

## SECTION 40 95 33.23 20

## FIBER OPTIC (FO) OUTSIDE PLANT (OSP) MEDIA

04/06

## PART 1 GENERAL

## 1.1 REFERENCES

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.

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

**EIA/TIA-455-78A** (1990; R 1998) Spectral-Attenuation  
Cutback Measurement for Single-Mode  
Optical Fibers

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

**IEEE C2** (2007; Errata 2007) National Electrical  
Safety Code

## INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

**ICEA S-87-640** (2006) Fiber Optic Outside Plant  
Communications Cable

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

**NEMA 250** (2008) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

**NEMA RN 1** (2005) Standard for Polyvinyl Chloride  
(PVC) Externally Coated Galvanized Rigid  
Steel Conduit and Intermediate Metal  
Conduit

**NEMA TC 2** (2003) Standard for Electrical Polyvinyl  
Chloride (PVC) Tubing and Conduit

**NEMA TC 3** (2004) Standard for Polyvinyl Chloride PVC  
Fittings for Use With Rigid PVC Conduit  
and Tubing

**NEMA TC 6 & 8** (2003) Standard for Polyvinyl Chloride PVC  
Plastic Utilities Duct for Underground  
Installations

**NEMA TC 9** (2004) Standard for Fittings for Polyvinyl  
Chloride (PVC) Plastic Utilities Duct for  
Underground Installation

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

**NFPA 70** (2007; AMD 1 2008) National Electrical  
Code - 2008 Edition

## TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-107A	(1999) Component Reflectance or Link/System Return Loss using a Loss Test Set
TIA-455-78-B	(2002) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation
TIA-472D000-A	(1993) Fiber Optic Communications Cable for Outside Plant Use
TIA-526-14-A	(1998) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-526-7	(2002) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant OFSTP-7
TIA-590-A	(1997) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
TIA-758-A	(2004) Customer-Owned Outside Plant Telecommunications Cabling Standard
TIA/EIA-455-B	(1998) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components
TIA/EIA-472DAAA	(1993) Detail Specification for All Dielectric Fiber Optic Communications Cable for Outside Plant Use Containing Class 1a 62.5 Um Core Diameter/125 um Cladding Diameter/250 um Coating Diameter Fiber(s).
TIA/EIA-4750000-C	(1996) Generic Specifications for Fiber Optic Connectors (ANSI)
TIA/EIA-568-B.1	(2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements
TIA/EIA-568-B.3	(2000; Addendum 2002) Optical Fiber Cabling Components Standard
TIA/EIA-569-A	(1998; Addenda 2000, 2001) Commercial Building Standards for Telecommunications Pathways and Spaces
TIA/EIA-598-B	(2001) Optical Fiber Cable Color Coding
TIA/EIA-604-3A	(2000) FOCUS 3 Fiber Optic Connector

## Intermateability Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1753F-601

(1994) Specifications for Filled Fiber  
Optic Cables (PE-90) Ref Title

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-188-176

(Notice 1) Standardized Profile for  
Asynchronous Transfer Mode (ATM)

MIL-STD-2042

(Rev B; Notice 1) Fiber Optic Cable  
Topology Installation Standard Methods for  
Naval Ships

## 1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

## 1.3 SUBMITTALS

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

## SD-02 Shop Drawings

Fiber Optic System; G

## SD-03 Product Data

Fiber Optic Media Types; G

Fiber Optic Splices Material Data; G

Fiber Optic Terminations and Connectors Material Data; G

Fiber Optic Enclosures; G

## SD-06 Test Reports

Fiber Optic Factory Test Plan; G

Fiber Optic Field Tests Plan; G

## SD-07 Certificates

Fiber Optic Cable Installer and Splicer Qualifications; G

Manufacturer's qualifications; G

## SD-08 Manufacturer's Instructions

Fiber optic system instructions; G

## 1.4 QUALITY ASSURANCE

### 1.4.1 Fiber Optic System

Provide drawings for the fiber optic cable and pathway system. Provide single line schematic details of the fiber optic and pathway media, splices, and associated construction materials. Drawings shall be in AUTOCAD.DXF or compatible format. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the fiber optic system. Include drawing details of fiber optic terminations in equipment rooms. System drawings shall show final configuration, including location, fiber pair count, pathway innerduct arrangement, and pathway assignment of outside plant. FO system shall be compatible with MIL-STD-188-176. Pier FO systems shall be designed for compatibility with MIL-STD-2042 and NAVSEA drawings.

