METRIC

MIL-STD-2042-4C(SH)
18 October 2016

SUPERSEDING
MIL-STD-2042-4B(SH)
25 July 2002

DEPARTMENT OF DEFENSE STANDARD PRACTICE

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

(CABLEWAYS)

(PART 4 OF 7 PARTS)

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 base 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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LIST OF FIGURES

1. SCOPE

1.1 Scope. This standard provides requirements and detailed methods for installing optical fiber cable cableways and cable protection 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 in 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 SPECIFICATIONS

MIL-DTL-15024	-	Plates, Tags, and Bands for Identification of Equipment, General Specification for
MIL-P-15024/5	-	Plate, Identification
MIL-PRF-85045/26	-	Cable, Fiber Optic, One Tube, Blown Optical Fiber, Standard and Enhanced Performance, Cable Configuration Type 5 (Tube), Application B (Shipboard), Cable Class SM and MM

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-2003-4	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Cableways)
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-2042-6	-	Fiber Optic Cable Topology Installation, Standard Methods for Surface Ships and Submarines (Tests) (Part 6 of 7 Parts)

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

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications 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.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) DRAWINGS

803-5184182 - Passive Fire Protection Insulation - Installation Details

(Copies of this document are available online at https://199.208.213.105/webjedmics/index.jsp. To request an NSEDR account for drawing access, send an email to NNSY_JEDMICS_NSEDR_HELP_DESK@navy mil.)

2.3 Non-Government publications. The following documents 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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z136.2 - Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources

(Copies of this document are available online at http://webstore.ansi.org.)

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-440 - Fiber Optic Terminology

(Copies of this document are available online at www.tiaonline.org.)

2.4 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 General fiber optics terms. Definitions for general fiber optics terms used in this standard are in accordance with TIA-440.

3.2 Other fiber optics terms. Definitions for other terms as they are used in this standard are given in the general standard MIL-STD-2042.

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

a. BOF: Blown Optical Fiber
b. FOCT: Fiber Optic Cable Topology
c FOICB: Fiber Optic Interconnection Box
d. LED: Light Emitting Diode
e. MCP: Multiple Cable Penetrator
f. NRC: Non-Redundant Channel
g. OFCS: Optical Fiber Communication System
h. TRB: Tube Routing Box

4. GENERAL REQUIREMENTS

4.1 Location of optical fiber cable runs. Optical fiber cable shall be located so as to avoid physical interference with electric cables and equipment and to minimize risk of battle damage. Cable runs shall be located so that optical fiber cables will not be disturbed by disassembly or removal of machinery, including the removal of bolted or welded equipment removal plates. While it is recommended that optical fiber cables be run only with other optical fiber cables, they may be run in cableways with electric power and signal cables. However, optical fiber cables should not be installed in cableways with armored cables unless no feasible alternative routing exists. If optical fiber cables must be installed in the same cableways as armored cables, additional precautions shall be taken during installation to prevent mechanical damage (see 4.2). Optical fiber cable shall not be run through bilge areas unless such routing is necessary to provide survivability through redundant signal paths. In such cases, suitable cable protection shall be provided (see 4.1.7).

4.1.1 Main fore and aft cable runs. Main fore and aft cable runs shall be routed as follows.

4.1.1.1 Surface ships. Main fore and aft cable runs shall be located port and starboard and high and low in the ship. The lower cableways shall be through the machinery spaces and corresponding platform decks, while the upper cableways shall be under the main deck. This location of cableways is designed to provide a quadrangular pattern to allow maximum athwartship and vertical separation of cables for systems requiring alternate signal paths for reliability and survivability. The athwartship separation shall be achieved by locating the cable runs not greater than 1.8 meters (6 feet) from the most outboard structure (2.4 meters [8 feet] from curved structure) on the respective sides of the ship. The vertical separation shall be achieved by separating the cable runs by not less than two decks. Where two deck separation is not possible due to ship geometry, a minimum of one deck separation shall be provided. The longitudinal separation distance between vertical or athwartship cable runs shall be not less than 19.7 meters (65 feet) in the hull and 12.1 meters (40 feet) in the superstructure.

