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USACE / NAVFAC / AFCEC / NASA **UFGS-33 82 00 (April 2006)**

Preparing Activity: NAVFAC **Replacing without change UFGS-16711 (August 2004)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

04/06

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SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)
04/06

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NOTE: This guide specification covers exterior telecommunications Outside Plant consisting of the campus distributor, outside copper and fiber optic (FO) cable media, and associated hardware necessary to support communications systems at facility installations including permanently constructed buildings. This specification covers outside plant (OSP) campus fiber optic and copper cable media for supporting information technology transfer systems to include voice, data, video, imaging, security, and audio systems used by various facilities. This guide specification is to be used in the preparation of project construction specifications.

Coordinate with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM and ensure that copper cable and fiber optic cable interconnecting components and patch cord assemblies mechanically intermate.

Use Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

For Navy projects use UFC 3-580-10, "Navy And Marine Corps Intranet (NMCI) Standard Construction Processes" for design guidance related to telecommunications infrastructure. Confirm specific system requirements with the using Activity.

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

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

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

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NOTE: This section will be used in conjunction with any other guide specifications required by the design. Show following information on project drawings:

1. Where specification identifies type, size, color, finish, or other definitive information to be "as indicated" the engineer shall show the information on the drawings.

2. Location and dimensions of manholes, handholes, ducts, and location and size of cables.

3. Types of wire and cable; number and sizes of conductors and conduits.

4. Special conditions.

5. Include tensioning and sag data on drawings in tabular form for aerial cable installation.

Provide a minimum of 12 single-mode fibers per fiber optic cable. Coordinate with activity and Base Communications Office (BCO) to determine fiber optic cabling requirements. Provide fiber optic cabling to piers in accordance with UFC 4-150-02, "Design: Dockside Utilities for Ship Service" for Navy projects only.

****

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.

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2023) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-87-640	(2023) Optical Fiber Outside Plant Communications Cable; 4th Edition
ICEA S-98-688	(2012) Broadband Twisted Pair Telecommunication Cable, Aircore, Polyolefin Insulated, Copper Conductors Technical Requirements
ICEA S-99-689	(2012) Broadband Twisted Pair Telecommunication Cable Filled, Polyolefin Insulated, Copper Conductors Technical Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C62.61	(1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-46A	(1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
TIA-455-78-B	(2020c) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation
TIA-455-107	(1999a) FOTP-107 Determination of Component Reflectance or Link/System Return Loss using a Loss Test Set
TIA-472D000	(2007b) Fiber Optic Communications Cable for Outside Plant Use
TIA-492AAAA	(2009b) 62.5-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers
TIA-492AAAB	(2009a) 50-Um Core Diameter/125-Um Cladding Diameter Class IA Graded-Index Multimode Optical Fibers
TIA-492CAAA	(1998; R 2002) Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers
TIA-492E000	(1996; R 2002) Sectional Specification for Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1550 nm Window
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
TIA-526-14	(2023d) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-568.1	(2020e) Commercial Building Telecommunications Infrastructure Standard
TIA-568.2	(2018d) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568.3	(2022e) Optical Fiber Cabling Components

	Standard
TIA-569	(2019e; Add 1 2022) Telecommunications Pathways and Spaces
TIA-590	(1997a) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
TIA-606	(2021d) Administration Standard for Telecommunications Infrastructure
TIA-607	(2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-758	(2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard
TIA/EIA-455	(1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
TIA/EIA-455-204	(2000) Standard for Measurement of Bandwidth on Multimode Fiber
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 1755	Telecommunications Standards and Specifications for Materials, Equipment and Construction
RUS Bull 345-50	(1979) Trunk Carrier Systems (PE-60)
RUS Bull 345-65	(1985) Shield Bonding Connectors (PE-65)
RUS Bull 345-72	(1985) Filled Splice Closures (PE-74)
RUS Bull 345-83	(1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)
RUS Bull 1751F-630	(1996) Design of Aerial Plant
RUS Bull 1751F-640	(1995) Design of Buried Plant, Physical Considerations
RUS Bull 1751F-643	(2002) Underground Plant Design
RUS Bull 1751F-815	(1979) Electrical Protection of Outside Plant
RUS Bull 1753F-201	(1997) Acceptance Tests of Telecommunications Plant (PC-4)
RUS Bull 1753F-401	(1995) Splicing Copper and Fiber Optic