### 1.4.2 Fiber Optic Cable Installer and Splicer Qualifications

Technicians installing FO media, splices and performing system tests shall be certified and trained in accordance with an approved manufacturers training program. Technicians shall have a minimum of 3 years FO experience in installing equivalent FO systems. Submit data for approval to the Contracting Officer. Submit FO technician qualifications for approval 30 days before splices are to be made on the cable. Certification shall include the training, and experience of the individual on specific type and classification of FO media to be provided under this contract.

### 1.4.3 Fiber Optic System Instructions

Provide installation methods and procedures for installing the FO media and pathway system. Include methods and procedures for installing FO media, pathway, splices, and associated hardware. Submit installation procedures and equipment list to the Contracting Officer.

### 1.4.4 Manufacturer's Qualifications

The FO media manufacturer shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of FO media which comply with RUS Bull 1753F-601. Manufacturer must provide a list of customers with 3 years of maintenance logs documenting experience with government customers.

### 1.4.5 Fiber Optic Factory Test Plan

Prepare and provide the government for review a test plan for factory and field tests of the FO media. Provide factory OTDR test data as part of the test report. Provide a list of factory test equipment. Include a FO link performance test plan. Submit the plan at least 30 days prior to tests for government approval. Refer to TIA/EIA-569-A for performance measurement criteria. Conduct tests at all operating bandwidths. Provide calculations for optical power budget and bandwidth as required by RUS Bull 1753F-601 using test method EIA/TIA-455-78A or TIA/EIA-455-B. Submit test plans and reports to the government for review and approval.

### 1.4.6 Fiber Optic Field Tests Plan

Prepare and provide technicians and test equipment for field tests of FO media. Conduct OTDR reel tests at the job site prior to installation. Perform OTDR and end to end tests of all installed media. Conduct tests on single mode fiber in accordance with TIA-526-7 for single mode fiber and

EIA TIA/EIA-526-14A for multi mode fiber.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Ship media to job site on factory reels or in factory cartons. Radius of the reel drum shall not be smaller than the minimum bend radius recommended by the manufacturer for the media. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at each end of the reel must be readily accessible for testing. Provide a permanent label on each reel showing length, media, identification number, and date of manufacture. Provide water resistant label and ink on the labels. Apply end seals to each end of the media after testing and before terminating to prevent moisture from entering the cable while stored at the job site. 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 zero to 100 percent. Equipment, other than FO media, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

Materials and FO system material shall be the standard products of a manufacturer regularly engaged in the manufacturer of such products and shall be the manufacturer's standard commercially available product.

##### 2.1.1 Fiber Optic Media Types

FO media shall meet all performance requirements of [TIA/EIA-568-B.1](#), [TIA/EIA-568-B.3](#) and the physical requirements of [ICEA S-87-640](#) and [TIA/EIA-598-B](#).

##### 2.1.1.1 Multi Mode Fiber Media

Provide FO media with outer sheath jacket, strength member, ripcords, water blocking material, optional steel shield, core tube, and core fibers as installed in a permanent underground pathway system as shown on the construction drawings. FO media shall have an all glass, graded index material with a nominal core diameter of 62.5 microns. Provide a cladding material for the fiber which is compatible with the core. Media transmission window shall be centered at 850 and 1300 nanometer wavelengths, attenuation at 1300 nanometers shall be less than 2.0 dB per kilometer. Minimum bandwidth shall be 500 mHz-Km.

##### 2.1.1.2 Single Mode Fiber Media.

Provide FO single mode media with outer sheath jacket, strength member, ripcords, water blocking material, optional steel shield, core tube, and core fibers as installed in a permanent underground pathway system as shown on the construction drawings. Media shall have all glass, dual window, graded index material with a core diameter of 8.7 microns. Fiber shall be coated with a cladding material which is concentric with the core. Fiber cladding diameter shall be nominal 125 microns. Media shall have a transmission window centered at 1300 and 1550 nanometer wavelengths, attenuation at 1550 nanometers shall be less than 0.5 dB per kilometer. FO media shall comply with [TIA/EIA-472DAAA](#), and [TIA-758-A](#).

## 2.2 FIBER OPTIC SPLICES

Provide FO splices and splicing materials for fusion or mechanical methods at locations shown on the construction drawings. The splice insertion loss shall be less than 0.1 dB mean, (0.3 dB max) 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-455-107A.