4.1.1.2 Submarines. Main fore and aft cable runs shall be located near the inner surface of the pressure hull in a quadrangular pattern to allow maximum athwartship and vertical separation of cables for systems requiring alternate signal paths for reliability and survivability.

4.1.2 Vertical cable runs. Vertical cable runs shall be organized on the basis of the fore and aft or athwartship separation of main cable runs and equipment served.

4.1.3 Optical fiber local cable runs. Optical fiber local cable runs shall be routed from the end user equipment to the interconnection box that services that equipment. Redundant local cable runs shall be survivably separated as specified (see 4.1.1) except when they are within 18.2 meters (60 feet) of the equipment. Systems that have redundant local cables shall have these local cables routed to separate interconnection boxes wherever practical. These separate interconnection boxes shall be separated in the athwartship direction to the maximum extent possible. For surface ship installations, these separate interconnection boxes shall be separated vertically by not less than two decks or by a horizontal distance of 19.7 meters (65 feet) in the hull or 12.2 meters (40 feet) in the superstructure.

4.1.4 Cable runs with special requirements.

4.1.4.1 Control from more than one location. Where equipment is controlled from more than one location, the cables from each location shall be routed in separate cableways.

4.1.4.2 Control by two cables from one location. Where equipment is controlled by two cables from one location and each cable performs the same function, the two cables shall be routed in separate cableways. These cableways shall come together only at the system equipment they service.

4.1.4.3 Cables containing redundant fibers. Where fiber optic interconnection boxes (FOICBs) are connected by cables containing non-redundant channel (NRC) fibers and cables containing the redundant fibers to those NRC fibers, the cables shall be routed in separate cableways. These cableways shall come together only at the interconnection boxes they service.

4.1.4.4 Cable runs utilizing single tube blown optical fiber (BOF) cable. Single tube BOF cable in accordance with MIL-PRF-85045/26 shall be limited to use in local BOF cable runs between end user equipment and FOICBs or tube routing boxes (TRBs) that service that equipment. Single tube BOF cables shall only be installed from a TRB within the same compartment as the end user equipment. If a TRB is not available within the designated compartment, a nearby TRB may be used with approval from the Naval Surface Warfare Center, Dahlgren Division (NSWCDD) (see 6.3). Single tube BOF cable shall not be installed in the primary cableways. An existing secondary cableway shall be utilized or installed exclusively for the single tube BOF cable.

4.1.5 Protection of cable runs.

4.1.5.1 Protection from battle damage. Protection afforded by ship structure shall be used to the greatest extent practical. Cable runs shall not be located on the exterior of deckhouses or similar structures above the main deck (including the island structure of aircraft carriers), except where necessary because of the location of the equipment served or because of structural interference or avoidance of hazardous conditions or locations.

4.1.5.2 Protection from mechanical damage. Cable runs subject to mechanical damage because of their proximity to areas frequented by personnel or by potential impact from equipment displacing under shock shall be protected by metal casings. Cableways in areas where their misuse as steps or handholds would cause damage shall be protected. Protective plates shall be installed over the cableways in all passages where cables might be stepped on. At hatch openings and in trunks where objects are raised and lowered, cableways shall be protected by steel casings. To protect the outer jacket of cables from being cut, channel rubber shall be used with banding straps as follows:

a. For each banding strap of a vertical cableway.

b. For each banding strap at a cableway bend, including breakout bends.

c. For optical fiber cables in direct contact with the banding strap.

Where optical fiber cables are run outside of the main cableways, they shall be supported by preformed brackets or hose clamp cable retention devices featuring integral rubber inserts. The supports shall be spaced along the cable such that they minimize stress and strain on the cable.

4.1.5.2.1 Protection in cargo spaces. Cable runs shall be routed outside cargo spaces wherever practical. Where routing through cargo spaces is unavoidable, cableways shall be protected from mechanical damage, including damage due to shifting of cargo.

