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DEPARTMENT OF DEFENSE STANDARD PRACTICE

FIBER OPTIC CABLE TOPOLOGY INSTALLATION STANDARD METHODS FOR SURFACE SHIPS AND SUBMARINES

FOREWORD

1. This standard is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

2. This standard provides detailed information and guidance to personnel concerned with the installation of fiber optic cable topologies (optical fiber cabling and associated components) on naval surface ships and submarines. The methods specified herein are not identifiable to any specific ship class or type except as noted. They are intended to standardize and minimize variations in installation methods to enhance the compatibility of the installations on all naval ships.

3. In order to provide flexibility in the use and update of the installation methods, this standard is issued in eight parts; the basic standard and seven numbered parts as follows:

Part 1: Cables

Part 2: Equipment

Part 3: Cable Penetrations

Part 4: Cableways

Part 5: Connectors and Interconnections

Part 6: Tests

Part 7: Pierside Connectivity Cable Assemblies and Interconnection Hardware

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy mil (copy DLGR_NSWC_FO_ENG@navy.mil), with the subject line “Document Comment”. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

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1. SCOPE

1.1 Scope. This standard provides requirements and detailed methods for the installation and testing of fiber optic cabling and associated components on surface ships and submarines.

1.2 Applicability. The installation requirements and methods in this document are intended to be used by all installing activities. These methods establish standards for installations on all naval ships and are not identifiable to any specific ship class or type, except as noted. The methods in this document are for new construction as well as for conversions, alterations, and repairs.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this standard, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1678-1	-	Fiber Optic Cabling Systems Requirements and Measurements (Part 1: Design, Installation and Maintenance Requirements) (Part 1 of 6 Parts)
MIL-STD-2042-1	-	Fiber Optic Cable Topology Installation, Standard Methods for Surface Ships and Submarines (Cables) (Part 1 of 7 Parts)
MIL-STD-2042-2	-	Fiber Optic Cable Topology Installation, Standard Methods for Surface Ships and Submarines (Equipment) (Part 2 of 7 Parts)
MIL-STD-2042-3	-	Fiber Optic Cable Topology Installation, Standard Methods for Surface Ships and Submarines (Cable Penetrations) (Part 3 of 7 Parts)
MIL-STD-2042-4	-	Fiber Optic Cable Topology Installation, Standard Methods for Surface Ships and Submarines (Cableways) (Part 4 of 7 Parts)
MIL-STD-2042-5	-	Fiber Optic Cable Topology Installation, Standard Methods for Surface Ships and Submarines (Connectors and Interconnections) (Part 5 of 7 Parts)
MIL-STD-2042-6	-	Fiber Optic Cable Topology Installation, Standard Methods for Surface Ships and Submarines (Tests) (Part 6 of 7 Parts)
MIL-STD-2042-7	-	Fiber Optic Cable Topology Installation, Standard Methods for Surface Ships and Submarines (Pierside Connectivity Cable Assemblies and Interconnection Hardware) (Part 7 of 7 Parts)

(Copies of these documents are available online at http://quicksearch.dla.mil/.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Acronyms. The following acronyms are used in this standard:

a. BOF: Blown Optical Fiber.

b. BOTR: Blown Optical Tube Routing Box.

c. FIB: Fiber Interconnection Box.

d. FOCP: Fiber Optic Cable Plant.

e. FOCT: Fiber Optic Cable Topology.

f. FOICB: Fiber Optic Interconnection Box.

g. LED: Light Emitting Diode.

h. MCP: Multiple Cable Penetrator.

i. NRC: Non-redundant Channel.

j. OFCC: Optical Fiber Cable Component.

k. OFCS: Optical Fiber Communication System.

l. TRB: Tube Routing Box.

3.2 Allocated and not used fiber. A fiber that is designated for use for a particular system, but is not being used to transmit information. Allocated and not used fibers include fibers identified as system spare fibers, system growth fibers, and system redundant fibers.

3.3 Allocated and used fiber. A fiber that is designated and required for use for a particular system link, and is being used to transmit information. Allocated and used fibers include fibers used for normal channels, fibers for alternate channels, and fibers for non-redundant channels.

3.4 Alternate channel. The allocated and used active backup link for a normal channel.

3.5 Authorized approval. Written approval from the cognizant Government activity.

3.6 BOF bundle. A group of optical fibers within a special jacket that allows the entire bundle to be blown into a BOF tube.

