and approved by the telecommunications manager. Labeling must be IAW the architectural wayfinding and not construction space number/naming conventions.

Provide labeling in accordance with ANSI/TIA-606, UFC 3-580-01, the JBLM NEC Labeling Scheme, and as submitted and approved on T4 shop drawings. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits must be provided using thermal ink transfer process. Stenciled lettering for protective entrance terminals (PET)s may be spray painted using black paint. Labeling of cabling shall be provided on all telecommunication outlet boxes.

3.8.2 Cable

Cables must be labeled in accordance with ANSI/TIA-606, the JBLM NEC Labeling Scheme and as submitted and approved on T4 shop drawings.

3.8.3 Termination Hardware

Equipment frames, workstation outlets, service outlets, and patch panel connections must be labeled using coded labels with identifiers in accordance with ANSI/TIA-606, the JBLM NEC Labeling Scheme, and as submitted and approved on T4 shop drawings.

3.9 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.

Painting must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.9.1 Painting Backboards

Backboards shall not be painted.

3.10 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. Nameplates must be installed plumb, level, and center to the device.

3.11 TESTING AND INSPECTIONS

3.11.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with [ANSI/TIA-568 Series](#), [ISO/IEC 14763-2](#), [ISO/IEC 14763-3](#), [UFC 3-580-01](#), [ANSI/TIA-526-7](#) and [ANSI/TIA-526-14](#) based on media. Test equipment must conform to [ANSI/TIA-1152](#). Provide results with coordinated as built record plans for labeling in accordance with [ANSI/TIA-606](#) and approved label scheme as a single complete package. Remove failed cable reels from project site upon attenuation test failure. Copper tests are required to be performed with Certification Test Equipment level IIIe at 500 MHz for class [6][6A][_____] with the results furnished in the native format of the tester and in PDF format. For service outlets and other cables that are not workstation outlets use the most applicable test for the class of cable per [ANSI/TIA-568 Series](#) standard. To test links with an MPTL run the test Permanent Link Adapter and a Patch Cord Adapter (PCA) on the other end following manufacturer recommendations.

Level	Frequency	Cable Category
IIe	100 MHz	5e and class D
III	250 MHz	6 and class E
IIIe	500 MHz	6A and class EA
IV	1000 MHz	8 and class F/FA*

3.11.1.1 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 [ANSI/TIA-568.1](#), [ANSI/TIA-568.2](#), [[ANSI/TIA-568.3](#)], [[ANSI/TIA-568.4](#)][[ANSI/TIA-568.5](#). Visually confirm [Category 6a][_____] marking of outlets, cover plates, outlet/connectors, and patch panels ensuring the entire channel is composed of components of the same marking. Visually inspect cabling jacket for deformation and discoloration. Cables may be required to be replaced, regardless of test results, if cabling jacket damage is deemed by the telecommunications manager or COR to be excessive.

3.11.1.2 Verification Tests

- a. Technicians who have successfully completed a training program for the test equipment and hold a current certificate as proof thereof must

execute the tests.

- b. The COR and the JBLM NEC project team must be notified of the start date of the testing phase 5 business days before testing commences and shall be invited to witness and review field-testing. Cable acceptance testing must only be performed after cabling is in place, both ends are terminated, and faceplates are installed.
- c. Bonding system testing is required to determine if an acceptable level of resistance is provided between the telecommunications bonding system and the building's electrical grounding electrode system. Prior to performing testing a visual inspection must be performed to verify all components are installed in accordance with [ANSI/TIA-607](#) recommendations. Perform bonding testing on all segments of the bonding system using a two-point test in accordance with [ANSI/TIA-607](#). Testing must be performed prior to the installation of any telecommunications equipment. Maximum value of resistance between any two points in the telecommunications bonding system and to the buildings electrical grounding electrode system must be less than 100 milliohms. Document and submit test results in accordance with paragraph SUBMITTALS.
- d. UTP backbone copper cabling must be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but prior to being cross-connected.

NOTE: Two methods for measuring the installed optical fiber cable plant loss are described in TIA/EIA-526-7 (single-mode cable). Tier 1 uses optical power measurement equipment. Tier 2 uses an Optical Time Domain Reflectometer (OTDR). Tier 2 is now recognized as a recommended test by TIA and BICSI. Method B is not recommended for existing cable plants containing branching devices and/or isolators. Tier 2 testing is required when certifying PON or FTTx to document the performance of splitters.

For multi-mode optical fiber, perform 100 percent of optical fiber end-to-end attenuation tests in accordance with [ANSI/TIA-568.3](#) and [ANSI/TIA-526-14](#) using Tier 1, Optical Power Meter and LED Light Source and Tier 2, OTDR for multi-mode optical fiber. For single-mode optical fiber, perform 100 percent of optical fiber end-to-end attenuation tests in accordance with [ANSI/TIA-568.3](#) and [ANSI/TIA-526-7](#) using Tier 1, Optical Power Meter and Light Source and Tier 2, OTDR for single-mode optical fiber. Test the link at both standard frequencies bidirectionally for multi-mode and single-mode. Reference grade connectors with an attenuation value equal to or less than .10dB for multimode and 0.20dB for single-mode must be used. The testing method must comply with [ANSI/TIA-526-7](#) using the single jumper method. Fiber connector loss must be .75dB or less and splice loss must be 0.3dB or less for cable acceptance.

An optical time domain reflectometer (OTDR) is required for all inside plant lengths using the launch cables and exit cables of the required length for the fiber type. This does not relieve the requirement for the OLTS above.

Final labeling must be verified as part of testing and certified as accurate per record documentation.

3.11.1.3 Performance Tests

Perform testing for each outlet CP and MUTOA as follows:

- a. Perform 100 percent of Category 6/6A cables using link tests in accordance with ANSI/TIA-568.1, ANSI/TIA-568.2, ANSI/TIA-568.5 and UFC 3-580-01. Tests for pass/fail must include Wire Map, DC Loop Resistance, Length, Propagation Delay, Delay Skew, Insertion Loss, Return Loss, NEXT, ACR-F, PS ACR-F, PSNEXT, PSAACR-F, DC Resistance Unbalance, DC Resistance Unbalance between pairs.

Testing of no less than 10 percent of cabling installed for Average PS ANEXT, PS AACR-F, Average PS AACR-F.

Test reports must be recorded for information only for the following tests: ACR-N, PS ACR-N, TCL, and ELTCTL.

- b. Optical fiber Links. Perform optical fiber end-to-end Tier 1 and Tier 2, bidirectional, link tests in accordance with ANSI/TIA-568.3, UFC 3-580-01, ANSI/TIA-526-7, and ANSI/TIA-526-14.

3.12 COMMISSIONING

Commissioning of the telecommunications system must be accomplished for projects where more than passive equipment is provided as further defined in Section 01 91 00.15 BUILDING COMMISSIONING.

-- End of Section --