4.1.5.2.2 Protection in riser boxes and multiple cable penetrators (MCPs). Topside or explosion proof deck penetrations for cable runs with three or more cables shall be accomplished using riser boxes with stuffing tube penetrations. Watertight deck penetrations in locations not open to the weather for cable runs with three or more cables shall be accomplished using riser boxes with MCPs or deck mounted MCPs with shields for mechanical protection. Non-watertight deck penetrations for cable runs with three or more cables shall be protected using a riser tube or welded collar. Where cable runs with fewer than three cables pass through a deck, kickpipes or swage tubes shall be installed in accordance with MIL-STD-2042-3.

4.1.5.2.3 Protection on an oiler weather deck. Cable runs routed on the weather deck of oilers shall be protected by a substantial, open bottom steel enclosure. Cable runs routed alongside or under the weather deck catwalks shall be completely enclosed in a steel enclosure, the bottom section of which shall consist of a removable steel plate. Enclosures shall be constructed to permit periodic inspection and maintenance of cables and hangers.

4.1.5.2.4 Special protection for blown optical fiber (BOF) cables. BOF cables shall be protected from cable bands using cable saddles. Cable saddles shall be used to protect the BOF cable from being crushed or deformed during and following cable banding. BOF cables shall also be positioned so that there is no pulling against the saddle crossbar or any other edges. Figures 4-1 and 4-2 are examples of acceptable saddle implementation.

4.1.5.2.4.1 Cable saddle material. All saddles shall be made of a sufficiently rigid and dimensionally stable material (e.g., metal or fiberglass) such that the saddle shall retain its shape and structural integrity and keep damaging forces off the BOF cable when a cable band is strapped down around the saddle. In addition, the material used for the cable saddle shall meet all other applicable Navy requirements for shipboard materials.

4.1.5.2.4.2 Vertical cable installations. Where BOF cables are installed in a vertical cable run, channel rubber may be installed under the cable saddle and in contact with the BOF cable to reduce cable slippage. Channel rubber may also be installed between the cable saddle and cable band if necessary to reduce saddle slippage.

4.1.5.2.4.3 Cable saddle positioning. Cable saddles protecting BOF cables shall be properly seated directly on a cableway cross bar.

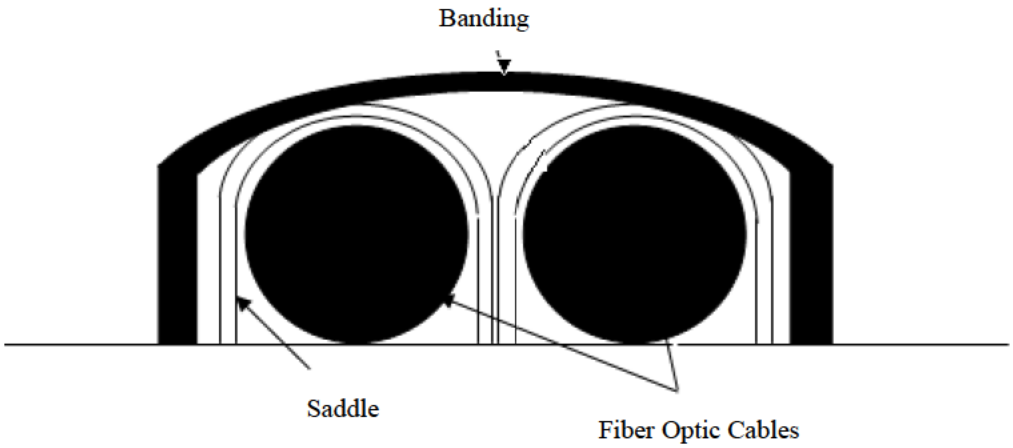

FIGURE 4-1. Installation using single cable, cable saddles.