3.7 BOF cable furcation. An assembly that joins the multiple tubes in a multi-tube BOF cable to multiple single-tube BOF cables.

3.8 Blown optical fiber (BOF). An optical fiber with a special coating that allows the fiber to be blown into a BOF tube.

3.9 BOF growth tube. An unallocated tube in a BOF trunk cable intended for later use by fiber optic systems installed after initial ship construction.

3.10 BOF path. The unique assemblage of concatenated BOF tubes, which form a continuous conduit through the FOCP between two BOF end points.

3.11 BOF tube. A tube within a BOF cable through which blown optical fibers or blown optical fiber bundles are blown.

3.12 BOF tube coupler. A device used to join two BOF tubes together.

3.13 BOF tube routing box (TRB). An enclosure for holding BOF cables (trunk and local), BOF tubes (trunk and local), and tube couplers to interconnect BOF tubes. Also known as a Blown Optical Tube Routing Box (BOTR).

3.14 Cable repair. Restoration or repair of only the outermost cable jacket.

3.15 Cable splicing.

3.15.1 BOF cable splicing. The joining of two BOF cable ends by connecting the tube ends together using tube couplers and providing an environmental enclosure at the spliced region.

3.15.2 Conventional cable splicing. Repair of a damaged conventional optical fiber cable by reconnecting severed fibers and providing an environmental enclosure at the spliced region.

3.16 Chafing collar. A chafing collar is a round or oval banding that protects two or more cables that penetrate structure from crimping and wear caused by rubbing against sharp edges.

3.17 Collective protection system (CPS). A CPS system is a system designed to inhibit the entry of chemical, biological, and radiological contaminants into collective protection zones aboard naval ships.

3.18 Concatenated optical link. A concatenated optical link is a link made up of two or more individual cable assemblies connected together in series.

3.19 End user equipment. Any cabinet, case, panel, or device that contains components that are either the origin or destination of an optical signal.

3.20 Fiber optic cable plant (FOCP). A subset of the FOCT that excludes local cables, cables internal to end user equipment, and their associated components. A conventional FOCP includes FOICBs, trunk cables, and their associated connectors and splices. A BOF FOCP consists of FOICBs, TRBs, tube couplers, BOF trunk cables, BOF fibers, BOF bundles, tube furcation units, and associated connectors and splices.

3.21 Fiber optic cable topology (FOCT). An integrated optical fiber distribution system that provides the optical interconnection between an optical transmitter and an optical receiver. A conventional FOCT includes the conventional FOCP components and outlet boxes, local cables, cables internal to end user equipment, and their associated connectors and splices. A BOF FOCT includes the BOF FOCP components, BOF cable furcations, local cables, local BOF cables, outlet boxes, cables internal to end user equipment, and associated connectors and splices.

3.22 Fiber optic interconnection box (FOICB). An enclosure for holding optical fiber cable (BOF and conventional), BOF tubes, tube furcation units, and optical fiber connectors, splices, and adapters. Also known as Fiber Interconnection Box (FIB).

3.23 FOCP growth fiber. An unallocated fiber intended for later use by fiber optic systems installed after initial ship construction.

3.24 Installing activity. Any military or commercial organization involved with the installation of FOCTs aboard naval ships.

3.25 Kickpipe. A kickpipe is a pipe welded into the deck with a stuffing tube attached. Kickpipes provide protection for cables at deck penetrations and are used to clear an obstruction or preserve alignment.

3.26 Local cable.

3.26.1 Local BOF cable. A BOF cable that runs between end user equipment and the FOCP.

3.26.2 Local conventional cable. A conventional optical fiber cable that runs between end user equipment and an FOICB (or outlet box), or between an FOICB and an outlet box.

3.27 Measurement quality jumper (MQJ). A jumper cable that is of high optical quality and is highly repeatable in successive connections.

3.28 Metal stuffing tube. A metal stuffing tube provides a means for making watertight, single-cable penetrations through shell plating, decks, and bulkheads, and into equipment.

3.29 Minimum bend diameter. The diameter at which a conventional optical fiber cable, OFCC, loose tube furcation unit, or BOF bundle can be bent without degrading optical performance, or the diameter at which a BOF cable or BOF tube can be bent without kinking a BOF tube. The short-term bend diameter applies during handling and installing; the long-term bend diameter applies to the completed installation.

