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DEPARTMENT OF DEFENSE STANDARD PRACTICE

ELECTRIC PLANT INSTALLATION STANDARD METHODS FOR SURFACE SHIPS AND SUBMARINES (CABLEWAYS)

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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 disseminates up-to-date information detailing requirements for standard installation methods employed for cableways for submarine and surface ship electrical distribution systems.

3. These criteria are for application to new construction, conversion, and alteration of existing ships.

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, 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 covers standard practices for electric plant installation of cableways on surface ships and submarines.

1.2 Application. The installation methods in this document are intended to be used by all installing activities as required by contract, ship specifications, or similar implementing documents. These methods do not normally identify ship or type but do establish standards for cableway installations in naval ships. The methods in this document are for new construction as well as for conversions, alterations, and repairs. It is the responsibility of the user activity to determine which method satisfies their requirements.

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-I-631	-	Insulation, Electrical, Synthetic-Resin Composition, Nonrigid
MIL-DTL-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-DTL-915	-	Cable, Electrical, for Shipboard Use, General Specification for
MIL-A-2877	-	Aluminum Alloy Tape (see 4.7)
MIL-I-3064	-	Insulation, Electrical, Plastic-Sealer
MIL-T-16366	-	Terminals, Electrical Lug and Conductor Splices, Crimp-Style
MIL-S-24149	-	Studs, Welding, and Arc Shields (Ferrules), General Specification for
MIL-J-24445	-	Joint, Bimetallic Bonded, Aluminum to Steel
MIL-DTL-24640	-	Cables, Lightweight, Low Smoke, Electric, for Shipboard Use, General Specification for
MIL-DTL-24640/15	-	Cable, Electric, -20 to +150 °C, 600 Volts, Lightweight, Multi-Pair, 22 AWG, Type 2XSAW (Including Variation Types 2XSAOW and 2XSAWA)
MIL-DTL-24643	-	Cables, Electric, Low Smoke Halogen-Free, for Shipboard Use, General Specification for
MIL-DTL-24643/24	-	Cable, Electrical, -20 °C to +150 °C, Types LSTCJX, LSTCKX, LSTCTX, LSTCJXN, LSTCKXN, and LSTCTXN
MIL-DTL-24643/25	-	Cable, Electrical, -20 °C to +150 °C, Type LSPI
MIL-DTL-24643/26	-	Cable, Electrical, -20 °C to +150 °C, 600 Volts Types LSDPS, LSTPS, LSFPS, LS7PS, LSDPSN, LSTPSN, LSFPSN, and LS7PSN
MIL-DTL-32180	-	Cable Assembly, Aircraft Electrical Service

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DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-22	-	Welded Joint Design
MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
MIL-STD-1689	-	Fabrication, Welding, and Inspection of Ships Structure
MIL-STD-2003-1	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Cable)
MIL-STD-2003-2	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Equipment)
MIL-STD-2003-3	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Penetrations)
MIL-STD-2003-5	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Connectors)
MIL-STD-2042	-	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-299	-	Cable Comparison Handbook Data Pertaining to Electrical Shipboard Cable

(Copies of these documents are available online at https://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) PUBLICATIONS

S9074-AR-GIB-010/278	-	Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels
S9407-AB-HBK-010	-	Handbook of Shipboard Electromagnetic Shielding Practices
T9070-AL-DPC-020/077-2	-	NAVSEA Hazardous Material Avoidance Process
T9074-AD-GIB-010/1688	-	Requirements for Fabrication, Welding, and Inspection of Submarine Structure

(Copies of these documents are available online via Technical Data Management Information System (TDMIS) at https://mercury.tdmis navy mil/ by searching for the TMIN without the suffix. Refer questions, inquiries, or problems to: DSN 296-0669, Commercial (805) 228-0669. These documents are available for ordering (hard copy) via the Naval Logistics Library at https://nll navsup navy.mil. For questions regarding the NLL, contact the NLL Customer Service at nllhelpdesk@navy.mil, (866) 817-3130, or (215) 697-2626/DSN 442-2626.)

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.

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ASTM INTERNATIONAL

ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

ASTM F594 - Standard Specification for Stainless Steel Nuts

(Copies of these documents are available online at www.astm.org.)

IEEE

IEEE 848 - Standard Procedure for the Determination of the Ampacity Derating Factor for Fire-Protected Cable Systems

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

SAE INTERNATIONAL

SAE-AS33671 - Strap, Tiedown, Electrical Components, Adjustable, Self-Clinching, Plastic, Type I, Class 1

SAE-AS23053/4 - Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Dual-Wall, Outer Wall Crosslinked

SAE-AS23053/5 - Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Flexible, Crosslinked

SAE-AS23053/6 - Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Semi-Rigid, Crosslinked

SAE-AS23053/15 - Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Heavy-Wall, Coated, Flexible, Outer Wall Crosslinked

(Copies of these documents are available online at www.sae.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 Bottom loading. Cable secured to the underside of a cableway tier.

3.2 Cableway tier. One row of cable installed in a cableway.

3.3 Double banking. Two rows of cable installed in a single tier of a cableway.

3.4 Multiple banking. Three or more rows of control or instrumentation cables on a single tier or in a cable tray.

3.5 N.W.T and W.T. Acronyms for non-watertight and watertight. These acronyms are used frequently in figures in this document.

4. GENERAL REQUIREMENTS

4.1 Location of cable runs. Main fore-and-aft cableways shall be located port and starboard, high and low in ship; lower cableways shall be through machinery spaces and corresponding platform decks, upper cableways under the main deck. This is to provide a quadrangular pattern to allow maximum athwartship and vertical separation of cables to loads requiring two sources of power for systems requiring alternate reliability circuits. For example, a ship service power feeder in the lower starboard cableway should have its complementary emergency or alternate feeder in the upper port cableway.

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4.1.1 Vertical cable runs. Vertical cable runs shall be organized on the basis of fore-and-aft or athwartship separation.

4.1.2 Emergency diesel generator seawater booster pumps. Cables supplying emergency diesel generator seawater booster pumps shall be run in the same compartment with, and as close as practicable to, but shall not be attached to the water piping connecting the pump to the diesel engine.

4.1.3 Interior communications and weapons control. The main runs of interior communications and weapons control system cables shall follow cable runs of lighting and power installations. Interior communication and weapons control cables for circuits having several interrelated main and interrelated auxiliary circuits shall be run so that main circuits including normal power supply will be in one group, and auxiliary circuits including alternate power supply will be in another group.

4.1.4 Control from more than one location. Where equipment is controlled from more than one location, the control cabling from each location to the equipment shall be installed in separate wireways.

4.1.5 Weather exposure. Cables shall not be exposed to the weather except where they penetrate a deck or bulkhead to supply equipment. Cables exposed to the weather shall be kept to a minimum. Where possible, cables exposed to the weather shall be protected by installation within conduit, masts, staffs, macks, and yardarms. Use of recessed electrical boxes shall be maximized to reduce exposure of cables to the weather.

4.1.6 Circuit trunking. Location and arrangement of cable runs shall provide circuit trunking avoiding physical interferences with piping, stanchions, foundations, structural members, and ventilation ducts. Spaces considered harmful to cable or subject to explosion hazards shall be avoided. Cableways shall be arranged so that ventilation will be adequate for maintaining the minimum practicable temperature of cables within the cableway. Cableways shall be located so the cables will not be disturbed by disassembly or removal of machinery.

4.1.7 Armored cable. Armored cable has been identified as detrimental to the ability of low smoke cable to self extinguish. As a result, armored cable is no longer permitted aboard Naval ships except where necessary to provide physical protection to certain cables. These applications are limited aboard ship. Armored cable shall not be installed in weather exposed areas unless run in conduit. The following armored cables are permitted aboard ships:

a. MIL-DTL-24640/15, 2XSAWA

b. MIL-DTL-24643/24, LSTCKX, LSTCTX, and LSTCJX

c. MIL-DTL-24643/25, LSPI

d. MIL-DTL-24643/26, LSDPS, LSTPS, LSFPS, and LS7PS

4.1.8 Dead-ended cable. Cables installed through error or rendered useless as a result of modification shall be removed. Vacated and unused penetrations shall be sealed by methods that satisfy the tightness requirements of the structure penetrated. See MIL-STD-2003-3 for penetration sealing methods. All unused cable not removed shall be disconnected from all sources of power and verified de-energized. Cables shall be end sealed in accordance with MIL-STD-2003-1. Dead-ended cables shall be permanently labeled at both ends for either future use or removal with cable tags in accordance with 5.6.

4.1.9 Gun mounts. Cables to gun mounts and directors shall be routed from the deck below through the center column. Watertight integrity shall be maintained. Cable shall be located and installed to avoid the possibility of chafing. Nonflexing cables shall terminate in submersible or watertight changeover connection boxes at the point of connection to the flexible cables. Length of flexible cables between changeover connection boxes and the slack cable enclosure shall be kept to a minimum. The slack cable enclosure shall be entered through stuffing tubes. 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 Rotating missile launchers. Cable connections to rotating missile launchers shall comply with the Government Furnished Information (GFI) for the specific ordnance system being connected.

4.1.11 Ballistic structures. Cables shall not be supported or attached to ballistic structures unless approved by NAVSEA. Preferences for cable routing to avoid ballistic structure are as follows:

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

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

4.1.12 Bulkheads and overheads. Cables shall not be routed on the outboard or forward bulkheads in the forward half of the ship, on the outboard or after bulkheads in the after half of the ship, or when the plating is 50 pounds per square foot (lb/ft^2) or heavier. This routing shall also be avoided for lighter plating unless no other route is feasible. The installation of cables on the overhead and on bulkheads shall comply with NAVSEA standard methods specified herein. Cables for vital systems, such as interior communication and weapons control systems, shall not be secured to the overhead, to shell planking, to shell plating, or to ballistic bulkheads.

4.1.13 Sonar system cables. Sonar system cables and other low frequency system cables shall be installed in accordance with the requirements of S9407-AB-HBK-010.

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

4.3 Or equal. MIL-STD-2003 uses the terms “or equal” to permit the use of parts, components, or tools that are equivalent and can perform the same function as the specified products. The use of the equivalent product is allowed as long as the same functional characteristics, performance, equipment safety, personnel safety, suitability for marine service, life cycle cost, maintenance cost, and supportability are attained, and agreement is obtained from NAVSEA. The request for agreement for the use of “equal” products shall include data that supports that functional and performance equivalence is retained.

4.4 Aircraft carrier cables. Through horizontal cable runs in aircraft carrier hangar spaces are not permitted. Through vertical runs, such as those from the second deck to the gallery or flight deck levels, shall be grouped to reduce the number of protective casings required and shall be protected from fire.

4.5 Cables to lighting fixtures and receptacles or other equipment. Cables terminating at lighting fixtures, receptacles, or other equipment shall be of unbroken lengths. Separate cables to each lighting fixture or receptacle are not required; a single cable may be run between fixtures or receptacles where more than one fixture or receptacle is installed in a space.

4.6 Consideration of electromagnetic shielding. For cable and cableway installations where electromagnetic shielding is required to be considered, the shielding practices of S9407-AB-HBK-010 shall be used.

4.7 Inactive for new design documents. Some of the documents referenced in MIL-STD-2003-4 have been declared as inactive for new design by decision of the Department of Defense. Where replacement documents are designated, the replacement document is normally substituted for the inactive for new design document. Methods that reference inactive for new design documents shall not be used for new ship design unless approved by NAVSEA. Components and products produced in accordance with the inactive for new design documents shall not be used for new design of systems or equipment; however, this does not prohibit use for maintenance, repair, or resupply purposes.

4.8 Cable bundling, ampacity, and cable derating considerations to avoid cable heating. The requirements and guidance for determining cable ampacity and cable derating for power cables bundled in raceways, trays, cableways, or otherwise bundled together, are as follows:

a. The ampacities for most power cables covered by MIL-DTL-24643, MIL-DTL-24640, and MIL-DTL-915 are provided in MIL-HDBK-299 for various ambient temperature conditions. These values may be used as the cable ampacity rating when the cable is physically or thermally isolated from other cables.

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b. Unless cables rated for temperatures above 105 °C are physically or thermally isolated from other cables of a lower temperature rating, the 105 °C rated cables shall be limited to 90 °C rated service regardless of whether the cables are in raceways, trays, cableways, or otherwise bundled together.

c. To the maximum extent practical, power cables in cableways should be separated from control and instrumentation cables and from other power cables to prevent overheating of the cables.

d. Where cables enter electrical equipment such as switchboards or machinery, care should be exercised to avoid bunching or closely grouping the cables in any manner that may restrict dissipation of heat from the cables.

e. Cables should be derated if installed in locations where the ambient temperature may exceed the temperature rating of the cable. See 5.3.3 for avoidance of exposure of cables to high temperatures.

f. MIL-HDBK-299 provides guidance for derating of cables in some applications. B.4.4 of this document provides requirements for arrangements of direct current propulsion cables on surface ships. For other situations where power cables must be grouped in close proximity, the cable ampacity derating may be determined by a test method or an analytical calculation method. IEEE 848 includes potential methods for determining the ampacity derating by test. If a test method is used, the ampacity for the baseline condition (cables separated) shall be compared to the planned configuration for grouping of the cables. The test or analytical calculation method and the resulting ampacities shall be approved by NAVSEA prior to cable installation.

4.9 Installation of fiber optic cables in cableways. Installation of fiber optic cables and blown fiber cables in cableways shall be in accordance with requirements of MIL-STD-2042 and this standard. For fiber optic cable installation, if there are conflicts between this standard and MIL-STD-2042, the requirements of MIL-STD-2042 take precedence.

4.10 Hazardous materials. Materials and products utilized to execute installation methods in this specification should avoid chemicals listed on the NAVSEA List of Targeted Chemicals (N-LTC) contained within T9070-AL-DPC-020/077-2. These chemicals pose significant risk to the user, environment, or both, and are deemed both undesirable and unsustainable by NAVSEA. NAVSEA is minimizing the use of hazardous materials in procedures such as those covered by this standard. Alternative materials should be considered for applications covered in this document to minimize the use of targeted chemicals. NAVSEA should be informed of the need for the use of any of the targeted chemicals prior to procedure execution.

4.11 The terms agreement or approval. Wherever such terms as “approved” or “agreement” are used without further qualification, it is the approval or agreement of the Supervising Authority or NAVSEA, as applicable, that is intended. In these cases, the approval request and the response shall be formal, in writing, and traceable. Existing methods allowed by applicable ship specifications, such as departures from specifications, are acceptable. The Supervising Authority, also referred to as the Supervisor, is defined in the applicable ship specifications.

5. DETAILED REQUIREMENTS

(See figures as well as requirements listed in this section.)

5.1 Cable slack. Cable slack requirements are as follows:

a. Cables shall be installed so that sufficient slack exists to allow for deflection of bulkheads under shock conditions.

b. 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 multiple cable penetrators, bends shall have liberal sweep to provide as much flexibility as practicable.

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

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

f. Cables crossing expansion joints, such as those under the flight deck and gallery deck of aircraft carriers, shall have slack allowance at such points at least equal to the maximum movement of the expansion joints.

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5.2 Cable bend radius. Cable bend radii shall not be less than the values listed in MIL-HDBK-299. The following general requirements are also applicable:

a. Bends at terminal entrances where stuffing tubes are required shall be made through angle stuffing tubes.

b. Straight stuffing tubes may be used in place of angle stuffing tubes if the bend in the cable is not less than the minimum bend radius.

c. Measurement point for minimum radius of bend is that surface of the cable jacket that is on the innermost portion of the cable bend.

d. The bend radius of individual cable conductors that have been broken out from power and lighting cables (as defined in MIL-HDBK-299) for entry into components shall not be less than the minimum bend radius of the cable. If equipment constraints dictate a smaller bend radius for the conductor, the conductor bend radius shall not be less than eight times the conductor outer diameter, as measured around the individual conductor jacketing. If, during inspections of existing installations, the individual conductor bend radius limit is exceeded, and there is no visible damage and the conductor insulation resistance is measured as satisfactory, no corrective action is required.

5.3 Protection of cable.

5.3.1 Battle damage. Protection afforded by the ship structure shall be used to the greatest extent practicable. Cables shall not be run on the exterior of deck houses 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.

5.3.2 Mechanical damage. Cables subject to mechanical damage because of their proximity to areas frequented by personnel 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 or lowered, cables shall be protected by metal casings.

5.3.2.1 Auxiliary ship installation. Auxiliary (cargo) ship cable installations shall be routed outside cargo spaces wherever practicable. Where routing through cargo spaces is unavoidable, cables shall be protected from mechanical damage, including damage due to shifting of cargo.

5.3.2.2 Riser boxes. Riser boxes, or multiple cable penetrators with mechanical protection, shall be installed for three or more cables passing through a deck in a group. Where fewer than three cables pass through a deck, kickpipes shall be installed. Kickpipes installed in the vicinity of hydraulic equipment, where the possibility of oil leakage exists, shall be welded in place. Details of kickpipe installations and the installation of top bracing, where required, shall conform to this standard.

5.3.2.3 Weather deck cableways. Cableways installed on weather decks shall be protected by a substantial open bottom steel enclosure. Cableways installed alongside or under weather deck catwalks shall be completely enclosed in a steel enclosure, the bottom section of which shall consist of a removable perforated steel plate. Enclosures shall be constructed so as to permit periodic inspection and maintenance of cables and hangers.

5.3.3 Excessive heat. Installation of cables in locations subject to excessive heat shall be avoided. Where required, heat insulating barriers shall be installed. Cable shall not be installed adjacent to machinery, piping, or other surfaces having an exposed surface temperature greater than 70 °C. Cables shall not be run over boilers in the upper portions of firerooms or in other locations where they may be surrounded by hot air. Cables shall not be run in locations where they will be exposed to hot stack gases. Unless necessary to support ship arrangement requirements, fire detection and aqueous film forming foam (AFFF) system cabling shall not be routed in close proximity to engine and gas turbine exhaust piping. If the fire detection and AFFF cabling needs to be in proximity of engine and gas turbine exhaust piping, heat protection for the cabling shall be provided.

5.3.4 Excessive moisture. Cables shall not be installed in locations where they may be subjected to excessive moisture. Where cable routing near firemains, water, steam, oil, or other piping is unavoidable, dripproof shields shall be provided for protection. Where cables must be installed in spaces subject to flooding, the cables shall be installed as high as practicable within the space.

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5.3.5 Cables installed through submerged spaces and voids. Cables 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 practicable to avoid cable runs in such spaces, cables shall be installed only in those spaces which are not provided with a means for flooding, and then only when temperature calculations show that the spaces have sufficient radiation area to maintain an ambient temperature at or below the temperature in which the cable was selected to operate. Cables shall be supported clear of decks and bulkheads to avoid condensate which might form on such surfaces.

5.3.6 Cable installations in hazardous locations. Cable runs shall be avoided through hazardous spaces, such as the following (except such cable runs that terminate in or cannot be routed around these spaces):

a. Compartments where hazardous materials are stowed, such as explosive signaling apparatus, ready service ammunition, chemical materials, film, paint, compressed oxygen, chlorine, and combustible gases.

b. Diesel, JP-5, and fuel tanks and stowage compartments (stowage in separate tanks or containers).

c. Gasoline hazard areas.

d. Hangar spaces.

e. LOX (liquid oxygen) handling and transfer spaces.

f. Magazines.

g. Missile magazines.

h. Warhead, depth charge, mine charge, aerial bomb, and explosives magazines.

i. Fire detection cabling and fire protection cabling transiting fire hazard spaces to serve adjacent spaces.

Cables within hazardous spaces shall be protected against mechanical damage. This protection shall be in the form of non-tight metal guards (expanded or solid) of sufficient strength to provide the required protection. Clearance shall be provided between the protective guards and the cables to provide ample ventilation. Protective guards shall be provided with drainage holes where required. Cables protected by the ship structure or by permanently installed equipment are considered adequately protected. Only cables having conductor insulation of silicone rubber (except for interior communication and weapons control cables totally within the compartment) shall be used. Through cables shall be of unbroken length within compartments.

5.3.7 Channel rubber. Channel rubber is used with banding straps and hose clamps in cableways to protect the outer jacket of cables from being cut and coaxial cables from being deformed by the banding strap or hose clamp. Cables such as coaxial, category, profibus, and other data and communication cables should be run in the middle of the cableway for increased mechanical protection.