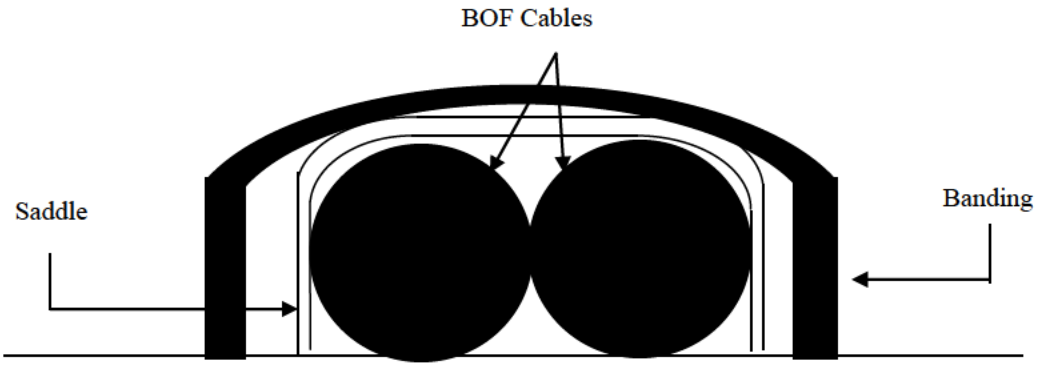

FIGURE 4-2. Installation using multi-cable, cable saddles.

4.1.5.3 Protection from the weather. Cable runs in the weather shall be kept to the minimum practical length to provide service to the equipment. Where possible, cables to equipment on masts, staffs, and yardarms shall be installed within the masts, staffs, and yardarms.

4.1.5.4 Protection from excessive heat. Cable runs in locations subject to excessive heat or risk of fire shall be avoided. Where required, heat-insulating barriers shall be installed. Cable runs shall not be installed adjacent to machinery, piping, or other surfaces having an exposed surface temperature greater than 65 °C (149 °F). Cable runs shall not be routed over boilers, in the upper portions of firerooms, in passageways at the aft end of aircraft catapults, or in locations where they will be exposed to hot stack gases.

4.1.5.5 Protection from excessive moisture. Cable runs shall not be routed through locations where they may be subjected to excessive moisture. Where cable routing near firemain, water, steam, oil, or other piping is unavoidable, dripproof shields shall be provided for protection. Where cable runs must be routed in spaces subject to flooding, they shall be installed as high as practical within the space.

4.1.6 Cable runs through bilges, submerged spaces, and voids. Cable runs through bilges and spaces that would normally be submerged, except for cables in the sonar dome, shall be enclosed in a single pipe in a manner similar to that for cables passing through tanks. Cable runs in voids and other dead air spaces shall be avoided. If it is not practical to avoid cable runs in such spaces, cables shall be installed only in those spaces that are not provided with a means for flooding. Cable runs shall be supported clear of decks and bulkheads to avoid condensate which might form on such surfaces.

4.1.7 Cable runs in hazardous locations. Cable runs may be routed in hazardous locations such as magazines, battery shops, and flammable liquid storage areas.

4.1.8 Cable runs in hangar spaces (aircraft carriers). Horizontal cable runs shall not pass through hangar spaces. Vertical cable runs, such as those from the second deck to the flight deck level, shall be grouped to the greatest extent practical to reduce the number of protective casings required, and shall be protected from fire in accordance with the methods in 5.1.4.

4.1.9 Cable runs to gun mounts and directors. Cable runs to gun mounts and directors shall be routed from the deck below through the center column and located so as to avoid the possibility of chafing. Watertight integrity, where required, shall be maintained. In compartments containing hydraulic systems, the cable installation shall not impair the airtightness or watertightness of decks and bulkheads forming the boundaries of the compartment.

4.2 Installation of optical fiber cables in cableways.

4.2.1 Cable pulling. Optical fiber cables shall be installed by feeding the cable through the cableway in a segment-by-segment fashion for the entire route and then securing it into the cableways. Block-and-tackle, chain falls, or other mechanical devices shall not be used to pull optical fiber cable. The cable shall be pulled to avoid kinking, twisting, sharp bending (see 4.2.3), or stretching by applying excessive pulling force. The optical fiber cable should be monitored at all bend points and at multiple points on long straight runs to ensure that the cable does not encounter sharp objects. It is recommended that the cable be pulled slowly, so that if it does get caught, it will be readily noticeable and cable pulling can be stopped before any damage occurs.

4.2.2 Cable pulling in armored cable cableways. Cableways containing armored cable should be avoided where possible. Where installation of optical fiber cables into cableways containing armored cable cannot be avoided, additional personnel shall be used to monitor during pulling due to the increased possibility for mechanical damage to the optical fiber cable.

