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DEPARTMENT OF DEFENSE
STANDARD PRACTICE

FIBER OPTIC CABLE TOPOLOGY INSTALLATION STANDARD METHODS FOR NAVAL SHIPS (CABLEWAYS)

(PART 4 OF 7 PARTS)

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FOREWORD

1. This Department of Defense Standard Practice 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. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Department of the Navy, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue Southeast, Stop 5160, Washington Navy Yard, DC 20376-5160 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. This standard practice 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, but are intended to standardize and minimize variations in installation methods to enhance the compatibility of the installations on all Naval ships.

4. In order to provide flexibility in the use and update of the installation methods, this standard practice is issued in eight parts; the basic standard practice 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

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1. SCOPE

1.1 Scope. This standard practice provides detailed methods for installing optical fiber cable cableways and cable protection on surface ships and submarines.

1.1.1 Applicability. These criteria apply to installations on specific ships when invoked by the governing ship specification or other contractual document. They are intended primarily for new construction; however, they are also applicable for conversion or alteration of existing ships. The rapidly changing state of the art in fiber optic technology makes it essential that some degree of flexibility be exercised in enforcing this document. When there is a conflict between this document and the ship specification or contract, the ship specification or contract shall take precedence. Where ship design is such that the methods herein cannot be implemented, users shall submit new methods or modifications of existing methods for approval prior to implementation to: Department of the Navy, Naval Surface Warfare Center, Dahlgren Division, ATTN: Code B35, 17320 Dahlgren Road, Dahlgren, VA 22448-5100.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4 and 5 of this standard practice. This section does not include documents cited in other sections of this standard practice 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 documents cited in sections 3, 4 and 5 of this standard practice, 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-2003-4 - Electric Plant Installation Standard Methods for Surface Ships and Submarines (Cableways).

MIL-STD-2042-1 - Fiber Optic Cable Topology Installation Standard Methods for Naval Ships (Cables)(Part 1 of 7 Parts).

MIL-STD-2042-3 - Fiber Optic Cable Topology Installation Standard Methods for Naval Ships (Cable Penetrations)(Part 3 of 7 Parts).

MIL-STD-2042-6 - Fiber Optic Cable Topology Installation Standard Methods for Naval Ships (Tests)(Part 6 of 7 Parts).

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Ave, Building 4D, Philadelphia, PA, 19111-5094.)

2.2.2 Other Government documents. The following other Government documents form a part of this standard practice to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DEPARTMENT OF DEFENSE DRAWINGS

NAVSEA Drawing - 803-5184182 Passive Fire Protection Insulation - Installation Details.

- 302-2146949 Electronics/Electrical Installation Methods.

- 302-4456087 Electronics/Electrical Installation Methods.

(Copies of documents should be obtained from the contracting activity or as directed by the contracting officer.)

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 the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not

listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

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

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018-3308.)

ELECTRONICS INDUSTRY ASSOCIATION/TELECOMMUNICATIONS INDUSTRY ASSOCIATION

EIA/TIA-440 - Fiber Optic Terminology.

(Application for copies should be addressed to Global Engineering Documents, 1990 M Street NW, Suite 400, Washington, DC 20036.)

2.4 Order of precedence. 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 specific exemption has been obtained.

3. DEFINITIONS

3.1 General fiber optics terms. Definitions for general fiber optics terms used in this standard practice are in accordance with EIA/TIA-440. Definitions for other terms as they are used in this standard practice are given in the following paragraphs.

3.2 Acronyms. The following acronyms are used in this standard practice:

BOF	Blown optical fiber
FOCP	Fiber optic cable plant
FOCT	Fiber optic cable topology
FOICB	Fiber optic interconnection box
TRB	Tube routing box

3.3 Alternate channel. Allocated and used backup link for a normal channel.

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

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

3.6 BOF fiber. An optical fiber with a special coating that allows the fiber to be blown into a BOF tube.

3.7 BOF tube. A tube within a BOF cable through which BOF fibers or BOF bundles are blown.

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

3.9 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.