5.3.7.1 Unarmored cable. For cableways that have unarmored cable in contact with banding straps, channel rubber is required in the following instances:

a. For each banding strap of a vertical cableway.

b. For each banding strap at a cableway bend, including breakout bends, and where the cableway changes direction.

c. Before and after each cable penetration of a deck or bulkhead.

d. For submarine external cableways.

5.3.7.2 Hose clamp retention devices. Where hose clamp retention devices are used (see Appendix 4C, C.4.4.l, table 4CX), channel rubber shall be required for unarmored cable under the following conditions:

a. When coaxial, category, profibus, and other sensitive data and communication cable would otherwise be in contact with the hose clamp.

b. On all vertical wireways.

c. On a single hanger, if needed, to properly secure cables of varying diameters.

d. On any cable hanger where the hose clamp could damage the cable, i.e., on a case-by-case basis.

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5.3.7.3 Armored cable. Unless specified in this standard or in the applicable ship specifications, for cableways that have armored cable that is not in contact with the banding strap or hose clamp, channel rubber is not required. For cableways that have only armored cables in contact with the banding strap or hose clamp, channel rubber is not required unless the cable in contact with the banding strap or hose clamp is connected to sound isolated equipment.

5.4 Installation of propulsion system cables. Propulsion system cables shall be installed in cableways separate from those used for other electrical system cables. Direct current or alternating current propulsion system cables shall be arranged and installed in such manner as to minimize heating of adjacent structural material by induced currents. Alternating current propulsion cables installed on insulating hangers shall be grounded at approximately the midpoint of the cable run. Propulsion system cables shall not be installed in bilges. When cables are located near dripping water or oil, they shall be protected by drip covers. These protective covers shall be spaced away from the cables so as not to restrict ventilation. Cables entering propulsion system equipment from above or from the sides shall enter through stuffing tubes or other NAVSEA-approved watertight enclosure penetration device and shall be braced and secured to prevent dislodgment under vibration, shock, and magnetic stresses. The ends of propulsion system cables 9,000 circular mils and larger shall be sealed with solderless waterseal type lug terminals in accordance with MIL-T-16366 and MIL-STD-2003-1.

5.5 Cable handling and stowage. All cables except flexing service and silicone rubber insulated type of MIL-DTL-915, MIL-DTL-24643, and MIL-DTL-24640 shall be given the following special handling at temperatures below 35 °F:

a. If the compartment in which the cable is to be installed cannot be heated, the cable shall first be stored in an ambient temperature of at least 50 °F but not above 120 °F until it is warm enough to be completely installed before it cools to 35 °F.

b. If cable must be installed when its temperature is 35 °F or lower, extra care shall be taken. The radius of bends shall be not shorter than the minimum values as specified in 5.2. Before bending to the final radius, that portion of the cable comprising the bend shall be warmed thoroughly by a portable warm air blower.

c. Cable shall be stored in a dry place that is not subject to accidental flooding, is protected from the weather, and is subjected to a minimum variation of temperature.

d. Portable cables for aircraft servicing in accordance with MIL-DTL-32180 shall be stowed in bins. In hangar bay areas, they shall be stowed on cable racks.

e. Cable that has been in storage for prolonged periods may be installed provided a visual inspection shows that it has sustained no mechanical damage that would impair the watertight integrity of its outer sheath.

f. Cable armor showing signs of corrosion shall be cleaned and a coat of zinc-chromate primer applied to all corroded areas.

5.6 Cable tags and conductor wire markers. Applicable ship specification requirements for cable tags and wire markers shall be followed in addition to the requirements of this standard. All permanently installed cables shall be tagged, as closely as practicable, to each point of connection. For cables with both points of connection within a compartment and that can be readily traced, a single cable tag will suffice. All permanently installed cables shall be tagged on both sides of structural penetrations, except as follows:

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

b. For multiple cable penetrations of decks and bulkheads (main cableways), individual cable tags may 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 shall be in accordance with ship or class drawings. Typical power cable tags should be about 11/16 inch wide with length to suit the lettering on the tag. Capital letters shall be used on cable tags, height of all letters and numbers shall be not less than 3/16 inch, and letters and numbers shall be embossed to at least 1/64 inch above the surface.

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5.6.1 Cable tag material and securing cable tags. Cable tags may be secured by using aluminum straps conforming to MIL-A-2877 (see 4.7) or by nylon strap conforming to SAE-AS33671, with the following exceptions:

a. Metal cable tags and straps shall NOT be used external to the pressure hull on submarines.

b. Metal cable tags and straps shall NOT be used in battery compartments.

c. Nylon tags and straps shall NOT be used in reactor compartments.

d. Nylon straps shall NOT be used in areas where the ambient temperature exceeds 70 °C.

Cable tags shall be secured with a minimum of two straps, except at cable splice locations at which three straps shall be used.

5.6.2 Conductor wire marking. Markings shall be applied in a permanent legible manner, resistant to water, oil and abrasion, and shall not be hand written. See MIL-STD-2003-5 for requirements for marking of conductors terminating into connectors. Use of flammable materials is prohibited. If shrinking phase marking, do not shrink over any portion of the terminal to ensure crimps can be seen. Tubing on conductors of single-phase cable need not be colored for phase-marking. Individual conductors shall be marked by one of the following methods:

a. Heat-shrinkable tubing with the markings permanently bonded to the tubing by a heating process. The tubing shall be in accordance with SAE-AS23053/5, class 1 or class 3, white, SAE-AS23053/4, class 2, SAE-AS23053/6, class 1, or SAE-AS23053/15, class 1.

b. Hot stamping (branding) insulating sleeving. Sleeving shall be in accordance with MIL-I-631, type F, grade A, form U, white.

5.7 Cable hangers and supports. Cable hangers and supports shall meet the following requirements:

a. MIL-DTL-901 shock.

b. MIL-STD-167-1 vibration.

c. Minimum weight.

d. Minimum maintenance on cable supporting systems.

e. Facilitate cabling procedures.

f. Convenience of servicing system.

g. Fireproof.

h. Material used is non-toxic.

i. Free of sharp protrusions, corners, and items dangerous to personnel.

j. Designed to permit repair with local market items. It is not intended that extensive back-up stocks be supplied for item by item replacement.

k. Compatible with and non-damaging to cables.

5.7.1 Insulation spacer block. The use of insulation spacer blocks is mandatory for propulsion system cables in order to prevent bunching.

5.7.2 Shock design. All cable supporting arrangements shall be tested for resistance to shock and vibration. Deformation to supporting members and retaining members is satisfactory providing cables are prevented from becoming whips or missiles and retainers, racks, and supports do not become missiles. Shock and vibration tests shall be conducted at an approved laboratory. No mechanical damage shall occur to cable specimens, and insulation resistance shall comply with cable specifications before and after the testing. These tests shall be conducted by each manufacturer for each type hanger supplied. Retesting shall be required when design, manufacturing process, or material is changed. Testing of a hanger with lesser tiers or lesser dimensions and spacing shall not be extended or exempt from testing for other hangers. The cable supports, when tested, shall be loaded with maximum design cable load. Material is not satisfactory unless it has successfully passed these tests. Shock tests shall be in accordance with MIL-DTL-901, class I. Cable supporting devices shall be arranged for testing as specified in 5.7.2.1 and 5.7.2.2.

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5.7.2.1 Multiple cable test racks (15 inches free length of cable support). If multiple cable racks are being tested for ability of cable support member only to withstand shock and vibration as fully loaded, a minimum of three supporting stations with 32-inch, 21-inch, or 16-inch spacing shall be provided. The maximum number of the largest cables that can be accommodated on these racks shall be applied. Cable overhang at each end shall be 16 inches or one-half the distance between supports. If tiers of multiple cable racks and supporting devices for attachments to the ship structure are to be tested for capability to withstand shock and vibration, a duplicate of the assembly proposed for shipboard installation with a minimum of three supporting stations with 32-inch, 21-inch, or 16-inch spacing shall be provided. The maximum number of the largest cables that can be accommodated on these racks shall be applied. Cable overhang at each end shall be 16 inches.

5.7.2.2 Single cable supports. All single cable supports shall be tested. These shall be arranged using a minimum of three supporting stations spaced 32 inches, 21 inches, or 16 inches apart. Cable overhang shall be 16 inches. Maximum size cables shall be mounted with these single cable supports. Two, three, or four cables shall be arranged for tests in a manner similar to that for single cables and supported using one of the methods shown on figures 4C1 through 4C12. A single tier of cables shall be arranged as described for multiple cable racks.

5.7.3 Installation.

5.7.3.1 Hanger loading, spacing, and tier limitations. These limitations apply unless there are specific exceptions in applicable ship specifications, in the individual figures in this standard, or as approved by NAVSEA.

The spacing of steel and aluminum cable supports shall be a maximum of 32 inches center to center along the cable run. Normally, the cable supports should not be spaced less than 16 inches apart to avoid installation of an excessive number of hangers. This spacing should be adjusted between 32 inches and 16 inches, as necessary, to suit particular ship conditions, with the following exceptions:

a. If needed for headroom clearance under cableways (see applicable ship specifications for habitability and access requirements), the spacing of hangers may be 21 inches or less to reduce cable sag in cable racks.

b. Hangers for overhead multiple tier aluminum cableways, when welded to aluminum decks, shall be spaced no more than 16 inches apart and the number of tiers shall be limited to three. If aluminum hangers or supports are being utilized from steel or structurally fire protected aluminum decks or bulkheads, a steel hanger or support or both shall be installed in lieu of an aluminum hanger or support every 5 feet, 4 inches as shown in figure 4B37. The cable weight supported by each tier shall not exceed 45.5 pounds.

c. Hangers for overhead multiple tier steel cableways, when welded to steel decks, shall be spaced 16 to 32 inches and the number of tiers shall be limited to five. The cable weight supported by each tier shall not exceed 91 pounds.

d. Hangers for bulkhead mounted multiple tier cableways shall be spaced 16 inches to a maximum of 24 inches. The weight per tier shall not exceed 68 pounds for steel hangers and 45.5 pounds for aluminum hangers.

e. The spacing of hanger supports adjacent to structural penetrations shall be a minimum of 16 inches and a maximum of 30 inches.

f. For hard mounted equipment, the first cable support adjacent to the enclosure shall be located as close as practical to the equipment while maintaining the cable bend radius and the required cable slack. The following is given as a guide for determining the distance: multiply the largest cable diameter by nine, add the mounting distance (offset) from the center of the connectors to the center of the conductors at the first hanger, and add the diameter of each additional cable. See figure 4C62 for illustration.

$(d_1 \times 9) + (\text{OFF}) + (d_2 + d_3 + \ldots d_N) = \text{Distance to first hanger.}$

g. For resiliently mounted equipment, the first cable support adjacent to the enclosure shall be located to have a minimum cable length of 18 inches from the support to the entrance device with a slack of at least 3 inches or the distance the equipment is designed to travel under maximum shock, whichever is greater. The slack is designed to provide for flexibility and movement of the equipment under shock or vibration conditions. The spacing from the enclosure to the first cable support shall not exceed 32 inches.

h. For gooseneck bends, the distance to the first support shall be the largest cable diameter multiplied by 15 or a maximum of 32 inches.

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5.7.3.1.1 Cable supports for higher voltage cables. Due to the greater diameter and potentially greater stiffness of higher voltage rated cable (5 kilovolts and higher), the cable support spacing, cable bend radius, and cable support weight requirements for higher voltage cables may be different than the requirements in this standard. The cableway spacing, weight limitations, cable bend radius limitations, and any other cableway requirements for higher voltage cables shall be in accordance with the applicable ship specifications and NAVSEA approved ship drawings. Figure 4C63 provides a typical installation of higher voltage cables in cableways. See 4.8 for cable bundling and ampacity requirements.

5.7.3.2 Cable racks. A maximum of five single tiers of cables may be supported from an overhead in one cable rack. Aluminum tiers shall be limited to three. A maximum of two tiers of cables may be supported from bulkheads in one cable rack. Eight tiers of double-banked cables may be supported in main cableways in machinery spaces and boiler rooms, when approved by NAVSEA. Backing plates are not required for cable support except that when bulkheads are 1/16 inch thick or less and cable run is over 4-inch width, backing washers shall be used. Multiple tiers of cable shall not exceed two on bulkheads except in congested locations, in which case three tiers may be used on request and subject to NAVSEA approval. Cable support angles shall be secured to ship structure by a weld of 180-degrees minimum except that in the following cases, the weld shall be 360 degrees:

a. Where the number of tiers of 15-inch cable rows in wireway exceeds two.

b. When welding to ballistic structure.

c. When the welds are in wet spaces, such as weather decks or shower rooms.

5.7.3.2.1 Support components. Stainless corrosion-resistant steel cable standoffs and clamps shall be used for cableway installations outboard or in corrosion environment locations. Cable support components shall be of the following materials. Refer to 5.7.3.7 for requirements regarding the use of mounting fasteners.

Nonmagnetic vessels

Inboard	Outboard
Hangers – aluminum	Hangers – aluminum
Supports – aluminum	Supports – aluminum
Ferrules – CRES, aluminum, or nylon	Ferrules – CRES or nylon
Screws – CRES in accordance with ASTM F593, group 1, condition A, with Supplementary Requirement S6	Screws – CRES 316 in accordance with ASTM F593, group 2, condition A, with Supplementary Requirement S6
Nuts – CRES in accordance with ASTM F594, group 1, condition A, with Supplementary Requirement S7	Nuts – CRES 316 in accordance with ASTM F594, group 2, condition A, with Supplementary Requirement S7
Lag screws – See table I, “Fastener materials and fastener specifications for bolted joints”, of MIL-STD-2003-2	Lag screws – See table I, “Fastener materials and fastener specifications for bolted joints”, of MIL-STD-2003-2
Wood screws – See table I, “Fastener materials and fastener specifications for bolted joints”, of MIL-STD-2003-2	Wood screws – See table I, “Fastener materials and fastener specifications for bolted joints”, of MIL-STD-2003-2
Round head square neck (carriage) bolts – CRES in accordance with ASTM F593, group 1, condition A, with Supplementary Requirement S6	Round head square neck (carriage) bolts – CRES 316 in accordance with ASTM F593, group 2, condition A, with Supplementary Requirement S6
Banding – aluminum	Banding – CRES (for external cableways, use nylon coated CRES 304 (preferred) or CRES 316)

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Other vessels

Inboard	Outboard
Hangers – aluminum or steel (see 5.7.3.1.b)	Hangers – aluminum or steel (see 5.7.3.1.b)
Supports – aluminum or steel	Supports – aluminum or steel
Screws and nuts – See 5.7.3.7	Screws and nuts– See 5.7.3.7
Banding – steel – zinc plated or CRES	Banding – nylon coated CRES 304 (preferred) or CRES 316
	Ferrules – CRES or nylon

Appropriate method details specified as submarine only may be utilized for surface ship applications, particularly for weather deck, wet/humid areas, and hull applications. Aluminum cable supports may be attached to steel deck and bulkhead where suitable design and interface is approved. Cable hangers shall be bracketed away from deck and bulkhead surfaces in food handling and food storage spaces to permit spraying for insect control. Refer to 5.7.3.6 for requirements regarding the use of mounting fasteners.

5.7.3.3 Double banking of cable. Not more than one row of cables shall be installed on a cable hanger. Where space is limited, and if Supervisor approval has been obtained, double banking of cables on hangers is permitted; however, the clearance between the top of the upper layer of cables and the hanger above shall be at least ⅜ inch. Multiple banking of control and instrumentation cables is allowed provided sufficient order is maintained in the installation to prevent intertwining of the cables and to allow removal of any cables in the run without affecting other cables in the run. See 4.8 for potential derating requirements for grouping of cables to avoid overheating.

5.7.3.4 Cable retention. Devices for cable retention meeting the requirements of 5.7 and 5.7.2 are required on horizontal cable supports in multiple racks. 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. On cable runs in which the cable is vertical, cable retention is required at every hanger.

a. Cable retention spacing shall be as specified in 5.7.3.1.

b. Cable straps shall be omitted on horizontal cable runs except as follows:

(1) Where the hanger has no side brackets.

(2) At those locations where the cable runs change direction or pass through beams or bulkheads.

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

c. Marine snaplock type cable clamps may be used. See Appendix 4C, C.4.4.l, table 4CX.

d. See Appendix 4C for further requirements for cable retention.

5.7.3.5 Plastic sealer. After the cables are properly secured, plastic sealer electrical insulation, MIL-I-3064, type HF, shall be used to seal the space around the cable as follows:

a. In cable clamps and bushings entering the top or side, with no drip loop, of an electrical enclosure.

b. In bushings, collars, or nipples used for passing cables through light-tight and fume-tight bulkheads.

5.7.3.6 Welding. Welding shall be in accordance with S9074-AR-GIB-010/278, T9074-AD-GIB-010/1688, MIL-STD-22, and MIL-STD-1689.

5.7.3.7 Fasteners used in cableways. Fasteners used in cableway components shall be in accordance with fastener requirements in MIL-STD-2003-2.

5.7.3.8 Collar and all weld studs. Collar and all weld studs shall be in accordance with MIL-S-24149.

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5.7.3.9 Bimetallic joints. Bimetallic joints in accordance with MIL-J-24445 may be used to secure aluminum or steel cable hangers to dissimilar decks or bulkheads in lieu of other methods identified for dissimilar materials. Sources for bimetallic bonding material are E.I. Dupont Denemours Co., Inc., Revere Copper, and Brass Co., North Technical Industries, Inc., or equal (see 4.3).

6. NOTES

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

6.1 Intended use. This standard specifies the requirements for submarine and surface ship cableways and protection methods to be employed both on surface ships and submarines. Standard methods identified for electric plant installation are intended for new construction, conversion, and alteration of existing ships. The use of this standard will be specified in the contract, ship specifications, and similar implementing documents (such as COMUSFLTFORCOMINST 4790.3, Joint Fleet Maintenance Manual (JFMM) and S9086-KC-STM-010/300, Naval Ships' Technical Manual Chapter 300, Electric Plant-General).

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

6.3 Designation of electric plant installation standard methods figures. MIL-STD-2003-4 contains drawings that depict standard methods that are applicable for general electric plant installation on both surface ships and submarines. Each drawing has been assigned a figure number. The methods shown on the figures are grouped together in the following appendices to this standard. Each appendix provides requirements for similar functions.

MIL-STD-2003-4 (Cableways)

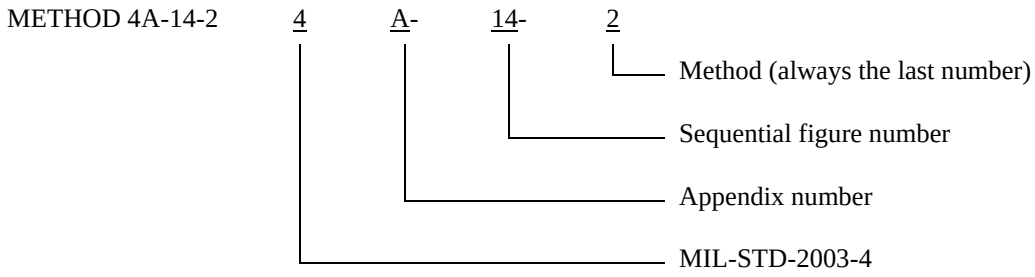
A. Cableways (Submarines) (Appendix 4A)

B. Cableways (Surface Ships) (Appendix 4B)

C. Cableways (General) (Appendix 4C)

D. Cable Protection (Appendix 4D)

The methods shown on the figures are identified by the following alphanumeric designation system:



Thus, method 4A-14-2 identifies method 2, figure 14 in Appendix 4A of MIL-STD-2003-4.

6.4 Subject term (key word) listing.

Banding
Banking
Cable bend radius
Cable retention
Cable rack
Cable run
Cable slack
Cable spacing

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Cable support

Cable tag

Channel rubber

Dead-ended

Derating

Fastener

Fiber optic cable

Hangers

Main cableway

Protection

Tier

Trunking

Wire marker

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.

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APPENDIX 4A – CABLEWAYS (SUBMARINES)

A.1 SCOPE

A.1.1 Scope. This appendix describes standard methods for the installation of cableways on submarines. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

A.2. APPLICABLE DOCUMENTS

A.2.1 General. The documents listed in this section are specified in this appendix. 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 this appendix, whether or not they are listed.