3.30 Multiple cable penetrator (MCP). A device that provides a means for making watertight, airtight, and fire-tight penetrations through decks and bulkheads, and into equipment.

3.31 Nipple. A smaller version of the chafing collar, and is used to protect a single cable penetration.

3.32 Non-redundant channel (NRC). Any allocated and used active link that has no system required backup link.

3.33 Normal channel. An allocated and used active link between system equipment that has a designated active backup link.

3.34 Optical fiber cable. A cable that contains optical fibers.

3.34.1 BOF cable. A cable that contains one or more BOF tubes through which blown optical fibers or blown optical fiber bundles are blown.

3.34.2 Conventional optical fiber cable. An optical fiber cable in which the optical fiber is an integral part of the cable and is installed during the cable manufacturing process.

3.35 Optical fiber cable component (OFCC). A buffered fiber augmented with a concentric layer of strength members and an overall jacket.

3.36 Outlet box. A small termination box (also known as a drop box) used to break out a local cable from an interconnection box to one or more equipments within a compartment or area.

3.37 Spare fiber. A fiber reserved for use as a maintenance spare in the event of damage to an allocated fiber within the FOCT.

3.37.1 FOCP spare fiber. An unallocated spare fiber for use by any system using the FOCP.

3.37.2 System spare fiber. A spare fiber that is allocated and not used and that is reserved for use by a specific system.

3.38 Swage tube. A swage tube provides watertight cable penetrations through decks and is an alternative to a stuffing tube with a kickpipe.

3.39 System growth fiber. An allocated and not used fiber identified as a growth requirement for a specific system.

3.40 System redundant fiber. An allocated and not used fiber identified by the user system as a required alternately routed fiber.

3.41 Trunk. A set of trunk cables that run along the same cableways between two FOCP boxes (e.g., TRBs and FOICBs).

3.42 Trunk cable. An optical fiber cable that runs between two FOICBs. Typically, trunk cables are run in the main cableways and have higher fiber counts per cable than local cables.

3.42.1 BOF trunk cable. A single BOF cable connecting two FOCP TRBs or between a FOCP TRB and a FOCP FOICB. A BOF trunk cable contains multiple BOF trunk tubes.

3.42.2 BOF trunk tube. A BOF tube bundled within a BOF trunk cable that runs between two FOCP TRBs or between a FOCP TRB and a FOCP FOICB.

3.42.3 Conventional trunk cable. A conventional optical fiber cable that runs between two fiber optic interconnection boxes.

3.43 Tube coupler. A device used to join two BOF tubes together.

3.44 Tube furcation unit. An assembly attached to the end of a BOF tube in a BOF cable used to separate the fibers and provide a cable structure to facilitate the termination of the optical fibers from that BOF tube.

3.45 Loose tube furcation cable. A subcomponent of a tube furcation unit consisting of a hollow tube (650 μm inner diameter, 900 μm outer diameter) augmented with a concentric layer of strength members and an overall jacket designed to allow for insertion and termination of individual BOF fiber strands.

3.46 Unallocated fiber. A fiber that is not designated for use for any system, but is required as part of the FOCT configuration. Unallocated fibers include FOCP spare fibers and FOCP growth fibers.

3.47 Unused fiber. A fiber that is not designated for use for any system and not required as part of the FOCT configuration. Unused fibers occur within the FOCT when the required systems fibers are not an integer multiple of the number of fibers available within standard cable sizes.

4. GENERAL REQUIREMENTS

4.1 Organization. This standard is comprised of a base standard and seven different parts, each of which is a separate publication with a unique identification number. This organization provides maximum flexibility in using, referencing, and revising the standard. The complete standard consists of the basic standard and seven numbered parts as follows:

MIL-Standard Number	Title
MIL-STD-2042	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines
MIL-STD-2042-1	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Cables) (Part 1 of 7 Parts)
MIL-STD-2042-2	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Equipment) (Part 2 of 7 Parts)
MIL-STD-2042-3	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Cable Penetrations) (Part 3 of 7 Parts)
MIL-STD-2042-4	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Cableways) (Part 4 of 7 Parts)
MIL-STD-2042-5	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Connectors and Interconnections) (Part 5 of 7 Parts)
MIL-STD-2042-6	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Tests) (Part 6 of 7 Parts)
MIL-STD-2042-7	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Pierside Connectivity Cable Assemblies and Interconnection Hardware) (Part 7 of 7 Parts)