Cables (PC-2)

UNDERWRITERS LABORATORIES (UL)

UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 497	(2001; Reprint Jul 2022) UL Standard for Safety Protectors for Paired Conductor Communication Circuits
UL 510	(2020; Dec 2022) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

1.2 RELATED REQUIREMENTS

****
NOTE: Choose Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM if it is used on the project. Choose Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION, and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.
****

[Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM,][Section 33 71 01, OVERHEAD TRANSMISSION AND DISTRIBUTION, and[Section 33 71 02, UNDERGROUND ELECTRICAL DISTRIBUTION] apply to this section with additions and modifications specified herein.

]1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568.1, TIA-568.2, TIA-568.3, TIA-569, TIA-606, and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

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

1.3.2 Entrance Facility (EF) (Telecommunications)

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

1.3.3 Entrance Room (ER) (Telecommunications)

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

1.3.4 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).)

1.3.5 Pathway

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

1.4 SYSTEM DESCRIPTION

****
For Army projects only: For MCA projects, telephone switch upgrades and line cards are procured and installed using funds provided by ISEC outside of the construction contract. Other types of projects, such as Army Reserve, DOD and work for others, may require that the switch upgrade and line cards be added to this section to be procured and installed as part of the construction contract. Choose the last bracketed sentences for Navy and Marine Corps projects only.
****

The telecommunications outside plant consists of cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use.[The telecommunications contractor must coordinate with the NMCI contractor concerning layout and configuration of the EF telecommunications and OSP. The telecommunications contractor may be required to coordinate work effort for access to the EF telecommunications and OSP with the NMCI contractor.]

1.5 SUBMITTALS

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

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for

Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

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

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

SD-02 Shop Drawings

Telecommunications Outside Plant; G[, [_____]]

Telecommunications Entrance Facility Drawings; G[, [_____]]

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

SD-03 Product Data

Wire and Cable; G[, [_____]]

Cable Splices, and Connectors; G[, [_____]]

Closures; G[, [_____]]

Building Protector Assemblies; G[, [_____]]

Protector Modules; G[, [_____]]

Cross-Connect Terminal Cabinets; G[, [_____]]

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

[Spare Parts; G[, [_____]]

] Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the

supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Pre-installation Tests; G[, [_____]]

Acceptance Tests; G[, [_____]]

Outside Plant Test Plan; G[, [_____]]

SD-07 Certificates

Telecommunications Contractor Qualifications; G[, [_____]]

Key Personnel Qualifications; G[, [_____]]

Minimum Manufacturer's Qualifications; G[, [_____]]

SD-08 Manufacturer's Instructions

Building Protector Assembly Installation; G[, [_____]]

Cable Tensions; G[, [_____]]

Fiber Optic Splices; G[, [_____]]

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data; G[, [_____]]

SD-10 Operation and Maintenance Data

Telecommunications Outside Plant (OSP), Data Package 5; G[, [_____]]

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than[2][_____] months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

SD-11 Closeout Submittals

Record Documentation; G[, [_____]]

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

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

1.6.1.1 Telecommunications Outside Plant Shop Drawings

****

NOTE: Coordinate drawings with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM, if used, to ensure activity responsible for telecommunications system maintenance and administration maintains a single complete and accurate set of drawings for the entire telecommunications system.

Choose bracketed option for RCDD approved drawings on Navy projects where multiple splices in the outside cable plant are required or when more than one telecommunications manhole and associated ductbanks are required. Choose the last bracketed sentence for facilities that currently have telecommunications outside plant drawings that require updating as a result of project installation.

****

Provide Outside Plant Design in accordance with TIA-758, RUS Bull 1751F-630 for aerial system design, and RUS Bull 1751F-643 for underground system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in accordance with TIA-606. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings.[Provide Registered Communications Distribution Designer (RCDD) approved drawings of the telecommunications outside plant.][Update existing telecommunication Outside Plant T0 drawings to include information modified, deleted or added as a result of this installation in accordance with TIA-606.] The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility Drawings

****

NOTE: Choose the last bracketed sentence when Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS is included in the specifications.
****

[Provide T3 drawings for EF Telecommunications in accordance with TIA-606 that include telecommunications entrance facility plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and[cabinet][, rack][, backboard][and] wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.][Provide T3 drawings for EF Telecommunications as specified in the paragraph TELECOMMUNICATIONS SPACE DRAWINGS of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.] The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

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

1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with TIA-758 within the past 3 years.