## 2.3 FIBER OPTIC ENCLOSURES

Provide metallic enclosures for fiber optic data transmission equipment. NEMA 250, type 4 enclosure. Enclosures shall protect the spliced fibers from moisture and physical damage. Splice closure shall provide strain relief for the cable and the fibers at splice points. Provide full documentation citing conformance to structural parameters.

## 2.4 FIBER OPTIC TERMINATIONS AND CONNECTORS

FO connectors shall comply with TIA/EIA-4750000-C and TIA/EIA-604-3A.

## 2.5 FIBER OPTIC PATHWAY SYSTEM

Provide an FO pathway system including raceway conduit, duct system, and maintenance manholes and handholes as shown on the drawings. Pathway materials shall comply with TIA/EIA-569-A, and the following commercial standards for construction materials, NEMA RN 1 (PVC), NEMA TC 2 (PVC), NEMA TC 3 (PVC), NEMA TC 6 & 8, and NEMA TC 9.

### 2.5.1 Conduit

Conduit as specified in Section 33 70 02.00 10 ELECTRICAL UNDERGROUND DISTRIBUTION.

## 2.6 FACTORY FO QUALITY CONTROL

Conduct factory quality tests of FO media as required by TIA-472D000-A.

## 2.7 PREPARATION FOR DELIVERY

Ship media on reels. Provide 6 1/2 feet pigtailed on each end of media accessible for testing. Reel drum shall comply with manufacturers recommended bend radius for the media. Wind media on reel so that unreeling can be done without kinking the media. Attach a permanent waterproof label with indelible text on reel showing the length, media type, bandwidth, attenuation, and date of manufacture.

## 2.8 FACTORY REEL TEST

Test 100 percent OTDR test of FO media at the factory prior to shipment in accordance with TIA/EIA-568-B.1 and TIA/EIA-568-B.3. Use TIA-526-7 for single mode fiber and EIA TIA/EIA-526-14A Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Provide digitized or photographic traces to the Contracting Officer.

## 2.9 MISCELLANEOUS ITEMS

### 2.9.1 FO Media Tags

Provide stainless steel, 1 5/8 inches in diameter 1/16 inch thick, and circular in shape.

### 2.9.2 Buried Warning and Identification Tape

Provide color, type and depth of tape as specified in paragraph "Buried Warning and Identification Tape" in Section 31 00 00 EARTHWORK, FO media must be marked and protected as required by TIA-590-A.

### 2.9.3 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. Braid shall be made from flat tin-plated copper.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install and test the FO media in accordance with contract drawings, specifications, IEEE C2, NFPA 70, and TIA-590-A. Provide all necessary power, utility services, technicians, test equipment, calibration equipment as required to perform reel and final acceptance tests of the media. All media which fail the factory or reel tests or final acceptance field tests shall be replaced and re-tested at the contractors expense. Splices are not permitted unless shown on the construction drawings. Field test splices within 24 hours after splice installation. Splices shall be tested to demonstrate a maximum 0.2 dB loss. Provide a splice box for each field splice. Provide a minimum of 2 meters for routing and testing media. Protect media ends of unspliced FO media during splicing operations.

#### 3.1.1 Contractor Damage

Promptly repair indicated utility and communications lines or systems damaged during site preparation and construction. In every event, immediately notify the Contracting Officer of damage.

#### 3.1.2 Direct Burial System

Installation shall be in accordance with TIA-590-A. 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 24 inches below finished grade. Trenches shall be not less than 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 36 inches. Where two or more cables are laid parallel in the same trench, space laterally at least 3 inches apart. When rock is encountered, remove it to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Do not unreel and pull cables into the trench from one end. Cable may be unreel on grade and lifted into position. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

### 3.1.2.1 Media Placement

- a. Separate FO media crossing other cables or metal piping from the other cables or pipe by not less than 3 inches of well tamped earth. Do not install FO media under or above traffic signal loops.
- b. Media shall be in one continuous length without splices except where splices are shown on the drawings.
- c. Do not allow bends in media which exceed the manufacturers minimum recommended radii. Do not bend media to a radius less than 10 times the outside diameter of the media.
- d. Leave a horizontal slack of approximately 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections.

### 3.1.2.2 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 20 inches square by 150 mm 6 inches thick and stake mounted warnings meeting the requirements of REA.