4.2.3 Cable bend diameter. During handling and installation in cableways, cable bends in optical fiber cables shall not violate the minimum short term bend diameter of the cable. The completed installation shall not violate the minimum long term bend diameter of the cable. Optical fiber cables should not be installed at or below temperatures of 2 °C (36 °F). If conventional optical cable must be installed when its temperature is 2 °C (36 °F) or lower, the cable shall be warmed thoroughly using a portable heater (or equivalent) before installing the cable in the cableway. BOF cabling is susceptible to collapse when exposed to high temperatures. BOF cable shall not be warmed above 70 °C (158 °F) during installation (see 4.2.12).

CAUTION: The cable shall be continuously monitored if it is directly exposed to the heat source. Prolonged exposure of the cable jacket to a temperature above 160 °C (320 °F) could cause damage to the cable jacket.

4.2.3.1 Conventional optical fiber cable minimum bend diameters. The minimum short term bend diameter for conventional optical fiber cable is eight times the cable outside diameter. The minimum long term bend diameter for conventional optical fiber cable is sixteen times the cable outside diameter.

4.2.3.2 Blown optical fiber (BOF) cable minimum bend diameters. The minimum short term and long term bend diameter for the single tube BOF cable is 0.127 meter (5 inches). The minimum short term and long term bend diameter for 7-tube BOF cable is 0.45 meter (17.7 inches). The minimum short term bend diameter for 19-tube BOF cable is 1 meter (39 inches), and the minimum long term bend diameter is 1.27 meters (50 inches).

NOTE: The minimum bend diameters identified are associated with tube cable bend damage limits. Installation of single tube cables at the minimum bend diameter may result in severe blowing limitations. BOF tube bend diameters shall be maximized to the greatest extent practicable.

NOTE: BOF tube bend diameters less than 0.45 meter (17.7 inches) will negatively impact the blowing distances achievable for 12- and 18-fiber BOF bundles.

4.2.4 Installed cable slack. Cables shall be installed in accordance with the following:

a. Sufficient slack shall exist to allow for deflection of bulkheads.

b. The sag between hangers shall be uniform for each row of cables so that clearance between rows will be the same throughout the cable run.

c. Where cables spread out to enter bulkhead stuffing tubes or MCPs, bends shall have a liberal sweep to provide as much flexibility as practicable.

d. Cables having only a minimum spread where they pass through bulkhead stuffing tubes shall have enough slack to give them the same flexibility as other cables in the group.

e. Cables from equipment shall enter cableways in a curve of sufficient radius to prevent transmission of stresses to the equipment during severe cableway deflection.

f. Cables entering or connected to equipment shall have additional slack as specified in MIL-STD-2042-2.

g. Cables crossing expansion joints shall have slack allowance at such points not less than the maximum movement of the expansion joints.

4.2.5 Cable placement in cable hangers. Optical fiber cables shall not be run through the cross-tier mounting holes of cable hanger vertical support channels. Optical fiber cables shall not be installed on the bottom or sides of cable hangers unless approved by NSWCDD (see 6.3). Where optical fiber cables are to be mixed with electric cables in the same cableway:

a. The optical fiber cables shall be installed last and be run on top of the electric cables where possible.

b. The optical fiber cables shall be located in the center of the cableway.

c. If electric cables are installed on top of optical fiber cables, they shall be installed in accordance with 4.3.

4.2.6 Installation on bulkheads and overheads. Installation of cables on the overhead and on bulkheads shall be in accordance with the methods described herein. Cables for vital systems, such as interior communications and weapons control systems, shall not be secured to the overhead, shell planking, plating, or ballistic bulkheads without authorized approval (see 6.3).

4.2.6.1 Protection from electric cables in bulkhead penetrators. BOF cables shall be placed in a position that will avoid the crushing of the BOF cables by electrical cables.

4.2.6.2 Protection from edges of bulkheads. BOF cables shall be positioned in bulkheads so that they are not pushed against the edges of the bulkhead penetrators.