1.6.2.2 Key Personnel Qualifications

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

Cable splicing and terminating personnel assigned to the installation of

this system or any of its components shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications outside plant systems, including broadband cabling, and provide the names and locations of at least two project installations successfully completed using[optical fiber and] copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

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

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

1.6.2.3 Minimum Manufacturer's Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of[3][_____] years experience in the manufacturing, assembly, and factory testing of components which comply with, TIA-568.1, TIA-568.2 and TIA-568.3. In addition, cabling manufacturers shall have a minimum of[3][_____] years experience in the manufacturing and factory testing of cabling which comply with ICEA S-87-640, ICEA S-98-688, and ICEA S-99-689.

1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the[copper conductor][and][optical fiber] cables, components, and

accessories for approval by the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least[30][_____] days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with TIA-568.1 and RUS Bull 1753F-201. Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

1.6.4 Standard Products

****
NOTE: Choose 2 years and 6000 hours for Navy projects and 1 year and 3000 hours for Army projects.
****

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least[2][1] year[s] prior to bid opening. The[2][1]-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the[2][1]-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a[2][1]-year field service record will be acceptable if a certified record of satisfactory field operation for not less than[6000][3000] hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

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

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the

Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in [152][305][_____] meter ([500][1000][_____] feet) [500][1000][_____] feet length with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

1.8 MAINTENANCE

1.8.1 Record Documentation

****

NOTE: Coordinate record documentation with Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM and choose the second bracketed paragraph if Section 27 10 00 is used on the project. TIA-606 describes the necessary data fields and reports for hard copy, spreadsheet and electronic media as well as cable management software requirements. Check with activity to determine if cable management software is currently employed at the activity and ensure contractor is required to provide necessary data input to update the existing system with information associated with project installation.

****

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project.

[Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided[in hard copy format][on electronic media using Windows based computer cable management software.][A licensed copy of the cable management software including documentation, shall be provided.][Update existing record documentation to reflect campus distribution T0 drawings and T3 drawing schedule information modified, deleted or added as a result of this installation.] Provide the following T5 drawing documentation as a minimum:

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

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

][Provide record documentation as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

][1.8.2 Spare Parts

****
NOTE: Do not use 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. Spare parts shall be provided no later than the start of field testing.

]1.9 WARRANTY

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

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

****
NOTE: The EF Telecommunications consists of the telecommunications service entrance to the building, including the entrance through the building wall, and continuing to the ER Telecommunications (if required). The EF Telecommunications contains the backbone pathways and campus distributor that link the building distributors (BD)s in the main terminal space and to other buildings in campus situations. Antenna entrances, if used, also constitute part of the EF Telecommunications.

The EF Telecommunications may contain both the CD and BD for the building. Facilities with few

telecommunications requirements may house all telecommunications cabling and equipment required for that facility in the EF Telecommunications. Coordinate this section with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM and provider of building telecommunications cabling system when Section 27 10 00 is used on a project. Other than building protector assemblies and modules, components for telecommunications spaces are specified in Section 27 10 00. If Section 27 10 00 is not used, copy the required components from Section 27 10 00 and paste them under this paragraph. Edit the component requirements as necessary.
****

2.2.1 Building Protector Assemblies

****
NOTE: Interbuilding backbone cables shall be terminated on protected entrance terminals and in a housing (when so directed) using current industry standard practice. Certain types of terminals are mounted on the outside walls of buildings. Outside terminal should be the exception and not the norm, and should only be installed on small buildings (e.g., storage sheds, small warehouses, guard gates, etc.). Copper cable termination components are specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. If the project does not include Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM copy connector blocks or patch panel information and paste information into this section under this paragraph heading and edit as necessary.
****

Provide self-contained[5 pin][screw type] unit supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for [_____] pairs of outside cable. Building protector assembly shall have interconnecting hardware for connection to interior cabling at full capacity. Provide manufacturers instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.2.2 Protector Modules

****
NOTE: Protector modules are not required for interbuilding cable runs of 42.7 m (140 feet) or less, directly buried or in underground conduit, where a continuous metallic cable shield or a continuous metallic conduit containing the cable is bonded to each building grounding electrode system.