A.2.2 Government documents.

A.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-PRF-6855	-	Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes, General Specification for
MIL-DTL-12133	-	Washer, Spring Tension, General Specification for
MIL-T-16420	-	Tube, Copper-Nickel Alloy, Seamless and Welded (Copper Alloy Numbers 715 and 706)
MIL-S-22698	-	Steel Plate, Shapes and Bars, Weldable Ordinary Strength and Higher Strength: Structural
MIL-S-24149	-	Studs, Welding, and Arc Shields (Ferrules), General Specification for
MIL-S-24149/1	-	Stud, Welding, and Arc Shields (Ferrules); Type I, Class 1, 2, 3, and Type II, Class 1, 4, 5, 5A, 6, Carbon Steel, for Direct Energy Arc Welding
MIL-S-24149/2	-	Studs, Welding, and Arc Shields (Ferrules); Type III, Class 1, 2, 3, and Type IV, Class 1, 2, 3, 4, 5, 6, Aluminum Alloy, for Direct Energy Arc Welding
MIL-S-24149/3		Studs, Welding, and Arc Shields (Ferrules); Type V, Class 1, 4, 5, 5A, Corrosion-Resistant Steel, for Direct Energy Arc Welding
MIL-P-24691/3	-	Pipe and Tube, Corrosion-Resistant, Stainless Steel, Seamless or Welded

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-2042-4	-	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Cableways)

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

A.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.

AEROSPACE INDUSTRIES ASSOCIATION (AIA)

NASM25027	-	Nut, Self-Locking, 250 °F, 450 °F, and 800 °F

(Copies of this document are available online at www.aia-aerospace.org.)

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ASTM INTERNATIONAL

ASTM A240/A240M	-	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM D704	-	Standard Specification for Melamine-Formaldehyde Molding Compounds

(Copies of these documents are available online at www.astm.org.)

SAE INTERNATIONAL

SAE-AMS-QQ-S-763	-	Steel, Corrosion Resistant, Bars, Wire, Shapes, and Forgings
SAE-AS23190	-	Wiring, Positioning, and Support Accessories
SAE-AS33671	-	Strap, Tiedown, Electrical Components, Adjustable, Self-Clinching, Plastic, Type I, Class 1
SAE-AS33681	-	Strap, Tiedown, Electrical Components, Identification, Adjustable, Self-Clinching, Plastic, Type II, Class 1

(Copies of these documents are available online at www.sae.org.)

A.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.

A.3 REQUIRED EQUIPMENT AND MATERIALS

A.3.1 Required equipment and materials. The equipment and materials in the tables and referenced in the text of this section shall be used for the installation of cableways on submarines. For fiber optic cable, refer to MIL-STD-2042-4. Refer to 5.7.3.7 for requirements regarding the use of mounting fasteners.

A.4 NOTES AND PROCEDURES

A.4.1 Dimensions. For figures and tables in this appendix, all dimensions are in inches unless otherwise noted.

A.4.2 Figures. Table 4AI provides information for the figures in this appendix. The details and methods shown on figures 4A1 and 4A2 specifically support the installation of battery cables on submarines; however, they may be used for general installations where applicable.

TABLE 4AI. Figures for cableway installations on submarines.

Figure number	Title	Page
4A1	Main cableway for battery cables (submarines)	27
4A2	Main cableway for battery cables (submarines)	28
4A3	Addition of cable to existing battery cableway (submarines)	29
4A4	Cableway adjacent to bulkhead penetration (submarines)	30
4A5	Spacer blocks for submarine cableways	31
4A6	Cableway for auxiliary cables (submarines)	32
4A7	Cableway for auxiliary cables (submarines)	33
4A8	Cableway for auxiliary cables (submarines)	34
4A9	Single row cableway (submarines)	35
4A10	Cableways through coamings (submarines)	36

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TABLE 4AI. Figures for cableway installations on submarines – Continued.

A.4.3 Internal wireway installation. Figures 4A1 through 4A12 may be used for installation of submarine internal wireways, as applicable.

a. The maximum cable hanger center separation that is qualified to withstand a high-impact shock environment is 16 inches. Where the number of cables to be supported would cause the maximum size of support shown to be exceeded, additional wireways shall be provided.

b. Dimensions and national stock numbers (NSNs) for angle collar studs used on figures 4A1-4A3, 4A6-4A9, 4A11, and 4A12 are listed in table 4AII. These tables are for user information to provide stock numbers for individual parts. The technical requirements in the figures in this appendix shall be met.

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TABLE 4AII. ⅜-16UNC angled threaded collar studs.

Length	MIL-S-24149/1 steel type II, class 6	MIL-S-24149/3 CRES type V	MIL-S-24149/2 aluminum type IV, class 4
0.625	5307-01-148-8237	5307-01-293-9583	--
0.750	5307-01-293-1815	5307-01-293-9584	--
0.875	5307-01-148-3720	5307-01-293-9585	--
1.000	5307-01-293-6161	5307-01-293-9586	5307-01-293-9596
1.125	5307-01-293-6162	5307-01-293-9587	5307-01-293-9597
1.250	5307-01-293-1816	5307-01-293-9588	5307-01-294-4372
1.350	--	--	5307-01-294-1750
2.250	--	--	5307-01-295-1097
1.500	5307-01-293-1074	5307-01-293-9589	5307-01-294-1751
1.625	--	--	5307-01-294-0267
1.750	5307-01-293-6163	5307-01-293-9590	5307-01-294-3147
1.875	--	--	5307-01-294-0268
2.000	5307-01-293-1075	5307-01-293-9591	5307-01-294-1752
2.500	5307-01-293-1817	5307-01-293-9592	--
3.000	5307-01-293-6164	5307-01-293-9593	--
3.500	5307-01-293-1076	5307-01-293-9594	--
4.000	5307-01-293-9598	5307-01-293-9595	--

c. Dimensions and NSNs for internal thread welding studs used on figures 4A6 through 4A9 are listed in tables 4AIII and 4AIV.

TABLE 4AIII. ⅝-18UNC aluminum internal thread welding studs.

Length	MIL-S-24149/2 aluminum type IV, class 5	Length	MIL-S-24149/2 aluminum type IV, class 5
1.000	5307-01-293-5417	1.875	5307-01-293-5424
1.125	5307-01-293-5418	2.000	5307-01-293-5425
1.250	5307-01-293-5419	2.250	5307-01-293-6712
1.375	5307-01-293-5420	2.500	5307-01-294-6829
1.500	5307-01-293-5421	2.750	5307-00-306-4912
1.625	5307-01-293-5422	3.000	5307-01-294-1749
1.750	5307-01-293-5423		

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TABLE 4AIV. 5/16-18UNC steel internal thread welding studs.

Length	MIL-S-24149/1 steel type II, class 5A	MIL-S-24149/3 CRES 316 type V, class 5A
0.875	5307-01-295-7614	5307-01-293-5411
1.000	5307-01-294-3146	5307-01-293-5412
1.125	5307-01-294-2273	5307-01-295-0179
1.250	5307-01-293-2911	5307-01-293-9578
1.375	5307-01-293-2912	5307-01-293-9579
1.500	5307-01-293-1073	5307-01-293-9580
1.625	5307-01-293-2913	5307-01-294-1747
1.750	5307-01-293-2914	5307-01-293-5413
1.875	5307-01-293-1814	5307-01-293-9581
2.000	5307-01-294-1748	5307-01-293-9582
2.250	5307-01-293-6710	5307-01-294-4367
2.500	5307-01-293-6711	5307-01-293-5414
2.750	5307-01-294-4368	5307-01-293-5415
3.000	5307-01-294-4369	5307-01-293-5416

A.4.4 Submarine external wireway installation. Figures 4A13 through 4A25 provide guidelines for the installation of all cabling external to the submarine hull. The figures illustrate the methods to be used for protecting and securing the cabling from an outboard appliance to an electrical hull fitting. These methods are not applicable to submarine antennae and mast assemblies.

a. Cables shall be completely protected for their entire length by the methods shown.

b. Radii of the cable bends shall be at least ten (10) times the diameter of the cable where possible.

c. Outboard cable identification tags shall be comprised of nylon cable straps with nylon identification plates attached conforming to SAE-AS23190 and SAE-AS33681 (see table 4AV, items 56 and 57). Identification tags shall be indelibly marked with 3/16-inch lettering.

d. All sharp edges shall be rounded, and all burrs shall be removed.

e. Banding straps shall be installed so as not to deform the cable sheath but shall be tightened sufficiently to preclude loosening of cable under environmental conditions. To prevent corrosion of the banding straps, the banding strap material and banding buckle material shall be either nylon coated CRES 304 (preferred) or CRES 316. Nylon coated CRES 304 material is preferred due to superior corrosion resistance.

f. Channel rubber shall be used in all cases between cables and banding straps in a manner to prevent any possible contact between the banding straps and the cables.

g. Enough cable slack shall be allowed for one complete turn around the hull fitting cable rack assembly. Where cable is shortened due to initial molding error, the cable shall be installed in the rack as shown on figure 4A23. All cable slack shall be taken up on the cable rack around the hull fitting. There shall be no slack in the cable pans. See figure 4A23.

h. Cable pans, angle bar, and tubing shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cables in pans shall be banded through each slot provided and banding shall be spaced not more than 16 inches apart. Cable angle bars shall be banded every 12 inches. Cables shall not sag. Covers shall be double banded every 16 inches. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.

i. All cable pan and angle bar runs shall be continuous and shall be broken only as indicated on the ship's installation plan.

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j. The cable pan, angle bars, mounting brackets, and tubing shall be painted in accordance with the material requirements of the submarine painting schedule.

k. Cable pan covers shall be installed at all times except during installation of cables in the pans. Cable pans shall be clean of all foreign matter prior to installation of cables.

l. Tubing shall not be used except in special installations where specified.

(1) The radius of tubing bending shall be a minimum of ten (10) times the diameter of the cable installed, where practicable.

(2) Tubing support clamps shall be assembled without rubber lining. Weld as shown for tubing support clamp assembly, figure 4A13.

(3) Rubber shall be inserted into tubing (2 inches minimum) and folded back 2 inches over tubing. Tubing shall not be flared. Remove all sharp edges. The rubber shall be held in back with a tubing support clamp. A piece of ¼-inch by 2-inch flat-bar shall be welded to the top half of the clamp. The thickness of the rubber and size of the clamp depends on the size of the tubing and cables in it. There shall be no mounting leg on clamps.

A.4.4.1 Bonding instructions for cable pan channel rubber (piece 19 of table 4AV).

a. Solvent wipe the edges of the cable pan in the area to be bonded with a solvent approved for shipboard use.

b. Apply a coat of primer by brushing and allow between 2 and 36 hours drying time at room temperature.

c. Solvent wipe the area to be bonded of the channel rubber insert with a solvent approved for shipboard use.

d. After primer areas are dry, brush apply a coat of adhesive to both the metal and channel rubber surfaces to be bonded. After a 20- to 30-minute drying time, join the surfaces of the channel rubber and the pan.

A.4.4.2 Welding. All welding shall be in accordance with 5.7.3.6.

A.4.4.3 Part numbers. Piece numbers referred to in figures 4A13 through 4A25 are from table 4AV. Quantities shall be as required for the installation.

TABLE 4AV. External wireway parts.

PC no.	Item name (all dimensions are in inches)	Material requirement	Material specification or standard
1	Pan, 12⅛ wide, 16 gauge, 8 sect (dimensions in table 4AVI)	CRES, CL FS-304	ASTM A240/A240M
2	Pan, 8⅞ wide, 16 gauge, 8 sect (dimensions in table 4AVI)	CRES, CL FS-304	ASTM A240/A240M
3	Pan, 6⅞ wide, 15 gauge, 8 sect (dimensions in table 4AVI)	CRES, CL FS-304	ASTM A240/A240M
4	Tubing, see A.4.4.l	Cu-Ni	MIL-T-16420
5	Cover, 77⁄16 wide, 16 gauge, use with PC 1 (dimensions in table 4AVI)	CRES, CL FS-304	ASTM A240/A240M
6	Cover, 55⁄16 wide, 16 gauge, use with PCs 2 and 3 (dimensions in table 4AVI)	CRES, CL FS-304	ASTM A240/A240M
7	Pan, offset, left-hand, 18 x 12, 16 gauge (dimensions in table 4AVII)	CRES, CL FS-304	ASTM A240/A240M
8	Pan, offset, right-hand, 18 x 12, 16 gauge (dimensions in table 4AVII)	CRES, CL FS-304	ASTM A240/A240M
9	Pan, offset, left-hand, 16¼ x 12, 16 gauge (dimensions in table 4AVII)	CRES, CL FS-304	ASTM A240/A240M
10	Pan, offset, right-hand, 16¼ x 12, 16 gauge (dimensions in table 4AVII)	CRES, CL FS-304	ASTM A240/A240M

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TABLE 4AV. External wireway parts – Continued.

PC no.	Item name (all dimensions are in inches)	Material requirement	Material specification or standard
11	Cover, offset, left-hand, 135/16 x 12, 16 gauge, use with PC 9 (dimensions in table 4AVII)	CRES, CL FS-304	ASTM A240/A240M
12	Cover, offset, right-hand, 135/16 x 12, 16 gauge, use with PC 10 (dimensions in table 4AVII)	CRES, CL FS-304	ASTM A240/A240M
13	Cover, offset, left-hand, 135/16 x 12, 16 gauge, use with PC 11 (dimensions in table 4AVII)	CRES, CL FS-304	ASTM A240/A240M
14	Cover, offset, right-hand, 135/16 x 12, 16 gauge (dimensions in table 4AVII)	CRES, CL FS-304	ASTM A240/A240M
15	Dropout, 3 x 6⅛, 16 gauge (dimensions in table 4AVIII)	CRES, CL FS-304	ASTM A240/A240M
16	Dropout, 3 x 4⅝, 16 gauge (dimensions in table 4AVIII)	CRES, CL FS-304	ASTM A240/A240M
17	Dropout, 3 x 5½, 16 gauge (dimensions in table 4AVIII)	CRES, CL FS-304	ASTM A240/A240M
18	Dropout, 3 x 3¾, 16 gauge (dimensions in table 4AVIII)	CRES, CL FS-304	ASTM A240/A240M
19	Channel rubber, see A.4.4.1 for bonding information	Rubber	MIL-PRF-6855
20	Angle bar, 1½ x 1½ x 3/16	CRES – CL FS-304	SAE-AMS-QQ-S-763
21	Angle bar, 2 x 2 x 3/16	CRES – CL FS-304	SAE-AMS-QQ-S-763
22	Rubber, synthetic, ⅛ thick	Class 2, grade 60	MIL-PRF-6855
23	Channel rubber, ¾ wide x ½ channel x 5/16 high	Class 2, grade 60	MIL-PRF-6855
24	Banding strip, ½ wide x 0.020 thick	Nylon coated CRES – CL FS-304 (preferred) or CRES 316	
25	Buckle banding, use with PC 24	Nylon coated CRES - CL FS-304 (preferred) or CRES 316	ASTM A240/A240M
26	Tubing, 0.250 x 0.049 Wall	CRES	MIL-P-24691/3
27	Elbow, 90° outside, 12⅛ wide x 18 long, 16 gauge (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
28	Elbow, 90° outside, 12⅛ wide x 18 long, 16 gauge (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
29	Elbow, 90° outside, 12⅛ wide x 18 long, 16 gauge (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
30	Elbow, 90° outside, 12⅛ wide x 18 long, 16 gauge (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
31	Elbow – 90° inside (8⅞ wide x 18 long – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
32	Elbow – 90° inside (6⅞ wide x 18 long – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
33	Elbow – 90° flat bend (20 sq – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M

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TABLE 4AV. External wireway parts – Continued.

PC no.	Item name (all dimensions are in inches)	Material requirement	Material specification or standard
34	Elbow – 90° flat bend (17 sq – 16 gauge) (dimensions below)	CRES – CL FS-304	ASTM A240/A240M
35	Elbow – 90° flat bend (16 sq – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
36	Cover, 90° elbow outside (7 7⁄16 wide x 22 long – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
37	Cover, 90° elbow outside (5 15⁄16 wide x 22 long – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
38	Cover, 90° elbow inside (7 7⁄16 wide x 17 long – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
39	Cover, 90° elbow inside (5 7⁄16 wide x 17 long – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
40	Cover, 90° flat bend (17 sq – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
41	Cover, 90° flat bend (16 sq – 16 gauge) (dimensions in table 4AIX)	CRES – CL FS-304	ASTM A240/A240M
42	Mounting bracket, hull & bulkhead, ¼ x 1½ flat bar x 14¾ long (dimensions in table 4AX)	CRES – CL FS-304	ASTM A240/A240M
43	Mounting bracket, hull & bulkhead, ¼ x 1½ flat bar x 13¼ long (dimensions in table 4AX)	CRES – CL FS-304	ASTM A240/A240M
44	Hose, 1¼ ID x 3⁄16" thick	Class 2, grade 60	MIL-PRF-6855
45	Mounting bracket (use with angle bar), ¼ x 1½ flat bar x 4 long	CRES – CL FS-304	ASTM A240/A240M
46	Mounting bracket (use with angle bar), 1¼ x 1¼ x 3⁄16 angle bar	CRES – CL FS-304	ASTM A240/A240M
47	Mounting bracket, frame & bulkhead, ¼ x 1½ flat bar x 20 long (dimensions in table 4AX)	CRES – CL FS-304	ASTM A240/A240M
48	Mounting bracket, frame & bulkhead, ¼ x 1½ flat bar x 18 long (dimensions in table 4AX)	CRES – CL FS-304	ASTM A240/A240M
49	Angle bar, 2 x 2 x 3⁄16	Steel, HT, TY A	MIL-S-22698
50	Flat bar, ¼ x 2	CRES	SAE-AMS-QQ-S-763
51	Pad, 1 round bar, 3 long	Grade AH-36	MIL-S-22698
52	Tubing support clamp assembly, ¼ x 1 flat bar	CRES, CL 304, cond A	SAE-AMS-QQ-S-763
53	Angle bar, 1¼ x 1¼ x ⅛	CRES, CL 304, cond A	SAE-AMS-QQ-S-763
54	Bolt, hex head, ⅜-16UNC - 1¼ long	See 5.7.3.7	
55	Elastic stop nut, ⅜-16UNC	See 5.7.3.7	
56	Identification tag	Nylon	SAE-AS23190 and SAE-AS33681
57	Cable ties	Nylon	SAE-AS23190 and SAE-AS33671

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TABLE 4AV. External wireway parts – Continued.

PC no.	Item name (all dimensions are in inches)	Material requirement	Material specification or standard
58	Flat bar, ¼ x 3	Steel, TY A	MIL-S-22698
59	Flat bar, ¼ x 1	Steel, TY A	MIL-S-22698
60	Angle bar, 2 x 3 x ¼	Grade AH-36	MIL-S-22698
61	Cover plate, 10.2#	Commercial Steel	MIL-S-22698
62	Bolt, hex head self-locking, ⅜-16UNC x ¾ long	See 5.7.3.7	
63	Bolt, hex head, self-locking ⅜-16UNC x 1 long	See 5.7.3.7	
64	Flatwasher, ⅜	See 5.7.3.7	

A.4.4.4 Dimensions for selected parts. Dimensions for selected pieces from table 4AV are listed in tables 4AVI through 4AX. All dimensions are in inches.

TABLE 4AVI. Dimensions for PCs 1, 2, 3, 5, and 6 from table 4AV.

Pan					Cover			
PC no.	A	B	C	Max. number of SS cables	PC no.	D	E	Remarks
1	6⅛	3	2⅝	50	5	6 7/16	½	U/W PC 1
2	4⅝	2⅛	1⅝	30	6	4 15/16	½	U/W PC 2 & 3
3	4⅝	1⅛	¾	16				

NOTE:
1. See figure 4A16 for dimension definitions.

TABLE 4AVII. Dimensions for PCs 7 through 14 from table 4AV.

Offset						Offset – cover				
PC no.		A	B	C	D	PC no.		E	F	G
LH	RH					LH	RH			
7	8	6⅛	3	12	13⅜	11	12	6 7/16	12 5/16	13⅜
9	10	4⅝	2⅛	12	14⅛	13	14	4-15/16	12-5/16	14⅛

NOTE:
1. See figure 4A21 for dimension definitions.