4.2 Arrangement and contents. Each numbered part of this standard contains a series of standard installation methods. Methods providing similar functions are grouped together for ease of use and referencing as follows:

MIL-STD-2042 Part Number	Functional Group	Function
1 (Cables)	A	Cable end-sealing
	B	Cable jacket repair
	C	BOF cable splicing
	D	Multiple-tube to single-tube BOF cable furcation
	E	OFCC and loose tube furcation end sealing
2 (Equipment)	A	Conventional cable entrance to equipment via nylon stuffing tubes
	B	Conventional cable entrance to equipment via MCP
	C	Conventional cable and buffered fiber forming and shaping
	D	Splice assembly and alignment
	E	BOF tube to OFCC furcation unit fabrication
	F	BOF tube to OFCC furcation unit installation
	G	BOF cable entrance to equipment via nylon stuffing tubes
	H	BOF cable entrance to equipment via MCP
	I	BOF cable routing, forming, and shaping
	J	BOF tube end sealing
	K	Fusion splicing, fiber routing, shaping forming
	L	8- to 5-millimeter BOF tube transitions
	M	5-millimeter BOF splice tray attachment
3 (Penetrations)	A	Cable penetrations via metal stuffing tubes
	B	Cable penetrations via MCP
4 (Cableways)	--	Methods in MIL-STD-2003 referenced
5 (Connectors and Interconnections)	A	Multiple terminus connector installation
	B	Single terminus connector installation
	C	Splicing installation
	D	Termination processes

MIL-STD-2042 Part Number	Functional Group	Function
6 (Tests)	A	Visual inspection
	B	Cable attenuation test
	C	Cable assembly link loss test
	D	Cable continuity test
	E	Cable topology end-to-end attenuation test
	F	Measurement quality jumper selection test
	G	Heavy duty connector mechanical pull test
	H	BOF cable BB test
	I	BOF cable pressurization test
	J	BOF tube seal verification test
	K	Cable assembly return loss test
	L	Cable topology end-to-end return loss test
	M	Connector cleaning and inspection
7 (Pierside Connectivity Cable Assemblies and Interconnection Hardware)	A	Hermaphroditic connector termination
	B	Shipboard interconnection box interior cable routing
	C	Umbilical assembly cable tie-down guidelines and practices
	D	Umbilical assembly cable spooling operations
	E	Cleaning and mating the hermaphroditic connector
	F	Optical test of pierside connectivity cable plant components
	G	Pier interconnection box installation
	H	Hermaphroditic connector position, mating, and concatenation
	I	Optical return loss testing of pierside connectivity cable assemblies
	J	Optical acceptance testing of pierside connectivity measurement quality jumpers

4.3 Method improvement. Where the methods herein cannot be implemented, users shall submit proposed new methods or proposed modifications of existing methods, as specified (see 6.4).

4.4 Personnel qualifications. Fiber optic installers, supervisors, and Quality Assurance (QA) personnel shall meet Navy shipboard personnel proficiency requirements identified in MIL-STD-1678-1, Requirement 1306 for all fiber optic installations, modifications, and repairs.

5. DETAILED REQUIREMENTS

This section is not applicable to this standard.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The standard methods for installation and testing of the fiber optic cable topology depicted in Parts 1 through 7 of this standard have been developed, tested, and approved so that the shipboard fiber optic installations described can withstand the environmental and operational conditions aboard U.S. Navy vessels. They are intended primarily for new construction; however, they are also applicable for conversion, alteration, or repair of existing ships. In the case of conversion, alteration, or repair, the degree of applicability of these criteria will be specified by the activity preparing instructions for the work.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this standard.

6.3 Subject term (key word) listing.

Arrangement and content

Blown optical fiber

Fiber optic cable plant

Organization

6.4 Proposed new methods or method modifications. As specified (see 4.3), proposed new methods or proposed modifications of existing methods should be submitted to DLGR_NSWC_FO_ENG@navy.mil or Department of the Navy, Naval Surface Warfare Center, Dahlgren Division, ATTN: Fiber Optic Engineering Manager, 17214 Avenue B, Suite 126, Dahlgren, VA 22448-5147.

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Preparing activity:
Navy – SH
(Project SESS-2014-004)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.