Solid-state surge protectors provide protection for sensitive equipment because it incorporates a fast semiconductor switch with operating voltage nearly

independent of transient rise time. Otherwise, use heavy duty gas tube protection modules unless area lightning damage probability is very high. Select the type of protector module required depending on their performance in categories of impulse life, maximum surge impulse and 60 Hz current carrying capacity.

****

Provide in accordance with UL 497[three][two]-electrode gas tube or solid state type[5 pin][screw type] rated for the application. Provide gas tube protection modules in accordance with RUS Bull 345-83 and shall be[heavy duty, A>10kA, B>400, C>65A][maximum duty, A>20kA, B>1000, C>200A] where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current in accordance with ANSI C62.61. The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils in accordance with UL 497. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

****

NOTE: Fiber Optic termination components are specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. If the project does not include Section 27 10 00 copy enclosure type connectors and adapters and paste information into this section under this paragraph heading and edit as necessary.

****

Provide fiber optic cable terminations as specified in 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Aerial Cable Closures

****

NOTE: Design of aerial plant should be in accordance with RUS Bull 1751F-630, Design of Aerial Plant. Indicate sizes on drawings.

****

Provide cable closure assembly consisting of a frame with clamps, a lift-off polyethylene cover, cable nozzles, and drop wire rings. Closure shall be suitable for use on Figure 8 cables. Closures shall be free breathing and suitable for housing[straight-through type][branch type][of the type indicated] splices of non-pressurized communications cables and shall be sized as indicated. The closure shall be constructed with ultraviolet resistant PVC.

2.3.1.2 Underground Cable Closures

****

NOTE: Indicate sizes on drawings.
****

a. Aboveground: Provide aboveground closures constructed of[not less than 14 gauge steel][ultraviolet resistant PVC] and acceptable for[pole][stake] mounting in accordance with RUS 1755.910. Closures shall be sized and contain a marker as indicated. Covers shall be secured to prevent unauthorized entry.

b. Direct burial: Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity in the buried environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with RUS Bull 345-72.

c. In vault or manhole: Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound. Closure shall be of suitable thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with RUS Bull 345-72.

2.3.2 Fiber Optic Closures

2.3.2.1 Aerial

Provide aerial closure that is free breathing and suitable for housing splice organizer of non -pressurized cables. Closure shall be constructed from heavy PVC with ultraviolet resistance.

2.3.2.2 Direct Burial

Provide buried closure suitable to house splice organizer in protective housing into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity, when metallic, in buried environment. Encapsulating compound shall be reenterable and shall not alter chemical stability of the closure.

2.3.2.3 In Vault or Manhole

Provide underground closure suitable to house splice organizer in a protective housing into which can be poured an encapsulating compound. Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.

2.4 PAD MOUNTED CROSS-CONNECT TERMINAL CABINETS

****
NOTE: Indicate size on the drawings.

****

Provide in accordance with RUS 1755.910 and the following:

a. Constructed of 14 gauge steel or [_____].

b. Equipped with a double set of hinged doors with closed-cell foam weatherstripping. Doors shall be locked and contain a marker as indicated.

c. Equipped with spool spindle bracket, mounting frames, binding post log,[and] jumpering instruction label[, and load coil mounting provisions].

d. Complete with cross connect modules to terminate number of pairs as indicated.

e. Sized as indicated.

2.5 CABLE SPLICES, AND CONNECTORS

2.5.1 Copper Cable Splices

****

NOTE: Multipair splices are insulation displacement (IDC) type splices.

****

Provide[multipair,[foldback][in-line]][single pair,[in-line][butt][box tap]] splices of a moisture resistant,[two][three][_____]-wire [insulation displacement] connector held rigidly in place to assure maximum continuity in accordance with RUS Bull 1753F-401. Cables greater than 25 pairs shall be spliced using multipair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable.

[2.5.2 Copper Cable Splice Connector

Provide splice connectors with a polycarbonate body and cap and a tin-plated brass contact element. Connector shall accommodate 22 to 26 AWG solid wire with a maximum insulation diameter of 1.65 mm 0.065 inch. Fill connector with sealant grease to make a moisture resistant connection, in accordance with RUS Bull 1753F-401.