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TABLE 4AVIII. Dimensions for PCs 15 through 18 from table 4AV.

Dropout			
PC no.	**Width**	**Use with**	**Remarks**
15	6⅛	PC 1	
16	4⅝	PC 2	
17	5½	PC 7 & 8	See figure 4A21
18	3¾	PC 7 & 8	See figure 4A21

NOTE:
1. See figure 4A18.

TABLE 4AIX. Dimensions for PCs 27 through 41 from table 4AV.

Elbow							Cover					
PC no.	**A**	**B**	**C**	**F**	**G**	**K**	**PC no.**	**D**	**E**	**H**	**J**	**Type**
27	6⅛	3				2⅝	36	6 7/16	11 1/16			90° Outside
28	4⅝	2⅛				1⅝	37	4 15/16	10 3/16			90° Outside
29	4⅝	1⅛				¾						
30	6⅛	3	11 1/16			2⅝	38	6 7/16				90° Inside
31	4⅝	2⅛	10 3/16			1⅝	39	4 15/16				90° Inside
32	4⅝	1⅛	9 3/16			¾						
33	6⅛	3		6	14 3/16	2⅝	40	6 7/16		7 29/32	14 11/32	90° Flat
34	4⅝	2⅛		6	12 11/16	1⅝	41	4 15/16		7 29/32	2 27/32	90° Flat
35	4⅝	1⅛		6	12 11/16	¾						

NOTES:
1. These 90° elbows are to be cut to obtain elbows of lesser degrees.
2. See figures 4A19/4A20 for dimension definitions.

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TABLE 4AX. Dimensions for PCs 42, 43, 47, and 48 from table 4AV.

PC no.	Pan ID	A	B	Remarks
42	6⅛	4" max	6¾	U/W PC 1
43	4⅝	4" max	5¼	U/W PC 2 & 3
47	6⅛	9¼	6	U/W PC 1
48	4⅝	7¾	6	U/W PC 2 & 3

NOTE:
1. See figure 4A16 for dimension definitions.

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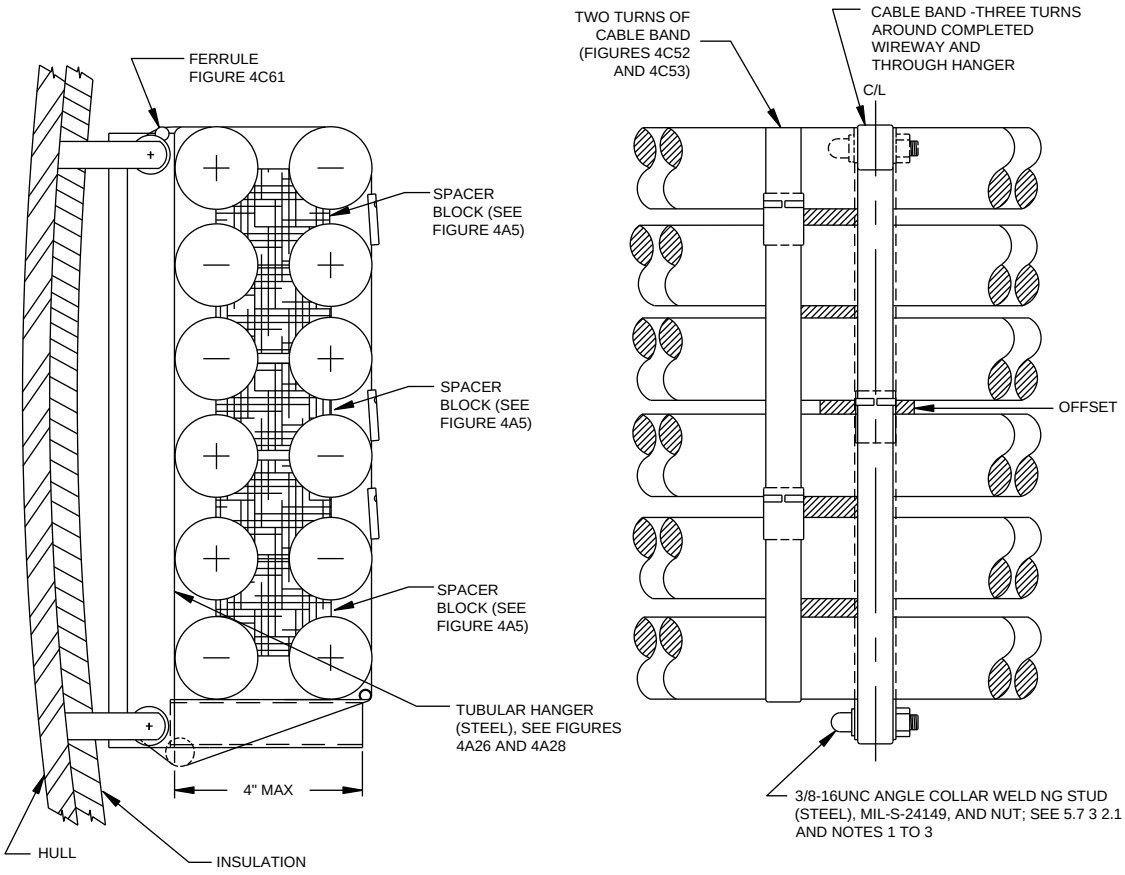
METHOD 4A-1-1
BANK OF 12 CABLES ARRANGED
IN DOUBLE VERTICAL T ERS WITH SPACERS



NOTES:

1. See A.4.3 for general installation information.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A1. Main cableway for battery cables (submarines).

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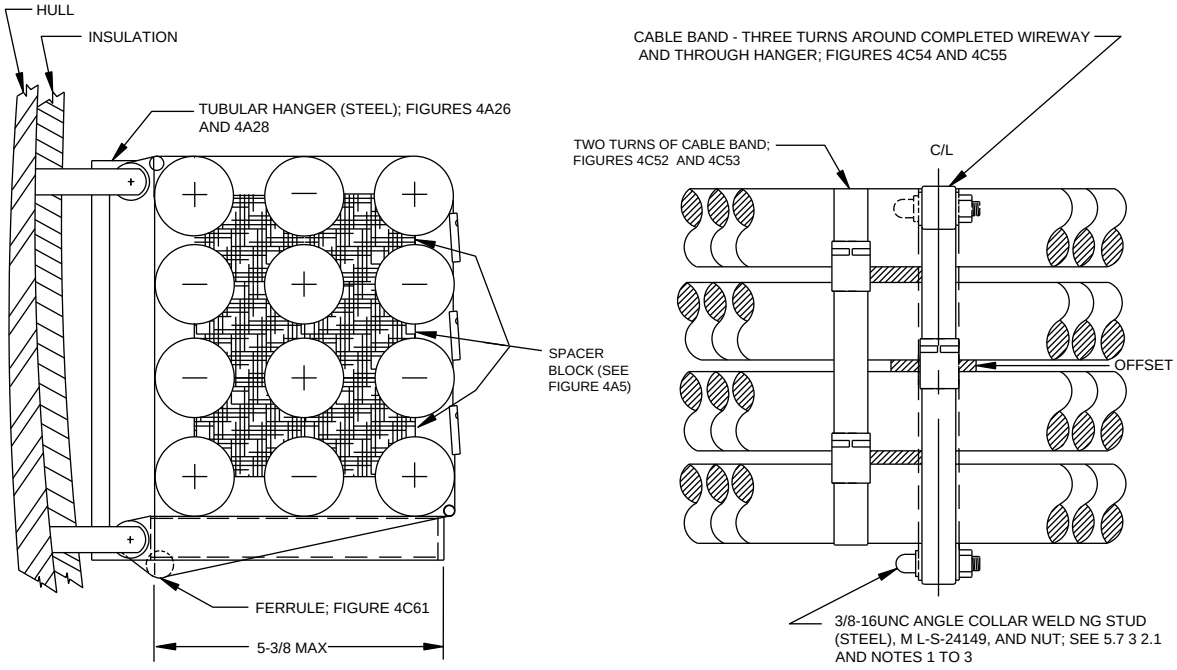
METHOD 4A-2-1
BANK OF 12 CABLES ARRANGED IN TRIPLE VERTICAL TIERS WITH SPACER BLOCKS



NOTES:

1. See A.4.3 for general installation information.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A2. Main cableway for battery cables (submarines).

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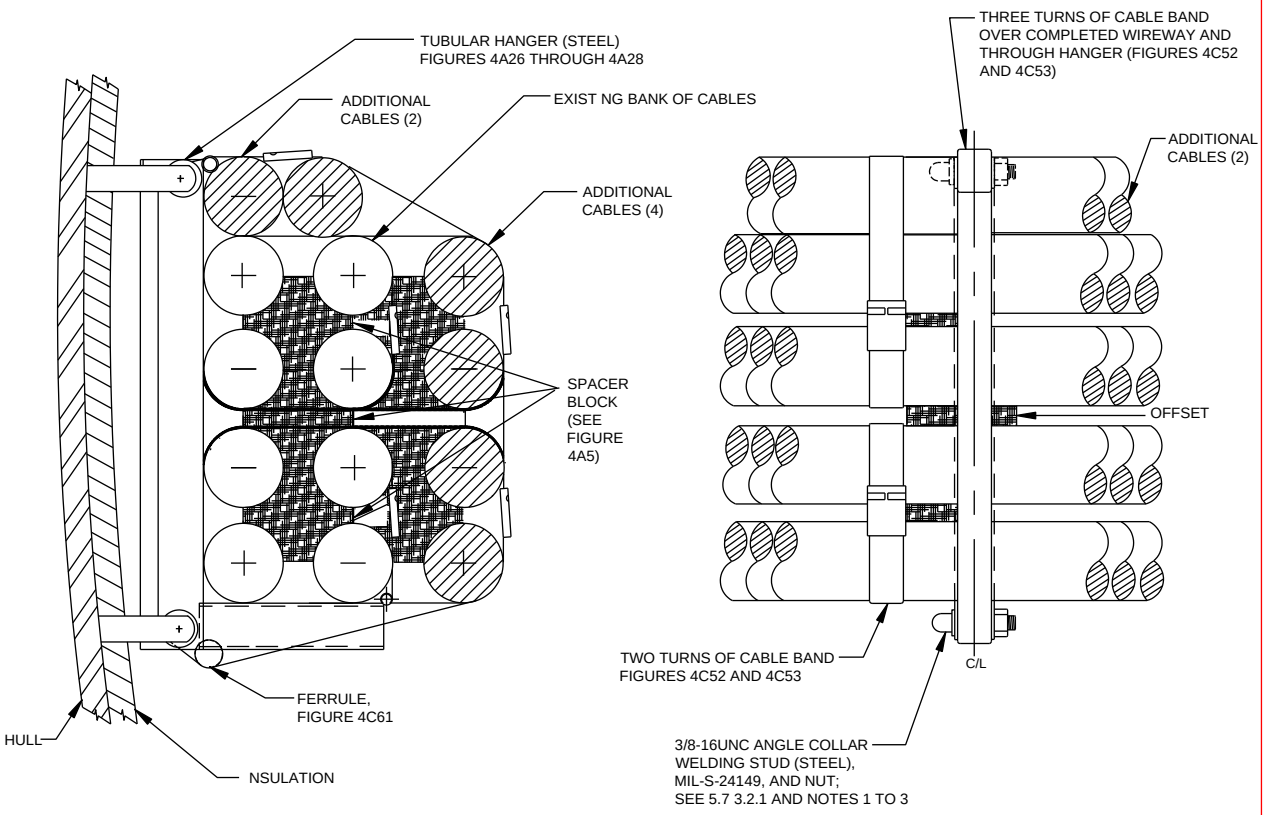
METHOD 4A-3-1
ADDITION OF CABLES TO EXISTING BATTERY CABLEWAY



NOTES:

1. See A.4.3 for general installation information.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A3. Addition of cable to existing battery cableway (submarines).

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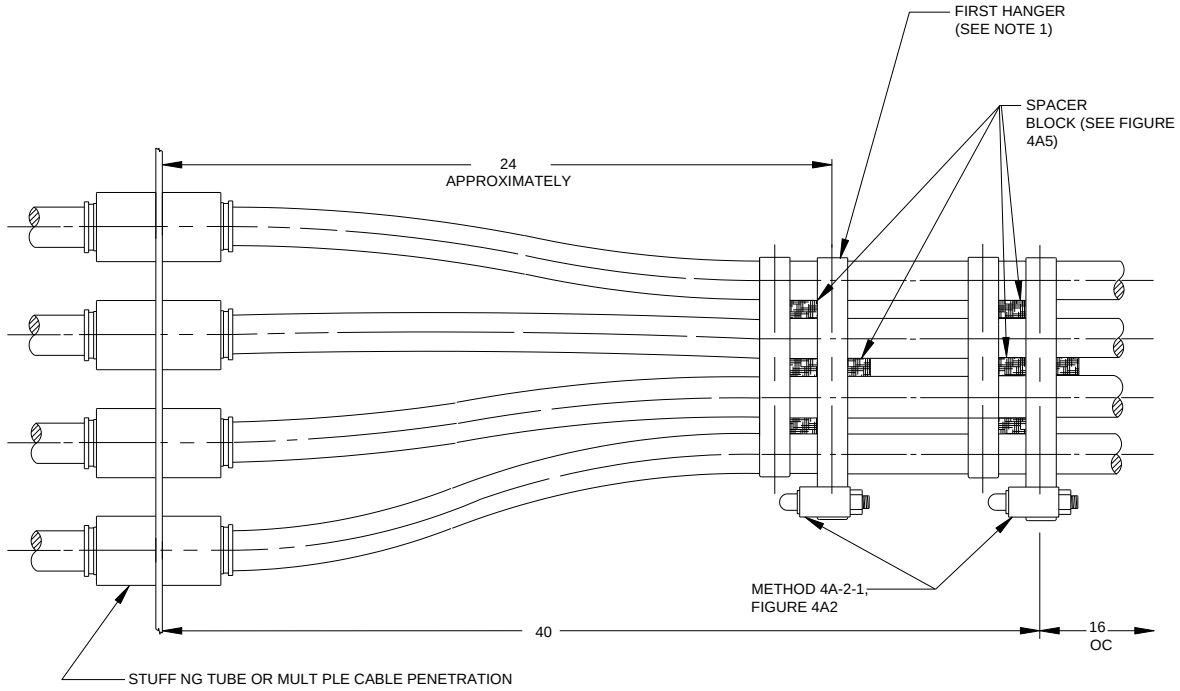
METHOD 4A-4-1
CABLEWAY ADJACENT TO BULKHEAD PENETRATION
(ALL DIMENSIONS ARE IN INCHES)



NOTES:

1. The first hanger next to the bulkhead shall be located to suit cable bends at penetration but shall not exceed 32 inches.
2. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4A4. Cableway adjacent to bulkhead penetration (submarines).

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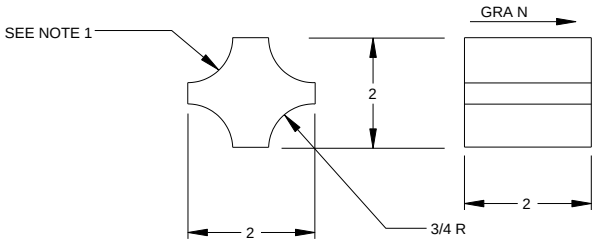
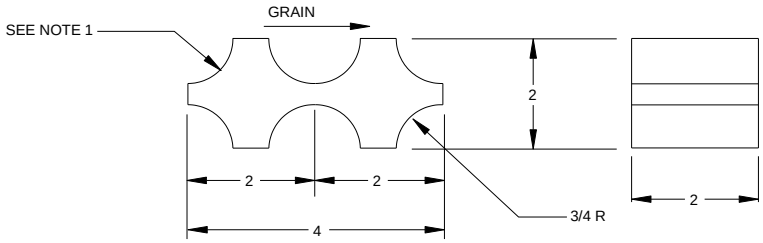
METHOD 4A-5-1
SPACER BLOCK
FOR FOUR CABLES



ALL DIMENSIONS ARE N INCHES

METHOD 4A-5-2
SPACER BLOCK
FOR SIX CABLES



NOTE:

1. Material may be maple wood finished with two coats of marine varnish or melamine in accordance with ASTM D704.

FIGURE 4A5. Spacer blocks for submarine cableways.

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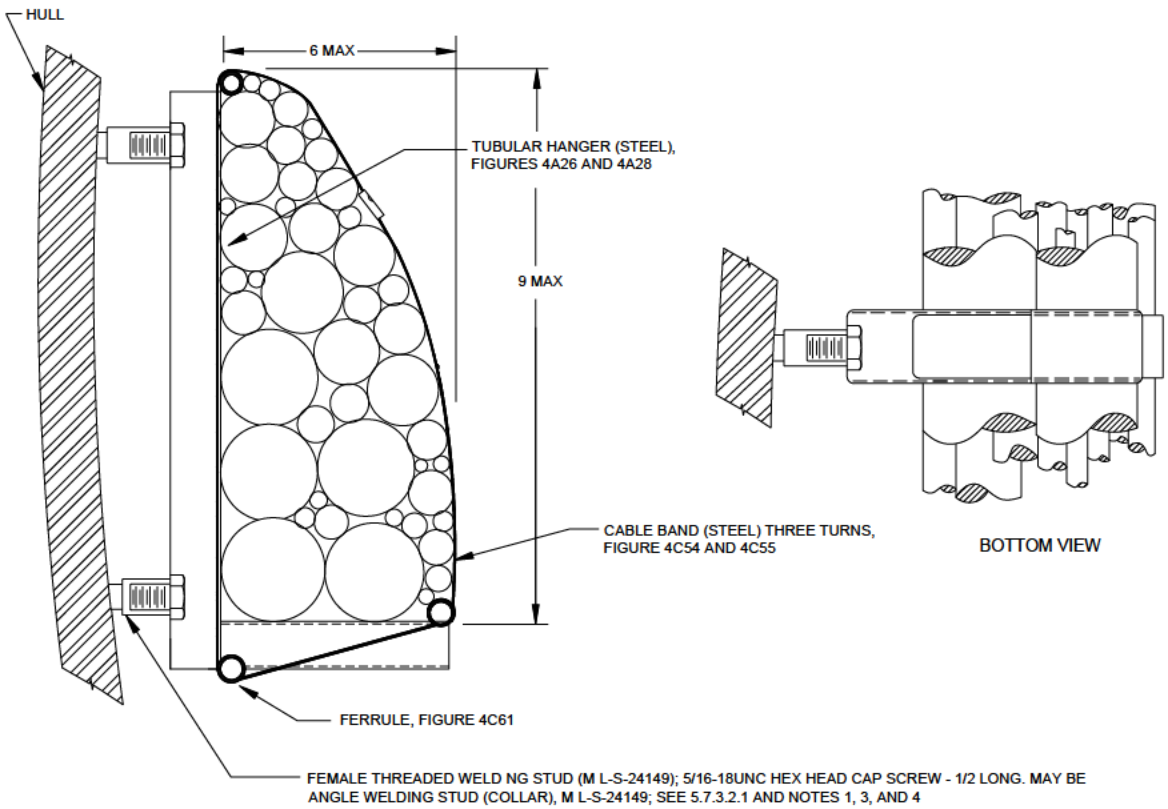
METHOD 4A-6-1
CABLE BANKS SUPPORTED BY WELD NG STUDS ON HULL WITHOUT INSULATION



ELEVATION V EW

NOTES:

1. See A.4.3 for general installation information.
2. Cables shall be arranged so that the larger cables are in the center of the hanger, if possible.
3. See 5.7.3.8 for collar and welding stud requirements.
4. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A6. Cableway for auxiliary cables (submarines).