4.2.6.3 Cable hangers and supports. Cable hangers and supports shall be in accordance with MIL-STD-2003-4 and as specified herein. Only steel hangers and supports shall be used where the deck or bulkhead is steel. Aluminum or steel hangers and supports shall be used where the deck or bulkhead is aluminum; however, if aluminum hangers and supports are used, a steel hanger and support shall be installed not less than every 1.8 meters (6 feet). In those locations where the ship structure is aluminum, details of the methods for attaching steel cable hangers to the structure shall be in accordance with 803-5184182.

4.2.7 Installation on ballistic structures. Attachment of cables and supports to ballistic structures shall be in accordance with the methods described herein and the following:

a. First preference shall be given to routing cables on the inboard or aft bulkheads in the forward half of the ship, and on the inboard and forward bulkheads in the aft half of the ship.

b. Second preference shall be given to routing cables on channels, or in cable racks on angles, attached to overhead deck beams.

c. Cables shall not be routed on the outboard or forward bulkheads in the forward half of the ship, nor on the outboard or aft bulkheads in the aft half of the ship, when the plating is 244 kilograms per square meter (kg/m^2) (50 pounds per square foot [lb/ft^2]) or heavier.

4.2.8 Double banking of cable. For surface ships, only one row of cables shall be installed on a cable hanger tier. Where space is limited, and if authorized approval is obtained (see 6.3), double banking (two rows maximum) of conventional fiber optic cables on tiers shall be permitted. Double banking of BOF cable shall be prohibited. The requirements of 4.1.5.2 and the restraints of 4.2.1 through 4.2.5 shall be observed when double banking conventional optical fiber cables with armored and unarmored electric cables.

4.2.9 Cable retention. Retention of cables on supports can be accomplished by the use of retainers such as contour straps, soft iron flat bars bent over the cables, semi-contour straps, or angle-iron retainers. Non-toxic strips or channel rubber material shall be used with semi-contour straps, bars, and angle retainers to reduce cable damage, distortion, and chafing (see 4.1.5.2). Cable retention is required at every hanger on vertical cable runs. Cable straps shall be omitted on horizontal cable runs except as follows:

a. Where the hanger has no side brackets.

b. At those locations where the cable runs change direction or pass through beams or bulkheads.

c. Where four consecutive hangers would not require straps. In this case, a minimum of one strap shall be installed on every fourth hanger.

d. Where the horizontal cable supports have multiple tiers.

4.2.10 Cable tags. Cable tags and marking shall be as specified in MIL-STD-2042-1. Cable tags shall be secured with metal bands in accordance with MIL-DTL-15024 and MIL-P-15024/5. All permanently installed cables shall be tagged to each point of connection, and on both sides of decks and bulkheads except as follows:

a. Where through cable runs within a compartment are easily traced (such as a vertical run between decks), a single tag will suffice.

b. For cables with both points of connection within a compartment and which can be readily traced, a single tag will suffice.

c. Where compartments are subdivided by internal bulkheads or where machinery or installed equipment makes tracking of cable runs difficult, additional tags shall be provided.

d. For multiple cable penetrations of decks and bulkheads (main cableways), individual cable tags can be omitted, and in lieu thereof, an identification plate shall be installed adjacent to the cableway penetration area showing each cable designation in the order of location in the penetration area.

4.2.11 Dead-ended cable. Cable installed through error or rendered useless as a result of modifications shall be removed where practical. Vacated and unused penetrations shall be sealed by methods that satisfy the tightness requirements of the structure penetrated (see MIL-STD-2042-2).

4.2.12 Temporary exposure of blown optical fiber (BOF) cables to excessive heat. BOF cables are more susceptible to excessive heat than conventional optical fiber cables. During BOF cable installation and blowing operations, care shall be taken to protect BOF cables from temporary exposure to temperatures above 70 °C (158 °F).

4.3 Electric cable installation over fiber cables. The installation of electric cables over optical fiber cables should be avoided where possible. Where installation of electric cables over optical fiber cables cannot be avoided, either protective coverings shall be placed over the optical fiber cables during the electric cable installation or personnel shall monitor the optical fiber cable during the electric cable pull to minimize damage to the optical fiber cable.