][2.5.3 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for[fusion][mechanical] methods at locations shown on the construction drawings. The splice insertion loss shall be 0.3 dB maximum when measured in accordance with TIA-455-78-B using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 db max for single mode fiber when tested in accordance with TIA-455-107. Physically protect each fiber optic splice by a splice kit specially designed for the splice.

][2.5.4 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly fashion. Splice organizer shall allow for a minimum of 1 m 3 feet of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual

strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

]2.5.5 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor in accordance with RUS Bull 345-65.

2.6 CONDUIT

****
NOTE: Use Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.
****

Provide conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.7 PLASTIC INSULATING TAPE

UL 510.

2.8 WIRE AND CABLE

****
NOTE: For Army projects follow guidelines set forth in USAISEC Technical Guide for Installation Information Infrastructure Architecture (I3A) or The Army Common User Information Transport Network (CUITN). Army ECB 2007-22 is available electronically at . Interbuilding backbone cabling is the cable (optical fiber and copper) media between the campus distributors of multiple buildings within a base complex (campus environment). Interbuilding backbone cable plant terminates in the telecommunications entrance facility, the first terminating point in a building. Cable may be direct buried, aerial, or underground (in conduit and ducts). The preferred method is underground with the cable terminating in the telecommunications entrance facility.
****

2.8.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs).

Copper conductor shall conform to the following:

2.8.1.1 Underground

****
NOTE: For WESTNAVFACENGCOM projects, delete this paragraph.

Use RUS 1755.390 for filled cable and RUS 1755.890 for filled cable with expanded insulation.
****

Provide filled cable meeting the requirements of ICEA S-99-689 and [RUS 1755.390] [RUS 1755.890].

2.8.1.2 Aerial

Provide filled cable meeting the requirements of[ICEA S-99-689][ICEA S-98-688], and RUS 1755.390 except that it shall be suitable for aerial installation and shall be Figure 8 distribution wire with 26,700 N 6,000 pound Class A galvanized steel or 26,700 N 6,000 pound aluminum-clad steel strand.

2.8.1.3 Screen

Provide screen-compartmental core cable filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.390.

2.8.2 Fiber Optic Cable

****
NOTE: Single-mode fiber optic cable is recommended for all fiber optic cable runs. Designer should identify whether multimode will be used. Multimode fiber system may be installed only if an existing communication network is being extended. If multimode fiber is used, single-mode fiber should also be placed for future use. Designer will indicate on the drawings the number of optical fibers required.
****

Provide[single-mode, 8/125-um, 0.10 aperture 1310 nm fiber optic cable in accordance with TIA-492CAAA][single-mode, 8/125-um, 0.10 aperture 1550 nm fiber optic cable in accordance with TIA-492E000][and][multimode 62.5/125-um, 0.275 aperture fiber optic cable in accordance with TIA-492AAAA][multimode 50/125-um, 0.275 aperture fiber optic cable in accordance with TIA-492AAAB], TIA-472D000, and ICEA S-87-640 including any special requirements made necessary by a specialized design. Provide[12][____] optical fibers[as indicated]. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with TIA/EIA-598

2.8.2.1 Strength Members

Provide[central][non-central],[non-metallic][metallic] strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable

core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

[2.8.2.2 Shielding or Other Metallic Covering

****

NOTE: Delete this paragraph if no additional physical protection is required or if aerial cable is specified. Designer must select the shield or metallic covering material required. Bare aluminum, coated aluminum, copper, copper alloy and copper and steel laminate are used as shielding tapes. Copper and stainless steel, coated stainless steel and bare low carbon steel are use for cable armoring. The copper alloy or stainless steel should be used for rodent protection. If additional physical protection is required use the dual aluminum and steel tape shield. Dual tape construction is normally used for armor protection of cables.

****

Provide[copper, copper alloy or copper and steel laminate][copper and stainless steel, coated stainless steel or bare low carbon steel][bare aluminum or coated aluminum],[single][dual] tape covering or shield in accordance with ICEA S-87-640.

]2.8.2.3 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

2.8.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Solid bare copper wire meeting the requirements of ASTM B1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

2.9 T-SPAN LINE TREATMENT REPEATERS

Provide as indicated. Repeaters shall be pedestal mounted with non-pressurized housings, sized as indicated and shall meet the requirements of RUS Bull 345-50.