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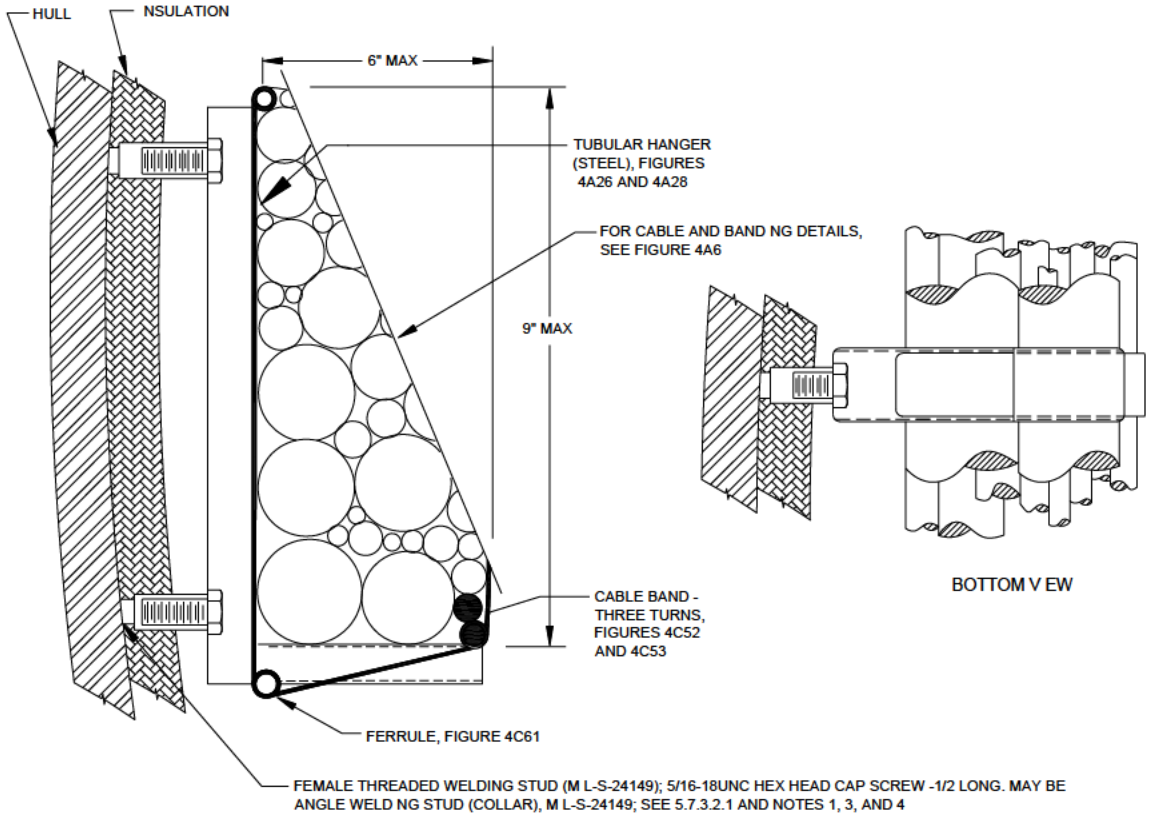
METHOD 4A-7-1

CABLE BANKS SUPPORTED BY WELDING STUDS ON HULL WITH INSULATION



ELEVATION VIEW

NOTES:

1. See A.4.3 for general installation information.
2. Cables shall be arranged so that the larger cables are in the center of the hanger if possible.
3. See 5.7.3.8 for collar and welding stud requirements.
4. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A7. Cableway for auxiliary cables (submarines).

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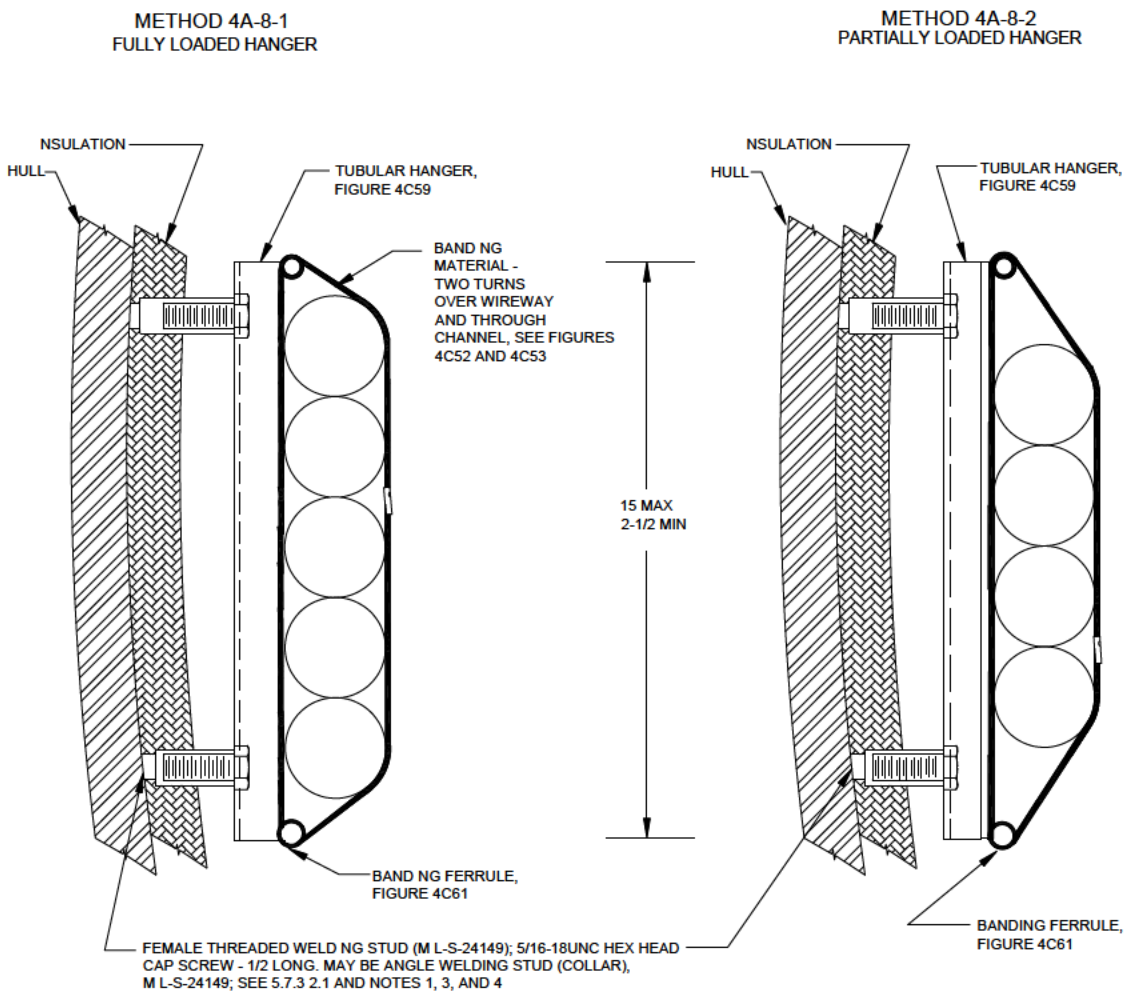

NOTES:

1. See A.4.3 for general installation information.
2. Cables shall be arranged so that the larger cables are in the center of the hanger, if possible.
3. See 5.7.3.8 for collar and welding stud requirements.
4. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A8. Cableway for auxiliary cables (submarines).

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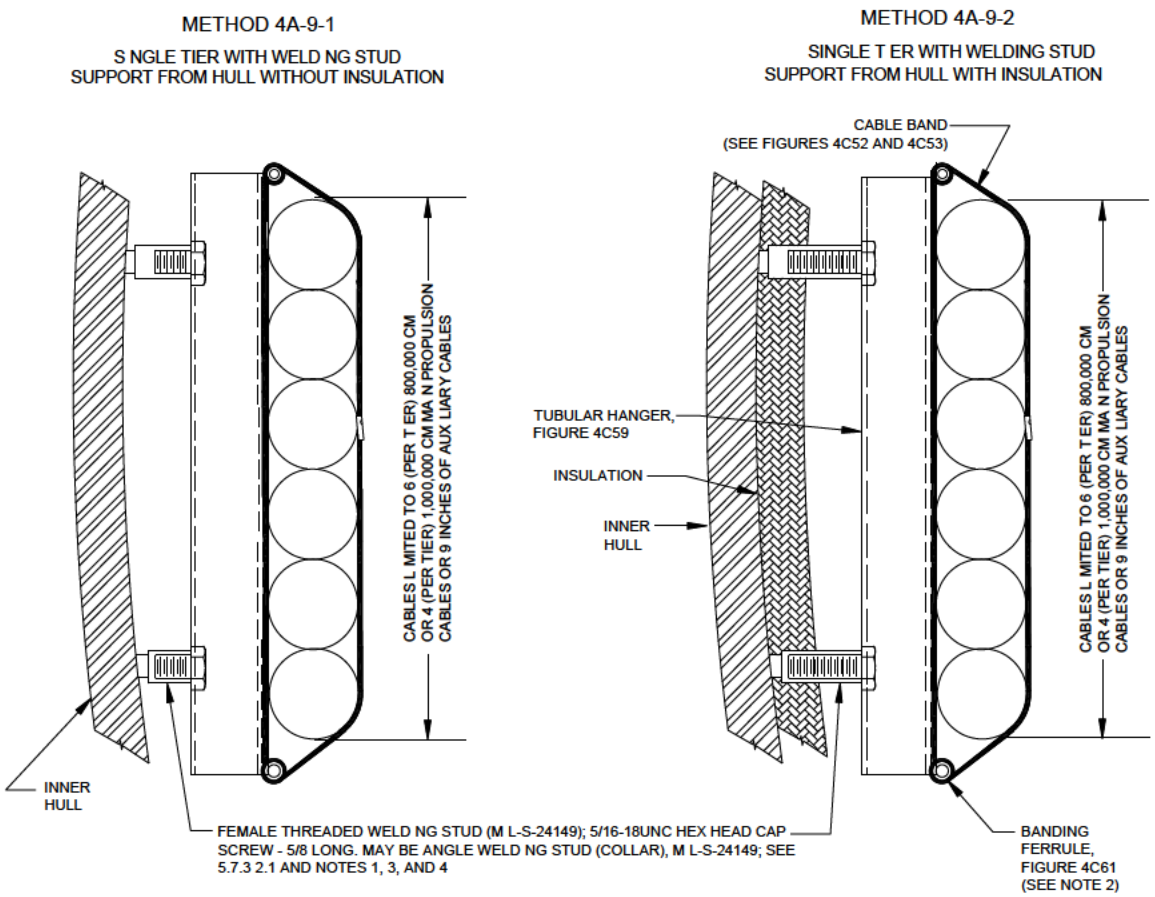

NOTES:

1. See A.4.3 for general installation information.
2. Ferrules (figure 4C61) are required for 7- through 9-inch hanger lengths where cable diameters are over 2 inches.
3. See 5.7.3.8 for collar and welding stud requirements.
4. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A9. Single row cableway (submarines).

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METHOD 4A-10-1
CABLEWAY THROUGH COAMING AND HATCHWAYS
FOR VERTICAL CABLE RUNS ONLY

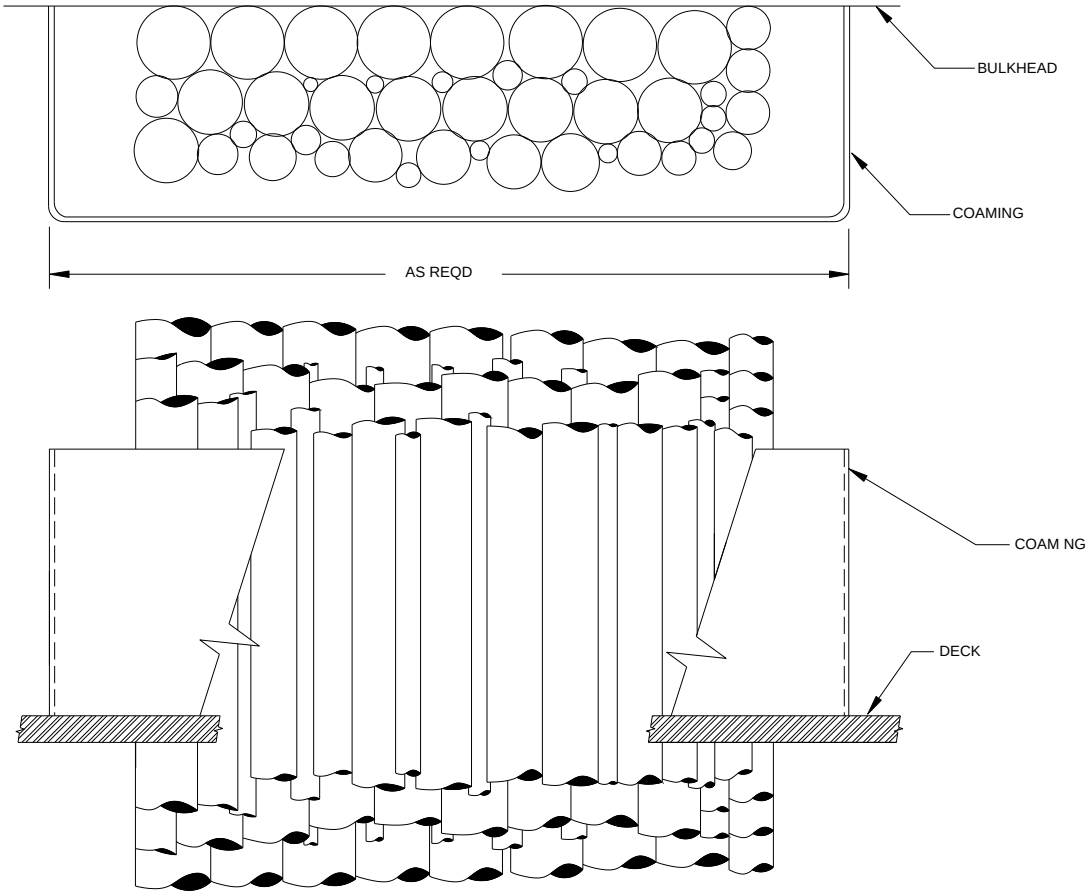

FIGURE 4A10. Cableways through coamings (submarines).

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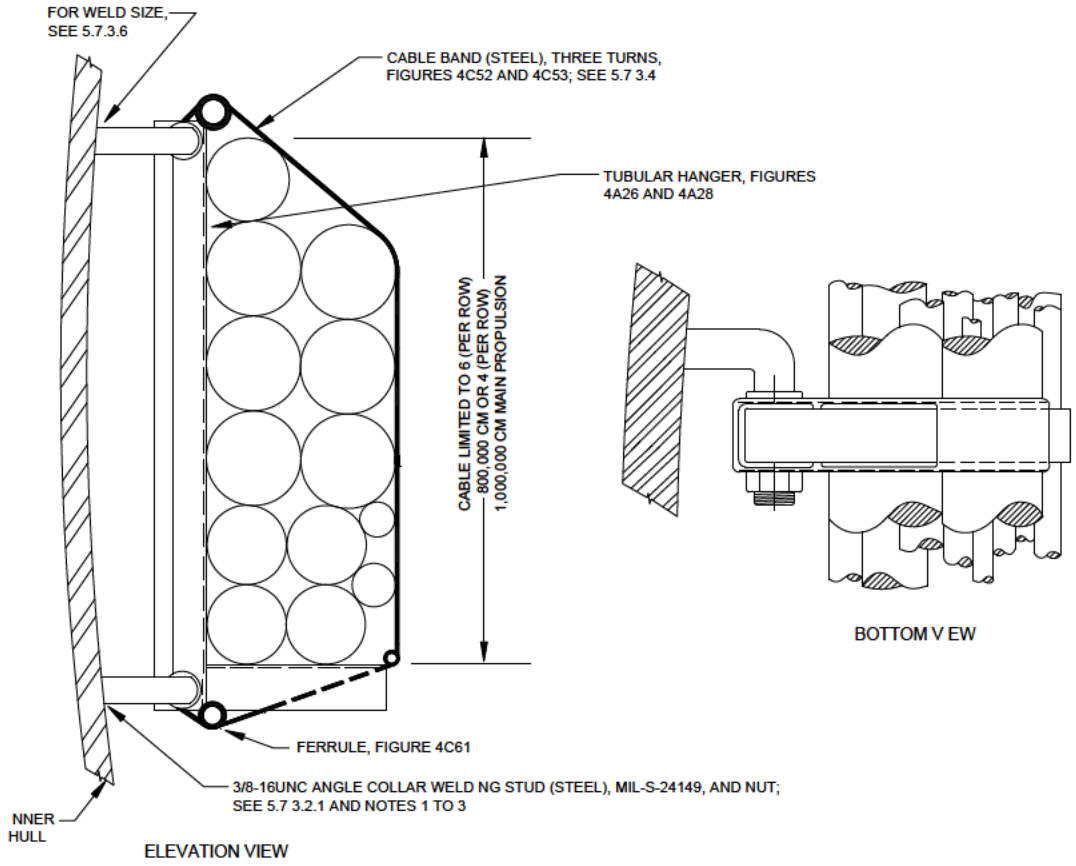
METHOD 4A-11-1

CABLE BANKS SUPPORTED BY WELD NG STUDS
ON INNER HULL WITHOUT INSULATION



NOTES:

1. See A.4.3 for general installation information.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A11. Cableway for double bank of main propulsion cables (submarines).

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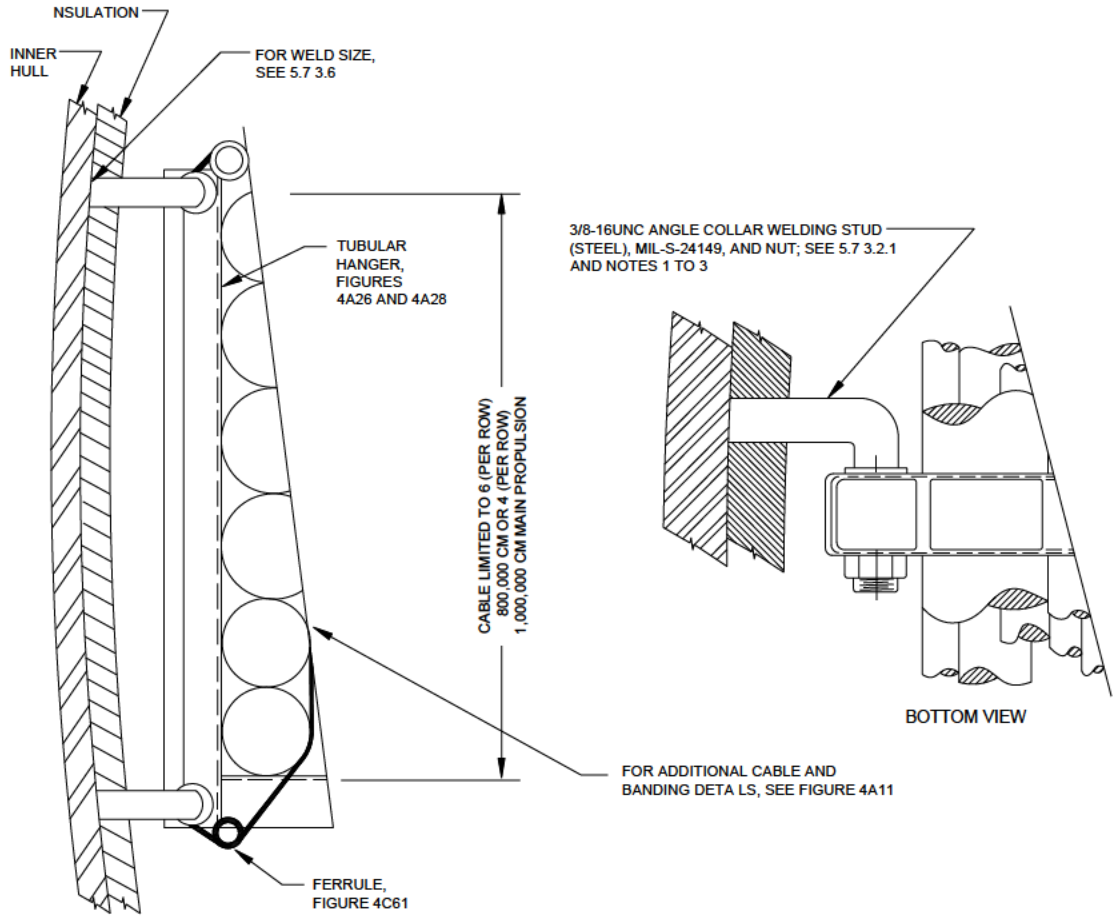
METHOD 4A-12-1

CABLE BANKS SUPPORTED BY WELD NG STUDS ON INNER HULL WITH NSULATION



ELEVATION V EW

NOTES:

1. See A.4.3 for general installation information.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4A12. Cableway for double bank of main propulsion cables (submarines).