### 3.1.3 Underground Duct

Construct underground duct as specified in Section 33 70 02.00 10 ELECTRICAL UNDERGROUND DISTRIBUTION. Encase in concrete any ducts under roads, paved areas, or railroad tracks.

#### 3.1.3.1 Connections to Existing Maintenance Holes and Handholes

For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and the duct line envelope.

#### 3.1.3.2 Connections to Concrete Pads

For duct line connections to concrete pads, break an opening in the pad out to the dimensions required and preserve the steel in the pad. Cut the steel and extend it out to tie into the reinforcing of the duct line envelope. Chip out the opening in the pad to form a key for the duct line envelope.

#### 3.1.3.3 Connections to Existing Ducts

Where connections to existing duct lines are indicated, excavate the lines to the maximum depth required. Cut off lines and remove loose concrete from the conduits before new concrete encased ducts are installed. Provide reinforced concrete collar, poured monolithically with the new duct line to take the shear at the joint of the duct lines.

### 3.1.4 Reconditioning of Surfaces

#### 3.1.4.1 Unpaved Surface Treatment

Restore unpaved surfaces disturbed during the installation of duct or direct burial cable to their original elevation and condition. Carefully preserve existing sod and topsoil and replace after the back-filling is completed. Replace damaged sod with sod of quality equal to that removed. Where the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

#### 3.1.4.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and in other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement to the same thickness and to the same kind as previously existed. Surface treatment or pavement shall also match and tie into the adjacent and surrounding existing surfaces.

#### 3.1.5 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of FO media. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on media when entering or leaving the maintenance holes. Do not place media 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 media reels on the same side of the maintenance hole as the pathway section in which the media is to be placed. Level the reel and bring into proper alignment with the pathway section so that the media pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the media be paid off from the bottom of the reel. Check the equipment set up prior to beginning the media cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between media reel and face of duct to protect media and guide cable into the duct as it is paid off the reel. As media is paid off the reel, lubricate and inspect media for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Stop media pulling if reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide media lubricants recommended by the cable manufacturer. Provide 3.3 feet of spare media in all manholes and enclosures for final termination and testing.

##### 3.1.5.1 FO Media Tensions

Install FO media as shown on construction drawings. Provide devices to monitor media tension during installation. Do not exceed manufacturers recommended maximum FO tensions and bending radii during installation.

##### 3.1.5.2 Pulling Eyes

Equip media 1- 1/4 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide media with diameter smaller than 1-1/4 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 grip of 3/4 inch links

between pulling-in eyes or grips and pulling strand.

### 3.1.5.3 Installation of Media in Maintenance Manholes, Handholes, and Vaults

Do not install media 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 media on brackets and cable insulators at a maximum of 4 feet. In existing maintenance manholes, handholes, and vaults where new ducts are to be terminated, or where new media are to be installed, modify the existing installation of media, cable supports, and grounding as required with cables arranged and supported as specified for new media.

### 3.1.6 Grounding

Ground exposed non current carrying metallic parts of telephone equipment, media sheaths, media splices, and terminals.

### 3.1.7 Housekeeping

The Contractor shall be responsible for cleaning up work area and maintaining the work area in orderly condition.

## 3.2 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working days notice prior to each reel and final acceptance 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.

### 3.2.1 Field Reel Tests

Perform the following tests on FO media 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 media. Perform OTDR tests with media on reels and compare factory and field test data.

#### 3.2.1.1 Reel Test Results

Provide results of reel tests to the Contracting Officer at least 5 working days before installation is to commence. Results shall indicate reel number of the media, manufacturer, type and number of fiber tested, and recorded readings. When reel tests indicate that the media does not comply with factory reel test results remove the media from the job site and replace with compliant media.

### 3.2.2 Final Acceptance Tests

Perform end-to-end tests including power meter light source and OTDR tests. Perform OTDR measurements as required by TIA/EIA-568-B.1 and TIA/EIA-568-B.3. Single mode fiber shall be tested in accordance with TIA-526-7 (Optical Power Loss). Multi mode fiber shall be tested in accordance with TIA-526-14-A (Optical Power Loss).

3.2.2.1 Test Results

Provide results of final acceptance tests (attenuation tests, OTDR traces, etc.), to the Contracting Officer at least 5 working days after completion of tests.

-- End of Section --