2.10 POLES AND HARDWARE

Provide poles and hardware as specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

2.11 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

****

NOTE: Designer must coordinate with the base communications office and use the current base standard for labeling, if one exists and choose the as indicated bracketed option. Show the labeling scheme on the drawings that the telecommunications

contractor is required to follow. If no labeling standard exists provide labeling for cable tags in accordance with TIA-606 and choose the bracketed option for TIA-606 labeling.
****

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be[stainless steel][or][polyethylene] and labeled[as indicated][in accordance with TIA-606]. Handwritten labeling is unacceptable.

[2.11.1 Stainless Steel

Provide stainless steel, cable tags 41.25 mm 1 5/8 inches in diameter 1.58 mm 1/16 inch thick minimum, and circular in shape. Tags shall be die stamped with numbers, letters, and symbols not less than 6.35 mm 0.25 inch high and approximately 0.38 mm 0.015 inch deep in normal block style.

][2.11.2 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 22.4 MPa 3250 pounds per square inch; and that are two millimeter 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C 170 degrees F. Provide 1.3 mm 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 778.75 N 175 pounds. The cable tags shall have black block letters, numbers, and symbols 25 mm one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

]2.12 BURIED WARNING AND IDENTIFICATION TAPE

****
NOTE: Buried warning tape requirements are specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00 EARTHWORK.
****

Provide fiber optic media marking and protection in accordance with TIA-590. Provide color, type and depth of tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00, EARTHWORK.

2.13 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS 1755.200. Braid shall be made from flat tin-plated copper.

2.14 MANUFACTURER'S NAMEPLATE

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

2.15 FIELD FABRICATED NAMEPLATES

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

2.16 TESTS, INSPECTIONS, AND VERIFICATIONS

2.16.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with TIA-568.1 and TIA-568.3. Use TIA-526-7 for single mode fiber and TIA-526-14 Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

3.1.3 Direct Burial System

****

NOTE: Indicate minimum radius allowed. Buried warning tape requirements are specified in paragraph

BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00 EARTHWORK.
****

Installation shall be in accordance with RUS Bull 1751F-640. Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment. Provide a minimum cable cover of 610 mm 24 inches below finished grade. Trenches shall be not less than 155 mm 6 inches wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than [915][_____] mm [36][_____] inches. Where two or more cables are laid parallel in the same trench, space laterally at least 78 mm 3 inches apart. When rock is encountered, remove it to a depth of at least 78 mm 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 6 mm 1/4 inch. Do not unreel and pull cables into the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00 EARTHWORK.

3.1.3.1 Cable Placement

a. Separate cables crossing other cables or metal piping from the other cables or pipe by not less than [78][_____] mm [3][_____] inches of well tamped earth. Do not install circuits for communications under or above traffic signal loops.

b. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.

c. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

d. Leave a horizontal slack of approximately 915 mm 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought aboveground, leave additional slack to make necessary connections.

3.1.3.2 Identification Slabs [Markers]

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 508 mm 20 inches square by 155 mm 6 inches thick.

3.1.3.3 Backfill for Rocky Soil

When placing cable in a trench in rocky soil, the cable shall be cushioned by a fill of sand or selected soil at least 53 mm 2 inches thick on the floor of the trench before placing the cable or wire. The backfill for at least 103 mm 4 inches above the wire or cable shall be free from stones, rocks, or other hard or sharp materials which might damage the cable or wire. If the buried cable is placed less than 610 mm 24 inches in depth[, a protective cover of[metal][concrete] shall be used].

3.1.4 Cable Protection

****
NOTE: Use Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.
****

Provide direct burial cable protection in accordance with NFPA 70 and as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be PVC coated and shall extend from the first coupling or fitting outside either side of the concrete minimum of 155 mm per 305 mm 6 inches per 12 inches burial depth beyond the edge of the surface where cable protection is required; all conduits shall be sealed on each end. Where additional protection is required, cable may be placed in galvanized iron pipe (GIP) sized on a maximum fill of 40 percent of cross-sectional area, or in concrete encased 103 mm 4 inches PVC pipe. Conduit may be installed by jacking or trenching. Trenches shall be backfilled with earth and mechanically tamped at 155 mm 6 inches lift so that the earth is restored to the same density, grade and vegetation as adjacent undisturbed material.

3.1.4.1 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.5 Underground Duct

****
NOTE: Use Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.
****

Provide underground duct and connections to existing[manholes,][handholes,][concrete pads,][and][existing ducts] as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION with any additional requirements as specified herein.