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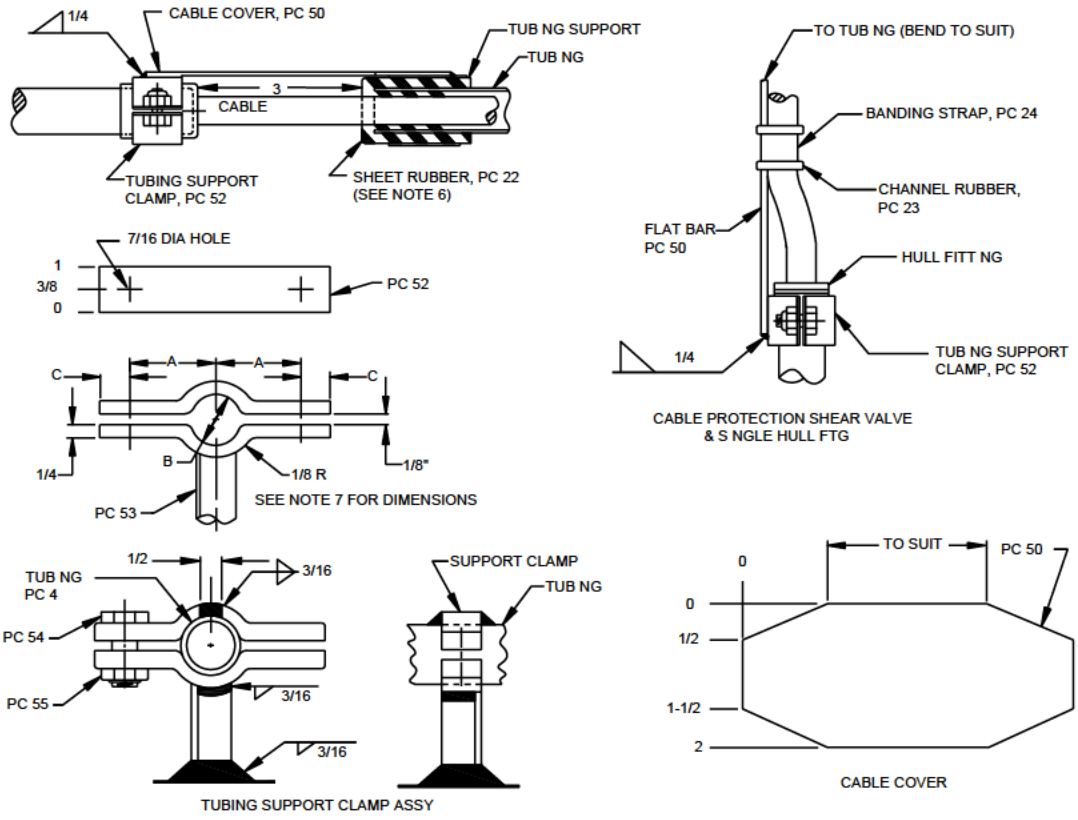
Method 4A-13-1
External Wireway Tubing Support

EXTERNAL WIREWAY DETAILS



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers called out on this figure.
2. Tubing (PC 4) shall not be used except in special installations where specified.
3. Tubing (PC 4) shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends.
4. Cables shall not sag. Covers shall be double banded every 16 inches.
5. All welding shall be on frame lines only.
6. Rubber shall be inserted into tubing (2 inches minimum) and folded back 2 inches over tubing. Tubing shall not be flared. Remove all sharp edges. The rubber shall be held in place with tubing support clamp. A piece of ¼-inch by 2-inch flat-bar shall be welded to the top half of the clamp. The thickness of the rubber and size of the clamp depends on the size of tubing and cables in it. There shall be no mounting leg on clamps.
7. Dimensions for tubing support clamp assemblies are as shown in table 4A13-I.

FIGURE 4A13. External wireways installation (submarines).

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TABLE 4A13-I. Tubing support clamp assembly dimensions.

Type	Tubing (O.D.)	Dimensions		
		A	B	C
A	0.840	1 3/16	23/32	7/16
B	1.050	1 7/32	1 1/16	11/32
C	1.315	1 9/32	1 3/16	11/32
D	1.660	1 17/32	1 9/16	11/32
E	1.900	1 31/32	1 13/16	11/32
F	2.375	2 1/8	2 13/32	½
G	2.875	2 5/16	2 7/8	½
H	3.500	2 5/8	3½	½
J	4.500	3 1/8	4½	½
K	5.563	3 5/8	5½	½

FIGURE 4A13. External wireways installation (submarines) – Continued.

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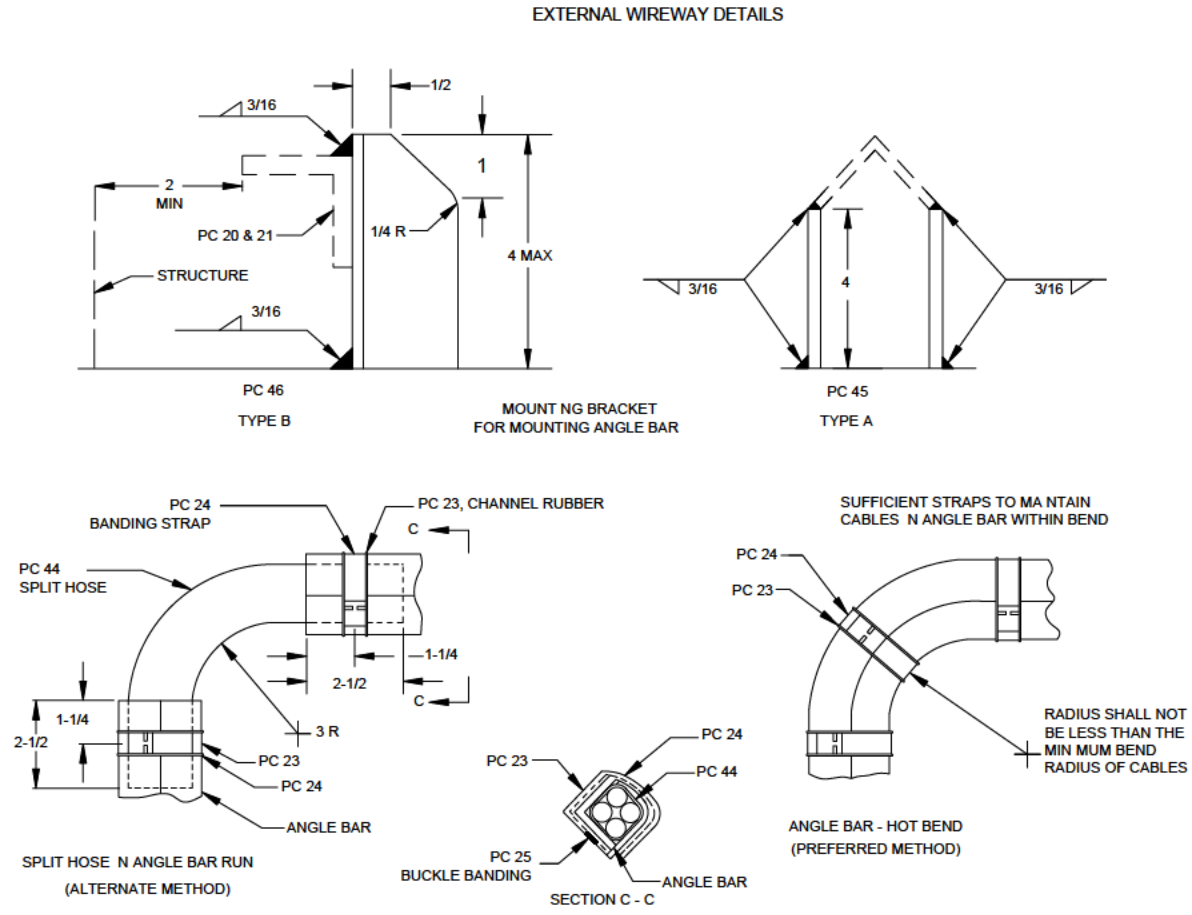
Method 4A-14-1
External Wireway
Angle Bar Cable Support



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure.
2. Angle bar (PCs 20 and 21) shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cable angle bars shall be banded every 12 inches. Cables shall not sag. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.
3. Angle bar runs shall be continuous and shall be broken only as indicated on ships' installation plans. Channel rubber (PC 23) shall be used in all cases between cables and banding straps in a manner to prevent any possible contact between the banding straps and the cables.
4. Mounting brackets (PC 45), type A, shall be staggered from each other. Staggering means that the flat bar brackets are not to be installed directly across from each other, but should be staggered left and right along the angle bar cable run.

FIGURE 4A14. External wireways installation (submarines).

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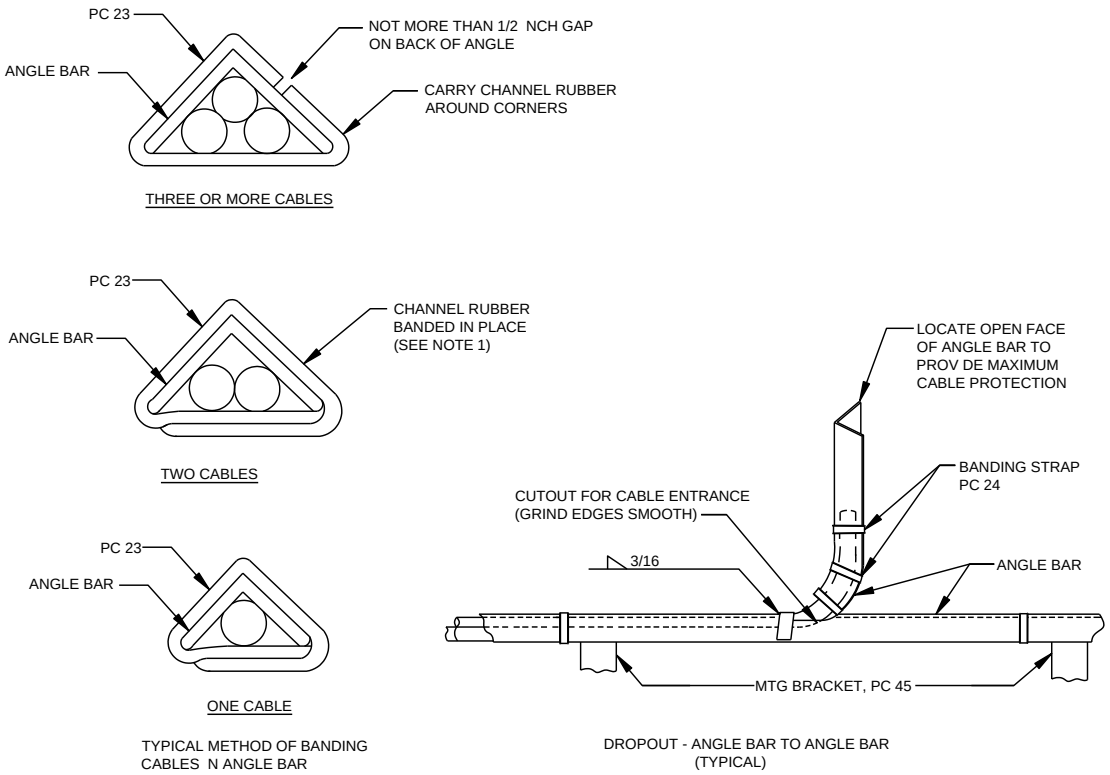
Method 4A-15-1
External Wireway
Angle Bar Cable Support

EXTERNAL WIREWAY DETAILS



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure.
2. Angle bar (PCs 20 and 21) shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cable angle bars shall be banded every 12 inches. Cables shall not sag. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.
3. Angle bar runs shall be continuous and shall be broken only as indicated on the ship's installation plan.
4. Channel rubber (PC 23) shall be used in all cases between cables and banding straps in a manner to prevent any possible contact between the banding straps and the cables.

FIGURE 4A15. External wireways installation (submarines).

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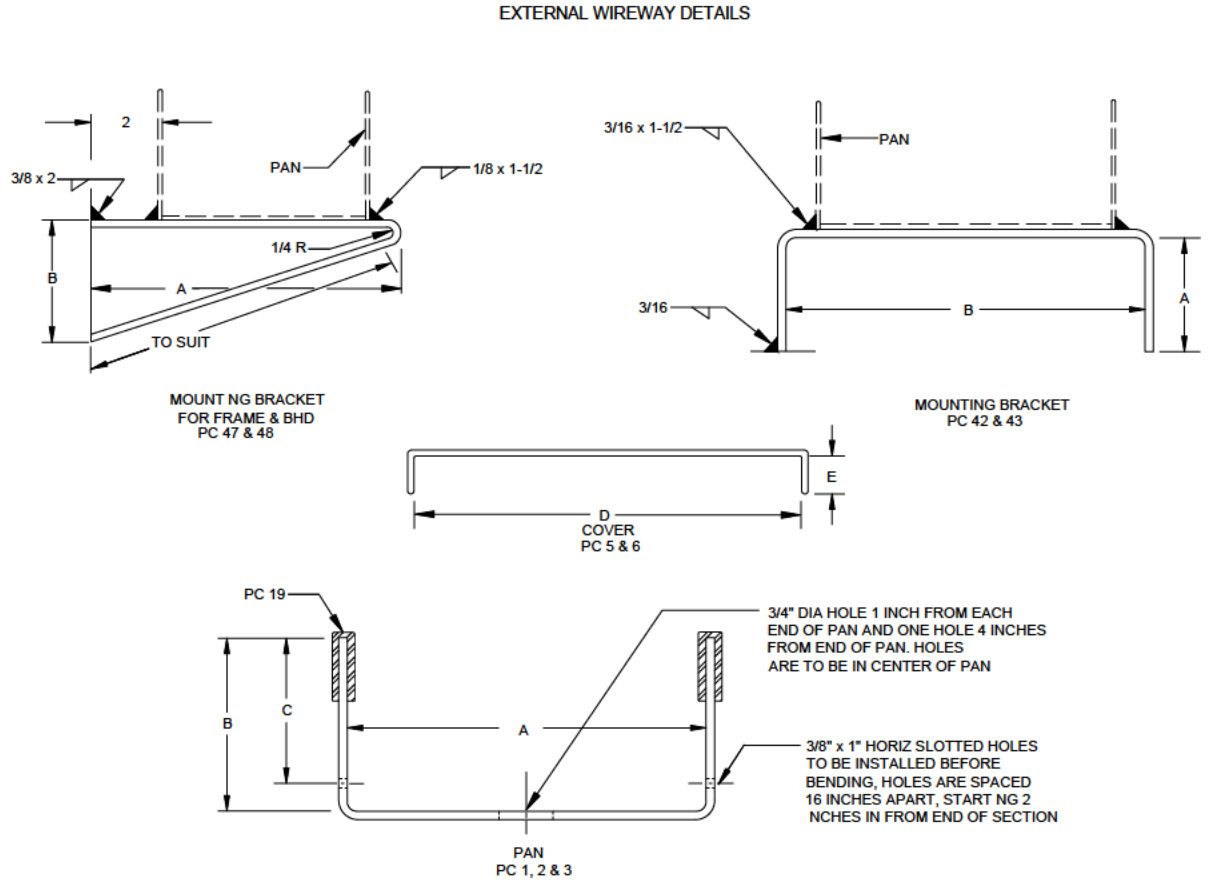
Method 4A-16-1
External Wireway
Cable Pan Support



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure. See table 4AVI and table 4AX for dimensions in this figure.
2. Cables shall be completely protected for their entire length by the methods shown.
3. Cable pans (PCs 1 through 3) shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cables in pans shall be banded through each slot provided and banding shall be spaced not more than 16 inches apart. Cables shall not sag. Covers shall be double banded every 16 inches. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.
4. Cable pan covers shall be installed at all times except during installation of cables in the pans. Cable pans shall be clean of all foreign matter prior to installation of cables.
5. All cable pans shall be continuous and shall be broken only as indicated on the ship's installation plan.

FIGURE 4A16. External wireways installation standard methods (submarines).

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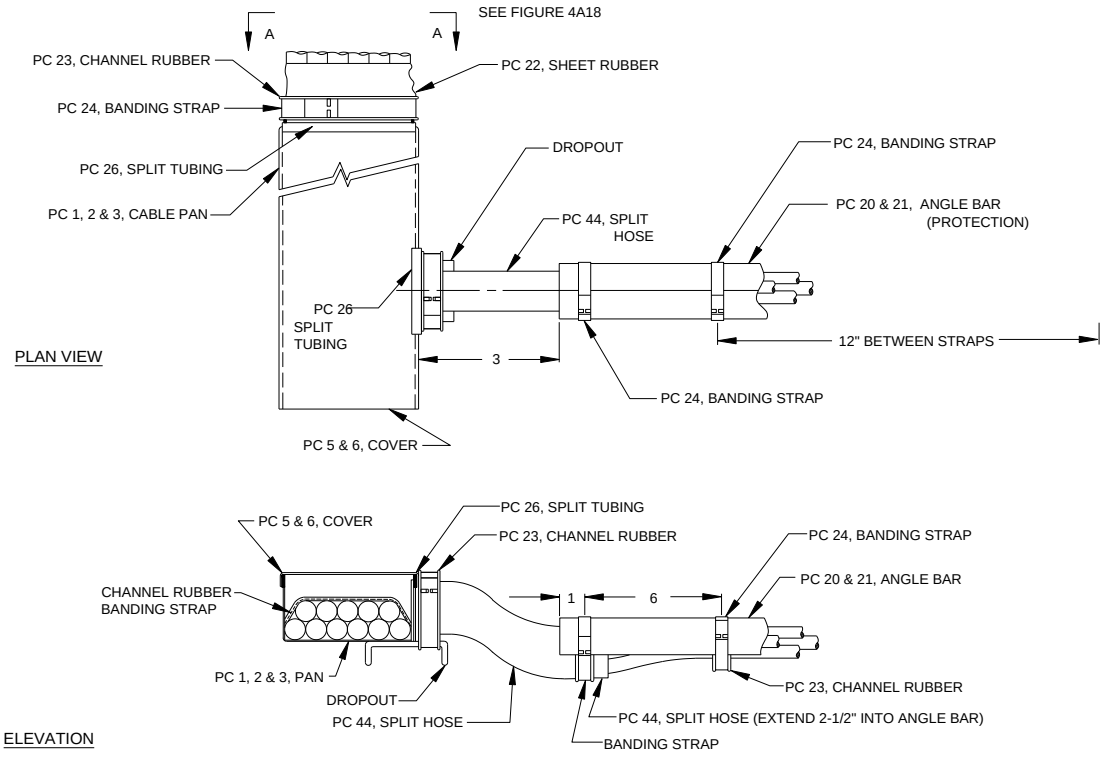
Method 4A-17-1
External Wireway
Cable Pan and Angle Bar Support Intersection



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers called out in this figure.
2. Cables shall be completely protected for their entire length by the methods shown.
3. Cable pans (PCs 1 through 3) and angle bar runs shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cables in pans shall be banded through each slot provided, and banding shall be spaced not more than 16 inches apart. Cable angle bars shall be banded every 12 inches. Cables shall not sag. Covers shall be double banded every 16 inches. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.
4. Channel rubber (PC 23) shall be used, in all cases, between cables and banding straps in a manner to prevent any possible contact between the banding straps and the cables.
5. Cable pan covers shall be installed at all times except during installation of cables in the pans. Cable pans shall be clean of all foreign matter prior to installation of cables.
6. All cable pan and angle bar runs shall be continuous and shall be broken only as indicated on ship's installation plan.

FIGURE 4A17. External wireways installation standard methods (submarines).