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

3.11 Fiber optic cable plant (FOCP). A subset of the FOCT that excludes local cables 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.

3.12 Fiber optic cable topology. An integrated optical fiber distribution system that provides the optical interconnection between end user equipments. A conventional FOCT includes the conventional FOCP components and outlet boxes, local cables and their associated connectors and splices. A BOF FOCT includes the BOF FOCP components, BOF cable furcations, local conventional cables, local BOF cables, and associated connectors and splices.

3.13 Fiber optic interconnection box (FOICB). An enclosure for holding optical fiber cable (BOF and conventional), BOF tubes, tube furcation units, and optical fiber splices, connectors and adapters.

3.14 Installing activity. An installing activity is any military, commercial, or industrial organization involved with the installation of fiber optic cable topologies aboard Naval ships.

3.15 Local cable.

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

3.15.2 Local BOF cable. A BOF cable that runs between end user equipment and a TRB, or between a TRB and an outlet box.

3.16 Minimum bend diameter. The diameter at which a conventional optical fiber cable, OFCC (see 3.20), loose tube furcation cable, or BOF bundle (see 3.5) can be bent without degrading optical performance, or the diameter at which a BOF cable or BOF tube (see 3.7) 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.

3.17 Non-redundant channel (NRC). A non-redundant channel is any allocated and used active link that has no system required backup link.

3.18 Normal channel. A normal channel is an allocated and used active link between system equipment that has a designated active backup link.

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

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

3.19.2 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.

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

3.21 Outlet box. An outlet box is a small termination box used to break out a local cable from an interconnection box to one or more equipments in a compartment or area.

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

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

3.23.1 Conventional trunk cable. A conventional optical fiber cable that runs between two FOICBs.

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

3.24 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.

4. GENERAL REQUIREMENTS

4.1 Location of optical fiber cable runs. Optical fiber cable shall be located 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. Optical fiber cables 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 must 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). Where the installing activity (see 3.14) is responsible for the design of the fiber optic topology cableways, it shall be as specified herein.

4.1.1 Main fore and aft cable runs.

4.1.1.1 Surface ships. Main fore and aft cable runs shall be routed as follows. 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 m (6 ft) from the most outboard structure (2.4 m (8 ft) 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 m (65 ft) in the hull and 12.1 m (40 ft) 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 (see 3.10) to the interconnection box that services that equipment. Systems that have redundant local cables shall have these local cables routed to separate interconnection boxes, wherever practical, unless otherwise specified in the drawings. These separate interconnection boxes shall be separated in the athwartship direction to the maximum extent possible and vertically by not less than two decks or by a horizontal distance of 19.7 m (65 ft) in the hull or 12.2 m (40 ft) in the superstructure. Redundant local cable runs shall be survivably separated as described in 4.1.1 except when they are within 18.2 m (60 ft) of the equipment.

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 are connected by cables containing 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.

4.1.5 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 by loose equipment during 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 to 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. 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 multiple cable penetrators (MCP's) or deck mounted MCP's 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 Part 3 of this standard practice.

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 BOF cables. BOF cables shall be protected from cable bands using 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 degrees Celsius (°C) [149 degrees Fahrenheit (°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, which 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 gallery or flight deck levels 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 such 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.

4.1.10 Cable runs to rotating missile launchers. Cable runs to rotating missile launchers shall comply with drawings furnished by NAVSEA.

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 (see 3.16) of the cable. The completed installation shall not violate the minimum long-term bend diameter of the cable. The installation of optical fiber cables at or below temperatures of 2°C (36°F) is not recommended. If 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.