3.1.6 Reconditioning of Surfaces

****
NOTE: Use Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.
****

Provide reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.1.7 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.8 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.8.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.8.2 Pulling Eyes

Equip cables 32 mm 1.25 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 32 mm 1.25 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 19 mm 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.1.8.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 1220 mm 4 feet. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.1.9 Aerial Cable Installation

****

NOTE: Include tensioning and sag data on drawings in tabular form.
****

Pole installation shall be as specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION. Where physical obstructions make it necessary to pull distribution wire along the line from a stationary reel, use cable stringing blocks to support wire during placing and tensioning operations. Do not place ladders, cable coils, and other equipment on or against the distribution wire. Wire shall be sagged in accordance with the data shown. Protect cable installed outside of building less than 2.5 meters 8 feet above finished grade against physical damage.

3.1.9.1 Figure 8 Distribution Wire

Perform spiraling of the wire within 24 hours of the tensioning operation. Perform spiraling operations at alternate poles with the approximate length of the spiral being 4575 mm 15 feet. Do not remove insulation from support members except at bonding and grounding points and at points where ends of support members are terminated in splicing and dead-end devices. Ground support wire at poles to the pole ground.

3.1.9.2 Suspension Strand

****
NOTE: Include tensioning and sag data on drawings in tabular form.
****

Place suspension strand as indicated. Tension in accordance with the data indicated. When tensioning strand, loosen cable suspension clamps enough to allow free movement of the strand. Place suspension strand on the road side of the pole line. In tangent construction, point the lip of the suspension strand clamp toward the pole. At angles in the line, point the suspension strand clamp lip away from the load. In level construction place the suspension strand clamp in such a manner that it will hold the strand below the through-bolt. At points where there is an up-pull on the strand, place clamp so that it will support strand above the through-bolt. Make suspension strand electrically continuous throughout its entire length, bond to other bare cables suspension strands and connect to pole ground at each pole.

3.1.9.3 Aerial Cable

Keep cable ends sealed at all times using cable end caps. Take cable from reel only as it is placed. During placing operations, do not bend cables in a radius less than 10 times the outside diameter of cable. Place temporary supports sufficiently close together and properly tension the cable where necessary to prevent excessive bending. In those instances where spiraling of cabling is involved, accomplish mounting of enclosures for purposes of loading, splicing, and distribution after the spiraling operation has been completed.

3.1.10 Cable Splicing

3.1.10.1 Copper Conductor Splices

Perform splicing in accordance with requirements of RUS Bull 1753F-401 except that direct buried splices and twisted and soldered splices are not

allowed. Exception does not apply for pairs assigned for carrier application.

3.1.10.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss[not greater than 0.2 dB for fusion splices][not greater than 0.4 db for mechanical splices].

3.1.11 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of RUS Bull 1751F-815.

3.1.12 Grounding

****
NOTE: Designer should verify the existence of grounding facilities. It is essential that all grounding facilities, new and existing, conform with IEEE C2, NFPA 70, MIL-HDBK-419, and MIL-STD-188-124.
****

Provide grounding and bonding in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.12.1 Telecommunications Master Ground Bar (TMGB)

The TMGB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a TMGB for connection point for cable stub shields to connector blocks and CD protector assemblies as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.12.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground shields of incoming cables in the EF Telecommunications to the TMGB.

3.1.12.3 Campus Distributor Grounding

a. Protection assemblies: Mount CD protector assemblies directly[on the telecommunications backboard][in the telecommunications [rack][cabinet]]. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to provide a low resistance path to TMGB.

[b. TMGB connection: Connect TMGB to TGB with copper conductor with a total resistance of less than 0.01 ohms.

][3.1.13 Cut-Over

All necessary transfers and cut-overs, shall be accomplished by the telecommunications contractor.

]3.2 LABELING

3.2.1 Labels

****
NOTE: Provide labeling in accordance with TIA-606 using a mechanical device for printing.
****

Provide labeling for new cabling and termination hardware located within the facility in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using[thermal ink transfer process][laser printer][_____].