4.4 Cableways. Cableways shall be in accordance with MIL-STD-2003-4 and as specified herein.

4.5 Fiber optic cable topology (FOCT) test. The FOCT shall be tested for continuity and loss during various stages of installation in accordance with MIL-STD-2042-6.

4.6 Blown optical fiber (BOF) bundle and BOF fiber installation. BOF bundles and BOF fibers shall be installed in accordance with the manufacturer's recommended procedures using the equipment recommended by the BOF bundle or fiber manufacturer. BOF cables and components shall not be exposed to compressed gas pressures greater than 138 megapascals (MPa) (200 pounds per square inch [psi]) during BOF bundle or fiber installation. Single mode and multimode optical fibers may both be installed in the same BOF cable. When both single mode and multimode optical fibers are installed in a BOF cable, the single mode optical fibers shall be installed in different tubes from the multimode optical fibers. BOF cables, fibers, bundles, and components from different manufacturers shall not be intermixed within an FOCT unless approved by NSWCDD (see 6.3).

4.7 Safety precautions. The following safety precautions shall apply:

a. The classification of a laser is based on the ability of the optical beam to cause damage to the eye. Under normal operating conditions, an optical fiber communication system (OFCS) is inherently an eye safe system; but, when an optical fiber connection is broken and optical viewing instruments are used, it is possible that hazardous energy can enter the eye. For this reason, four service group hazard classes have been devised to indicate the degree of hazard and required hazard control measures. Refer to ANSI Z136.2 for a full technical definition. The following laser safety precautions shall apply:

(1) Ensure personnel are familiar with the laser degree of hazard and the required control measures.

(2) Light generated by light emitting diodes (LEDs) and laser diodes may not be visible but may still be hazardous to the unprotected eye. Do not stare into the end of an optical fiber connected to an LED or laser diode and do not stare into broken, severed, or disconnected optical cables.

(3) Do not view the primary beam or a specular reflection from an OFCS with an optical microscope, eye loupe, or other viewing instrument. The instrument may create a hazard due to its light gathering capability.

b. Wear safety glasses when handling bare fibers. Always handle cable carefully to avoid personal injury. The ends of optical fibers may be extremely sharp and can lacerate or penetrate the skin or cause permanent eye damage if touched. If the fiber penetrates the skin, it most likely will break off, in which case the extraction of the fiber should be performed by trained medical personnel to prevent further complications.

c. Wash hands after handling bare fibers.

d. Do not eat or drink in the vicinity of bare optical fibers. Ingested optical fibers may cause serious internal damage.

e. Never look into the end of a BOF tube. Always wear approved safety glasses when handling BOF tubes that may be connected to a pressure source.

4.8 Method improvement. Where the methods herein cannot be implemented, users shall submit proposed new methods or proposed modifications of existing methods, as specified (see 6.3).

4.9 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

5.1 Cableways. Cableways for optical fiber cables shall be the same as those for electrical cables given in MIL-STD-2003-4 and as specified herein. These methods will not be repeated in this standard; however, they are identified and listed here to aid the user in rapidly locating the applicable method in MIL-STD-2003-4 to be used for optical fiber cable runs.

5.1.1 Cableways (submarines). The following methods and drawings shall be used to install cableways on submarines only: MIL-STD-2003-4, all figures in Appendix 4A, Cableways (Submarines).

5.1.2 Cableways (surface ships). The following methods shall be used to install cableways on surface ships only: MIL-STD-2003-4, all figures in Appendix 4B, Cableways (Surface Ships).

5.1.3 Cableways (general). The following methods shall be used to install cableways on both submarines and surface ships: MIL-STD-2003-4, all figures in Appendix 4C, Cableways (General).

5.1.4 Cable protection. The following methods shall be used to protect cables from mechanical or environmental damage: MIL-STD-2003-4, all figures in Appendix 4D, Cable Protection.

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 cableway requirements and cable protection methods depicted in 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 applicable for conversion, alteration, or repair of existing ships.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

6.3 Proposed new methods or method modifications. As specified (see 4.8), 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.

6.4 Subject term (key word) listing.

Cable runs

Cable tags

Installation of optical fiber cable in cableways

Protection of cables

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-2014-008)

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.