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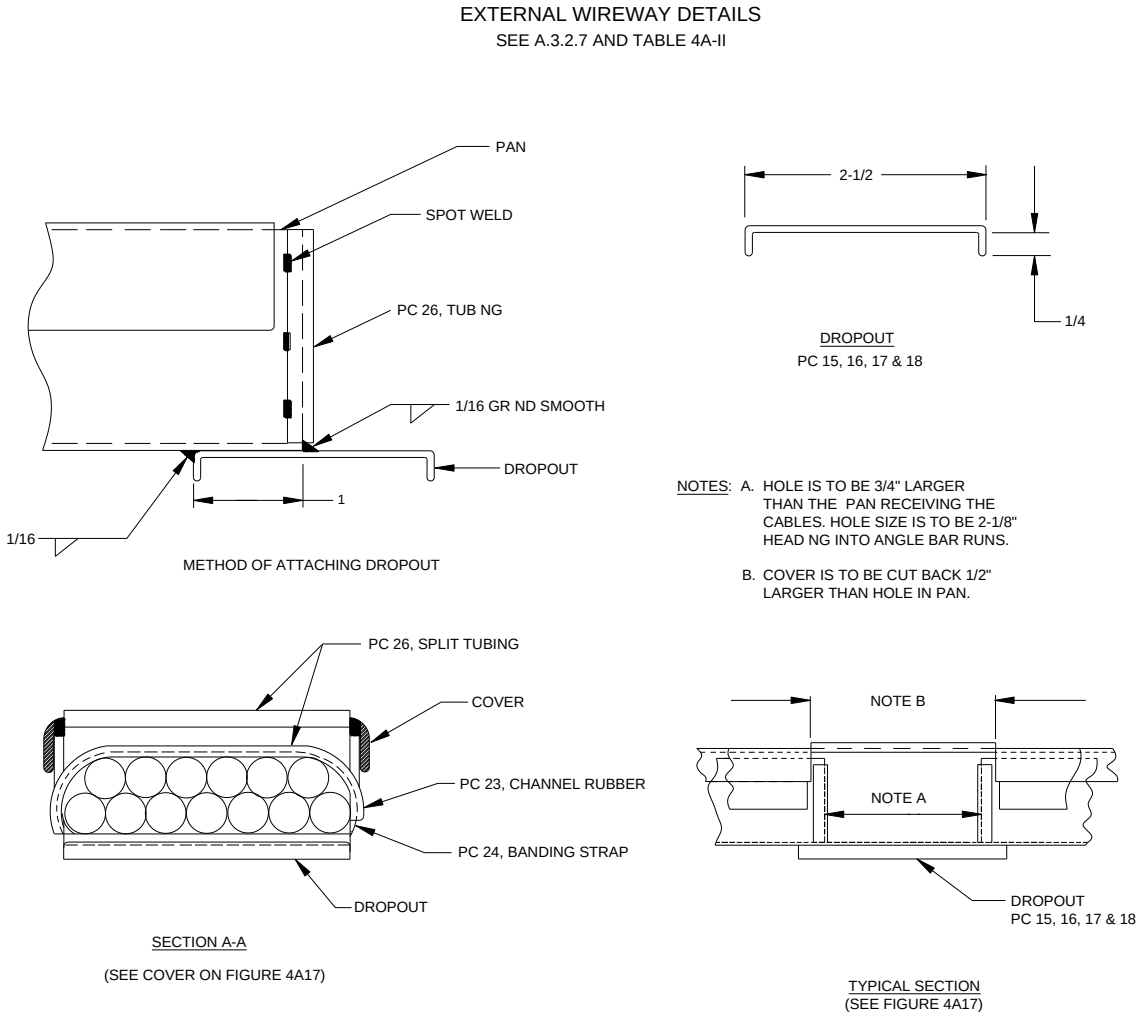
Method 4A-18-1
External Wireway
Dropout Cable Pan Support



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure. See table 4AVIII for dimensions for parts in this figure.
2. Cables shall be completely protected for their entire length by the methods shown.
3. Cable pans shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cables in pans shall be banded through each slot provided, and banding shall be spaced not more than 16 inches apart. Cables shall not sag. Covers shall be double banded every 16 inches. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.
4. Cable pan covers shall be installed at all times except during installation of cables in the pans. Cable pans shall be clean of all foreign matter prior to installation of cables.
5. All cable pan runs shall be continuous and shall be broken only as indicated on the ship's installation plan.

FIGURE 4A18. External wireways installation standard methods (submarines).

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Method 4A-19-1
External Wireway
Curved Cable Pan

EXTERNAL WIREWAY DETAILS

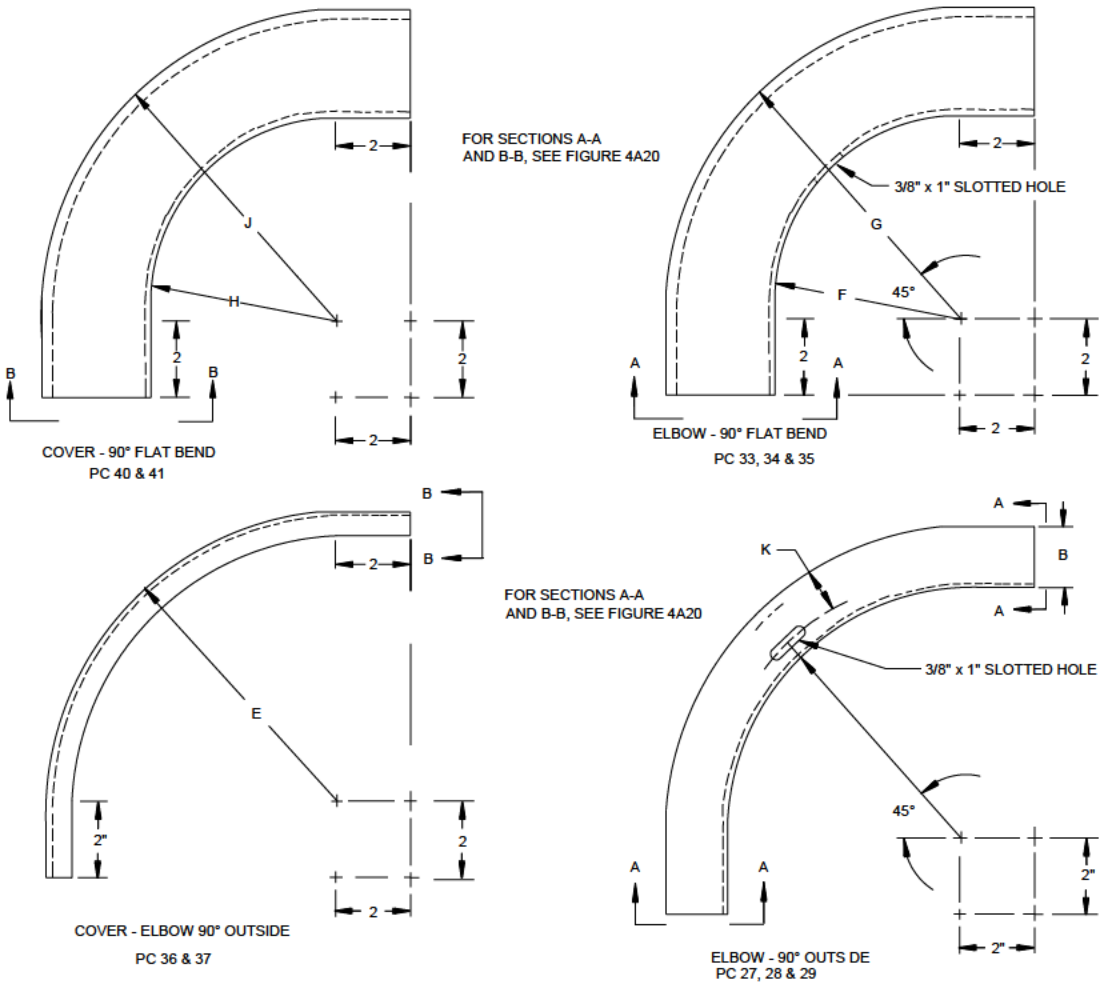

FIGURE 4A19. External wireways installation standard methods (submarines).

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NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure. See table 4AIX for dimensions in this figure.
2. Cables shall be completely protected for their entire length by the methods shown.
3. Cable pans shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cables in pans shall be banded through each slot provided and banding shall be spaced not more than 16 inches apart. Cables shall not sag. Covers shall be double banded every 16 inches. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.
4. Cable pan covers shall be installed at all times except during installation of cables in the pans. Cable pans shall be clean of all foreign matter prior to installation of cables.
5. All cable pan runs shall be continuous and shall be broken only as indicated on ships installation plan.

FIGURE 4A19. External wireways installation standard methods (submarines) – Continued.

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Method 4A-20-1
External Wireway
Curved Cable Pan

EXTERNAL WIREWAY DETAILS

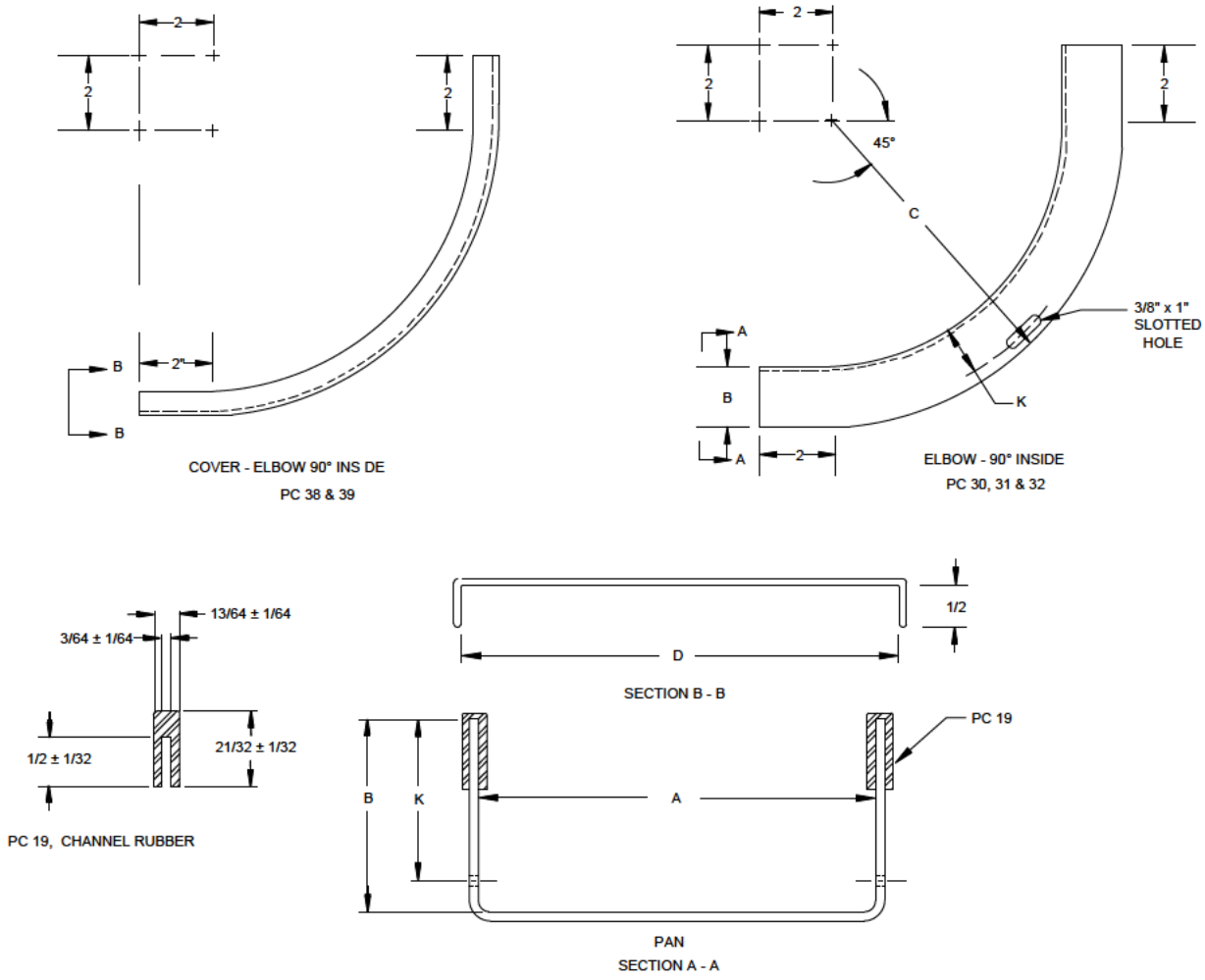

FIGURE 4A20. External wireways installation standard methods (submarines).

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NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers called out in this figure. See table 4AIX for dimensions in this figure.
2. Cable pans shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cables in pans shall be banded through each slot provided and banding shall be spaced not more than 16 inches apart. Cables shall not sag. Covers shall be double banded every 16 inches. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.
3. Cable pan covers shall be installed at all times except during installation of cables in the pans. Cable pans shall be clean of all foreign matter prior to installation of cables.
4. All cable pan runs shall be continuous and shall be broken only as indicated on the ship's installation plan.

FIGURE 4A20. External wireways installation standard methods (submarines) – Continued.

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Method 4A-21-1
External Wireway
Offset Cable Pan and Cover

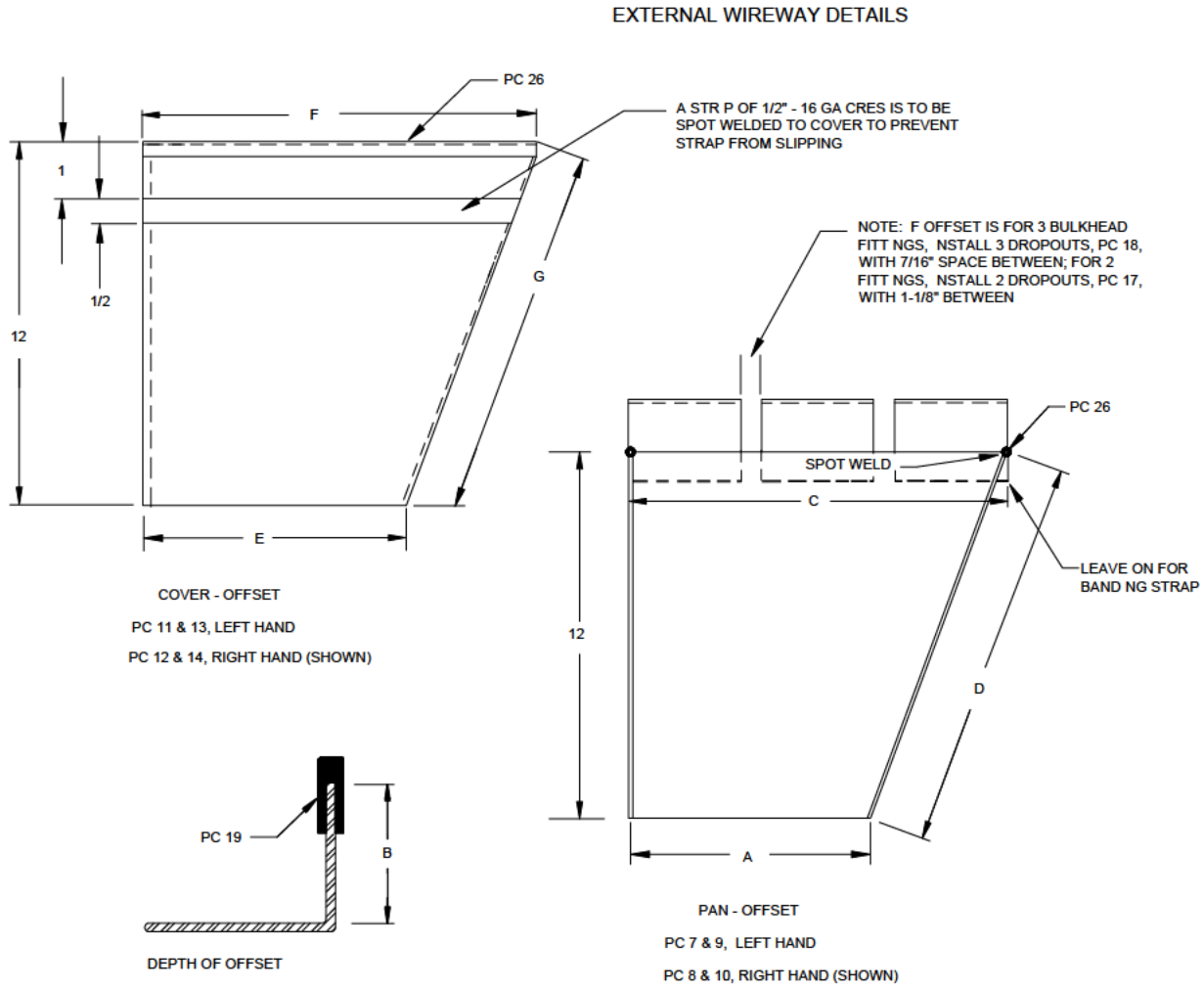

FIGURE 4A21. External wireways installation standard methods (submarines).

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NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure. See table 4AVII for dimensions in this figure.
2. Cable pans shall be mounted from the hull or frame at each frame space or 3-foot maximum spacing and no more than 6 feet from the ends. Cables in pans shall be banded through each slot provided, and banding shall be spaced not more than 16 inches apart. Cables shall not sag. Covers shall be double banded every 16 inches. All welding shall be on frame lines only. Banding of cables on angle bar wireways and cable pans shall be one turn minimum.
3. Cable pan covers shall be installed at all times except during installation of cables in the pans. Cable pans shall be clean of all foreign matter prior to installation of cables.
4. All cable pan runs shall be continuous and shall be broken only as indicated on the ship's installation plan.

FIGURE 4A21. External wireways installation standard methods (submarines) – Continued.

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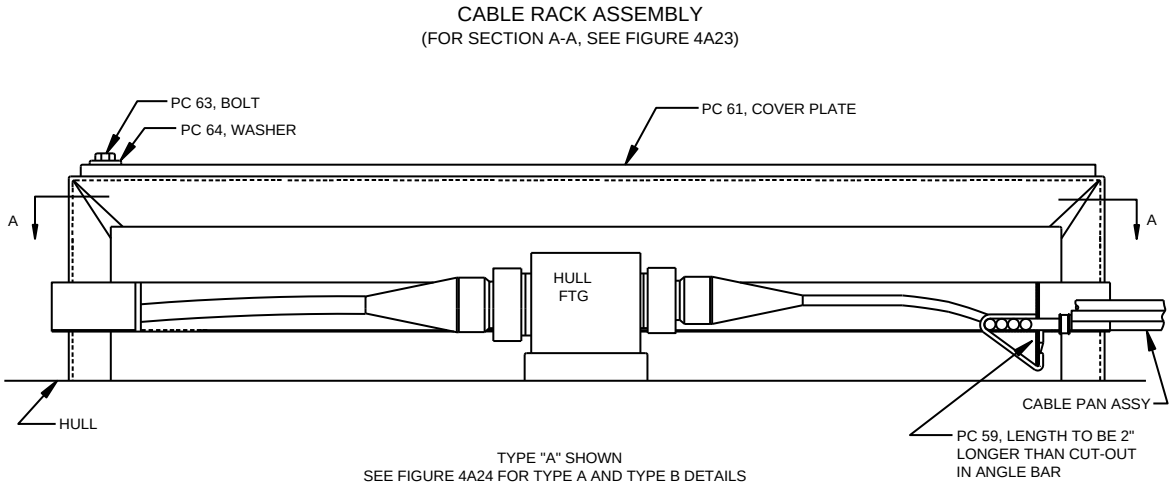
Method 4A-22-1
External Wireway
Cable Rack Assembly.



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure.
2. Flat bar (PC 59) shall be welded to the underside of cover plate (PC 61), if needed, to prevent vibrations. Number and spacing of flat bars shall suit plate.
3 The number of mounting holes shall be determined by the size of the plate; the maximum distance between holes is 8 inches.
4. Cable racks and cover plates shall be painted to the requirements of the ballast tanks, as stated in submarine painting schedule.

FIGURE 4A22. External wireways installation methods (submarines) – cable rack assembly.