3.2.2 Cable Tag Installation

****
NOTE: Verify cable labeling requirements with the local Activity. Label in accordance with TIA-606 for activities without current labeling standards. Choose appropriate cable labeling requirements based on verification results.
****

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice.[Tag only new wire and cable provided by this contract.][Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract.] The labeling of telecommunications cable tag identifiers shall be[as indicated][in accordance with TIA-606].[Tag legend shall be as indicated.] Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

****
NOTE: Select the second bracketed sentence if Section 09 90 00 PAINTS AND COATINGS is used on the project and delete the subparagraphs for CLEANING, PRIMING, and FINISH COAT.
****

[Provide ferrous metallic enclosure finishes in accordance with the following procedures. Ensure that surfaces are dry and clean when the coating is applied. Coat joints and crevices. Prior to assembly, paint surfaces which will be concealed or inaccessible after assembly. Apply primer and finish coat in accordance with the manufacturer's recommendations.][Provide ferrous metallic enclosure finishes as specified in Section 09 90 00 PAINTS AND COATINGS.]

[3.3.1 Cleaning

Clean surfaces in accordance with SSPC SP 6/NACE No.3.

][3.3.2 Priming

Prime with a two component polyamide epoxy primer which has a bisphenol-A base, a minimum of 60 percent solids by volume, and an ability to build up a minimum dry film thickness on a vertical surface of 0.127 mm 5.0 mils. Apply in two coats to a total dry film thickness of 0.127 to 0.2 mm 5 to 8 mils.

][3.3.3 Finish Coat

Finish with a two component urethane consisting of saturated polyester polyol resin mixed with aliphatic isocyanate which has a minimum of 50 percent solids by volume. Apply to a minimum dry film thickness of 0.05 to 0.076 mm 2 to 3 mils. Color shall be the manufacturer's standard.

]3.4 FIELD FABRICATED NAMEPLATE MOUNTING

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

3.5 FIELD QUALITY CONTROL

Provide the Contracting Officer[10][_____] working days notice prior to[each][_____] test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.5.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.5.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.5.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.5.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least[5][_____] working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable,

pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.5.2 Acceptance Tests

****
NOTE: Designer should delete tests that are not required.
****

Perform acceptance testing in accordance with RUS Bull 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting Officer at least[14][_____] days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

3.5.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with TIA-758:

a. Wire map (pin to pin continuity)

b. Continuity to remote end

c. Crossed pairs

d. Reversed pairs

e. Split pairs

f. Shorts between two or more conductors

3.5.2.2 Fiber Optic Cable

****
NOTE: The OTDR works on the principal of the amount of light that is reflected back to the source and therefore gives an estimated loss value. Typically, the OTDR can be used for locating problems causing high attenuation. It should be noted, however, that the distances needed for accurate OTDR readings must exceed 100 m 328 ft. To overcome the long tail on the trace due to the initial reflection at the OTDR connector, a "dead-zone fiber" with a length exceeding the displayed pulse duration may be used between the OTDR connector and the specimen. (Numerically, pulse length in meters corresponds to approximately one-tenth the pulse duration in ns.) To avoid the tail, the dead-zone fiber length may be

up to 20 times the pulse length, depending upon characteristics of the individual OTDR. Recommend a 20 meter 66 feet jumper minimum, for testing fiber optic cabling using the OTDR, however on long cabling runs this length may be inadequate to overcome the dead-zone and potentially skew test results. Select 850 or 1300 nanometer light source for multimode fiber and 1310 or 1550 nanometer light source for single-mode fiber.

****

Test fiber optic cable in accordance with TIA/EIA-455 and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multimode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber,[20][_____] m[66][_____] feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with TIA-526-7 for single-mode fiber and TIA-526-14 for multimode fiber. Splice losses shall not exceed 0.3 db.

b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a[850][1300][1310][1550] nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with[TIA-455-46A for multimode][and][TIA-526-7 for single-mode] fiber optic cables. The measurement method shall be in accordance with TIA-455-78-B. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber. Attenuation losses shall not exceed 5.0 db/km at 850 nm and 1.5 db/km at 1300 nm for multimode fiber.

c. Bandwidth Test: The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with TIA/EIA-455-204.

3.5.3 Soil Density Tests

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NOTE: Choose one of the following options.

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[a. Determine soil-density relationships for compaction of backfill material in accordance with ASTM D1557, Method D.

][b. Determine soil-density relationships as specified for soil tests in Section 31 00 00 EARTHWORK.

] -- End of Section --