CAUTION: Continuously monitor the cable 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 BOF cable minimum bend diameters. The minimum short term and long term bend diameter for the single tube BOF cable is 0.13 mm (5 inches). The minimum short term and long term bend diameter for 7-tube BOF cable is 0.46 m (18 inches). For 19-tube BOF cable the minimum short term bend diameter 1.0 m (39 inches) and the minimum long term bend diameter is 1.27 m (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. Maximize BOF tube bend diameters to the greatest extent practicable.

NOTE: BOF tube bend diameters less than 18 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 MCP's, 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 Part 2 of this standard practice.

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. Where optical fiber cables are to be mixed with electric cables in the same cableway, the optical fiber cables shall be installed last and be run on top of the electric cables where possible, and shall be located in the center of the cableway. 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, or to shell planking, or plating, or to ballistic bulkheads without authorized approval (see 3.4).

4.2.6.1 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 m (6 ft). 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 NAVSEA Drawing 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 3.4), double banking (two rows maximum) of cables on tiers is permitted. The requirements of 4.1.5.2 and the restraints of

4.2.1 through 4.2.5 shall be observed when double banking 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 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. 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.

Cable tags and marking shall be as specified in Part 1 of this standard practice.

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.

4.2.12 Temporary exposure of BOF cables to excessive heat. BOF cables are more susceptible to excessive heat than conventional optical fiber cables. During BOF cable installation, care shall be taken to protect BOF cables from temporary exposure to excessive heat.

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.

4.4.1 Spare cable allowance. In the organization of principal cableways, spare cable space of approximately 20 percent of that to be occupied by the final combined electric and optical fiber cable installation (as known at the time of delivery of the ship) shall be reserved on tier bars of cable hangers and in electric and optical fiber cable penetration areas for future cable installations. The additional cable space may consist of unused hangers or a combination of unused hangers and space available on used hangers, assuming that double banking will be allowed for future optical fiber cable (see 4.2.8). During the planning phase, the Contractor shall provide cableway space in excess of the required 20 percent, in order to accommodate electric and optical fiber cables added as a result of design development occurring during the construction period.

4.5 Fiber optic cable topology test. The fiber optic cable topology shall be tested for continuity and loss during various stages of installation in accordance with Part 6 of this standard practice.

4.6 BOF bundle and BOF fiber installation. BOF bundles and BOF fibers shall be installed in accordance with the manufacturers recommended procedures using the equipment recommended by the BOF bundle and fiber manufacturer. BOF cables and components shall not be exposed to compressed gas pressures greater than 138 MPa (200 PSI) during BOF bundle and 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.

4.7 Safety precautions. The following safety precautions 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 (LED's) and laser diodes may not be visible but may still be hazardous to the unprotected eye. Never 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. Safety glasses shall be worn 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 to the eye. 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.

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 practice; 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, Figures 4A1 through 4A14 and
NAVSEA Drawings 302-2146949 and 302-4456087

5.1.2 Cableways (surface ships). The following methods shall be used to install cableways on surface ships only:

MIL-STD-2003-4, Figures 4B1 through 4B55

5.1.3 Cableways (general). The following methods shall be used to install cableways on both submarines and surface ships:

MIL-STD-2003-4, Figures 4C1 through 4C27

5.1.4 Cable protection. The following methods shall be used to protect cables from mechanical or environmental damage:

MIL-STD-2003-4, Figures 4D1 through 4D10

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 practice are intended primarily for new construction; however, they are applicable for conversion or alteration of existing ships.

6.2 Issue of DODISS. When this standard practice is used in acquisition, the applicable issue of DODISS must be cited in the solicitation (see 2.1.1).

6.3 Subject term (key word) listing.

Cable runs
Cable tags
Installation of optical fiber cable in cableways
Protection of cables

6.4 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

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I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-STD-2042-4	**2. DOCUMENT DATE (YYMMDD)**

3. DOCUMENT TITLE
FIBER OPTIC CABLE TOPOLOGY INSTALLATION STANDARD METHODS FOR NAVAL SHIPS (CABLEWAYS)

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

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