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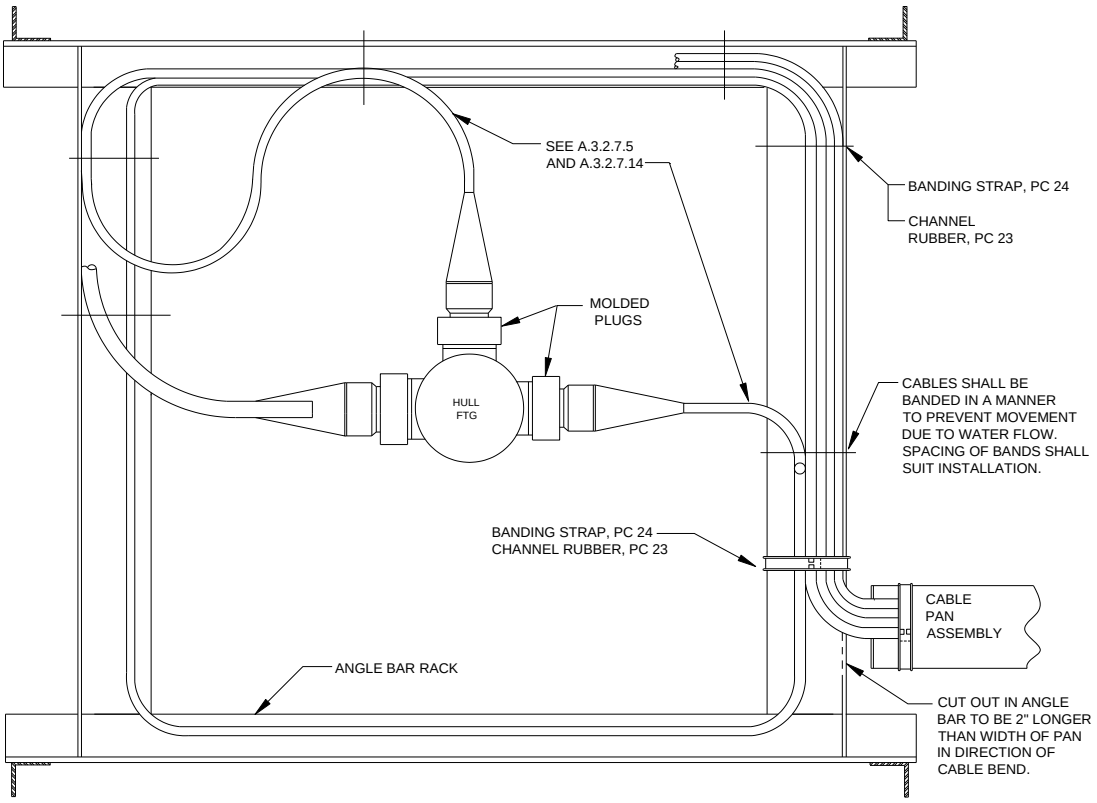
Method 4A-23-1
External Wireway
Cable Rack Assembly

SECTION A-A FOR FIGURE 4A22



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure.
2. The number of mounting holes shall be determined by the size of the plate; the maximum distance between holes is 8 inches.
3. Cable racks and cover plates shall be painted to the requirements of the ballast tanks, as stated in submarine painting schedule.

FIGURE 4A23. External wireways installation methods (submarines) – section A-A for figure 4A22.

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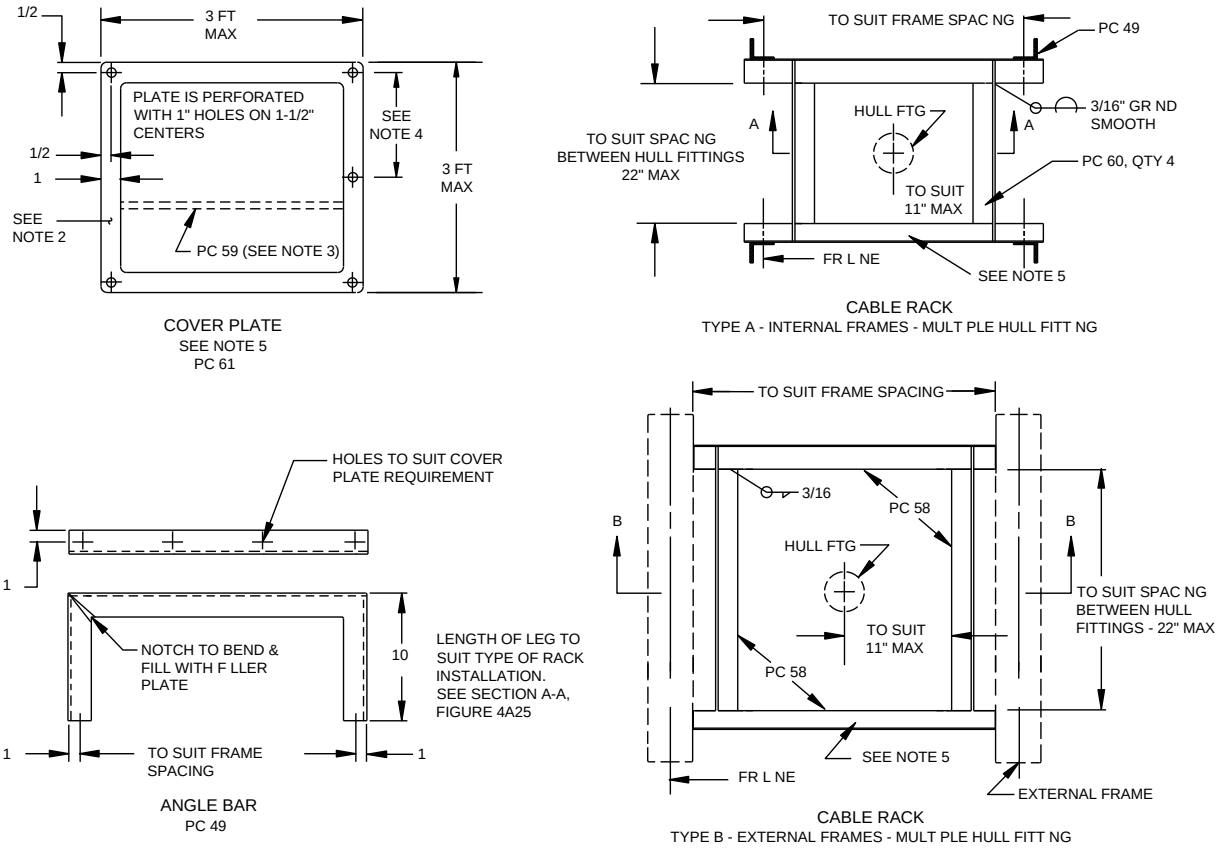
Method 4A-24-1
External Wireway
Cable Rack Assembly

EXTERNAL WIREWAY DETAILS



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure.
2. If 1-inch margin is cut off the cover plate edge to suit installation, a piece of flat bar (PC 59) shall be welded on the edge for mounting.
3. Flat bar (PC 59) shall be welded to the underside of plate (PC 61), if needed, to prevent vibrations. Number and spacing of flat bars shall suit the plate.
4. The number of mounting holes shall be determined by the size of the plate; the maximum distance between holes is 8 inches.
5. Cable racks and cover plates shall be painted to the requirements of the ballast tanks, as stated in submarine painting schedule.

FIGURE 4A24. External wireways installation methods (submarines).

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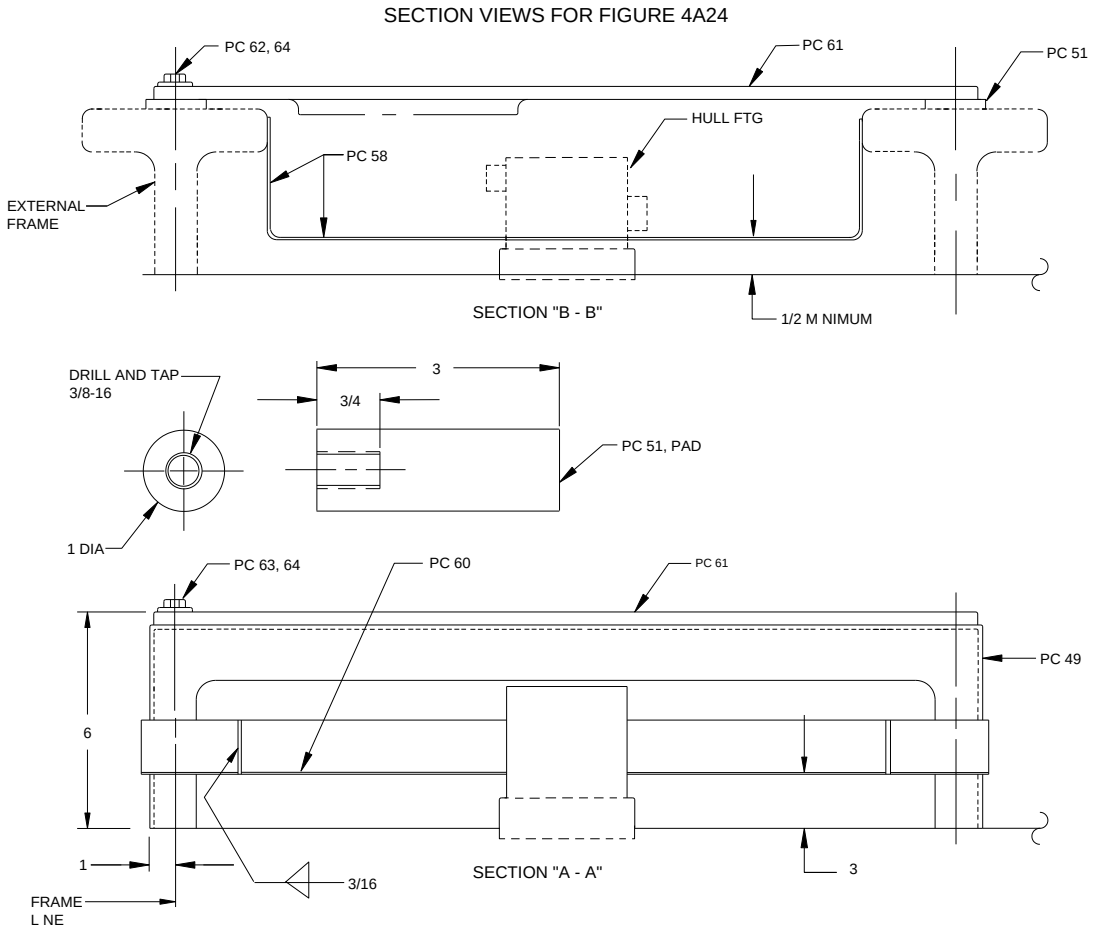
Method 4A-25-1
External Wireway
Cable Rack Assembly Pads



NOTES:

1. See A.4.4 for general installation information. See List of Material in table 4AV for details on piece numbers referenced on this figure.
2. If 1-inch margin is cut off to suit installation, a piece of flat bar (PC 59) shall be welded on the edge for mounting.
3. Flat bar (PC 59) shall be welded to the underside of plate, if needed, to prevent vibrations. Number and spacing to suit plate.
4. The number of mounting holes shall be determined by the size of the plate; the maximum distance between holes is 8 inches.
5. Cable racks and cover plates shall be painted to the requirements of the ballast tanks, as stated in submarine painting schedule.

FIGURE 4A25. External wireways installation methods (submarines) – pad and section views.

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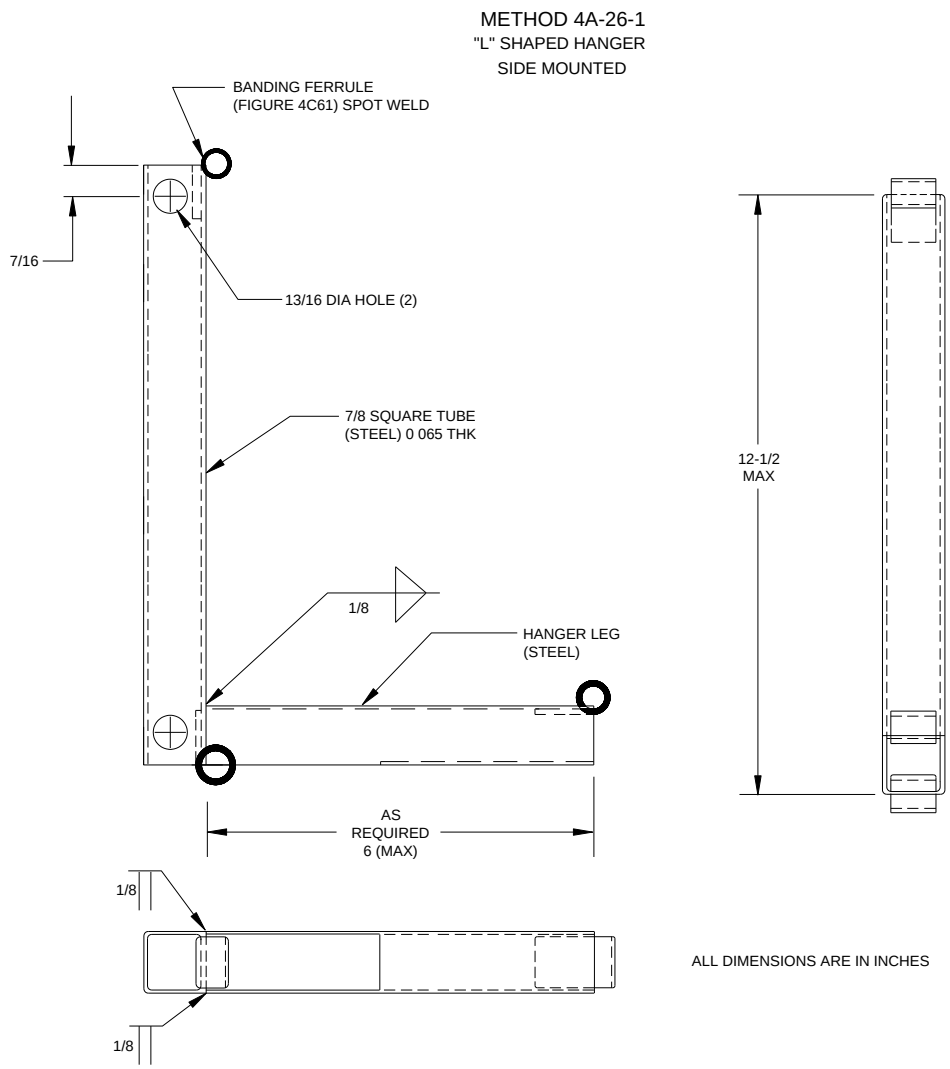

FIGURE 4A26. Tubular hanger details “L” shape for submarines.

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METHOD 4A-27-1
"L" SHAPED HANGER
BOTTOM MOUNTED

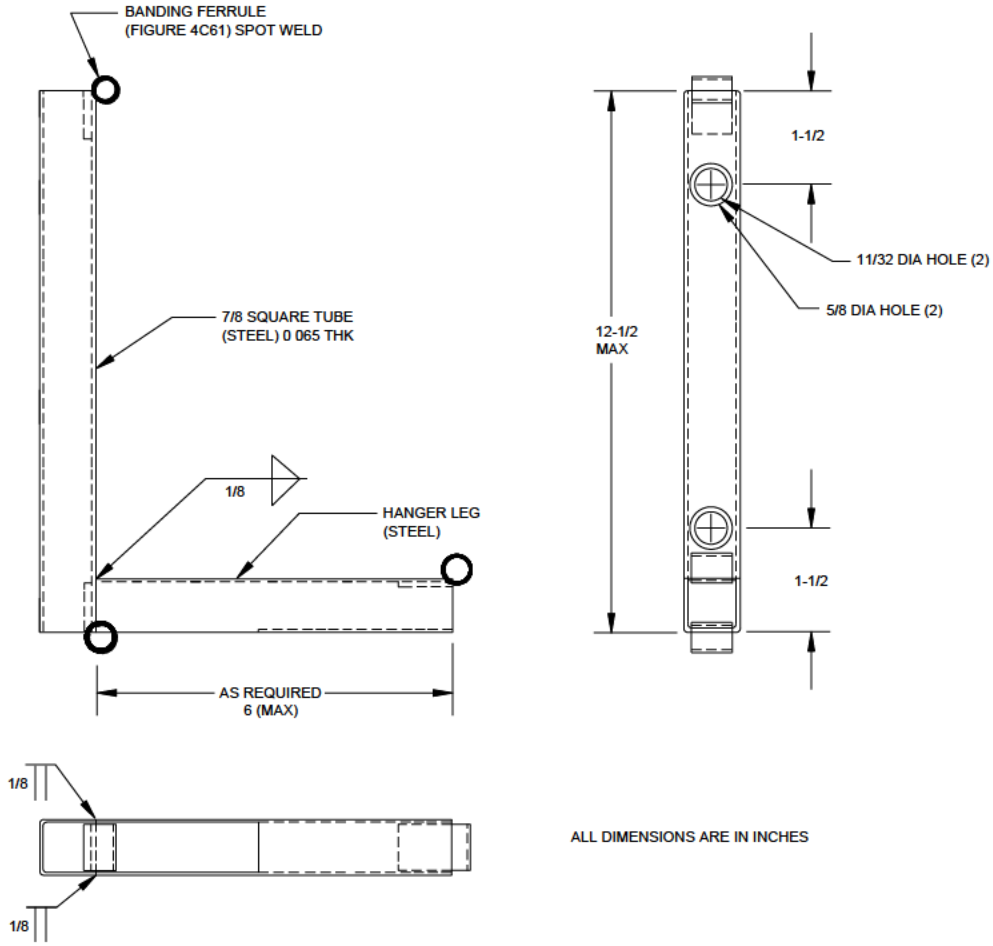

FIGURE 4A27. Tubular hanger details "L" shape for submarines.

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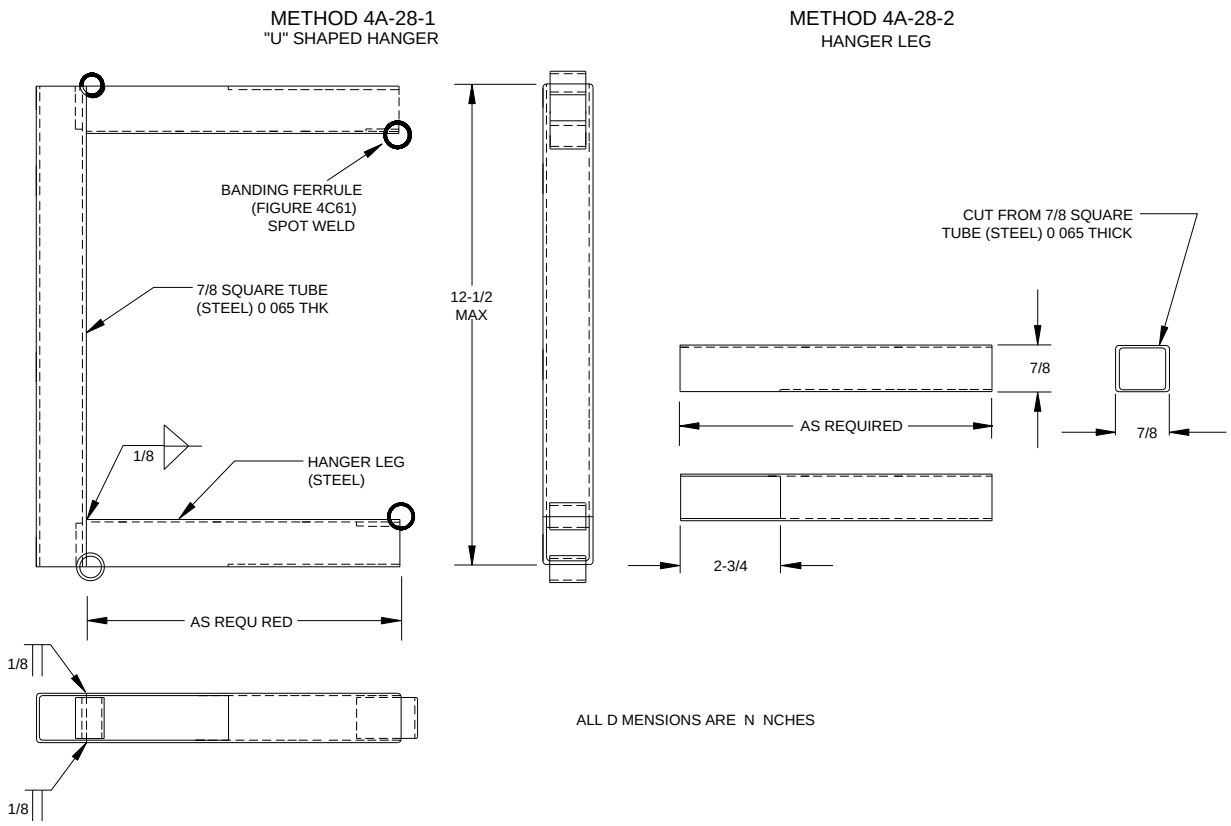

FIGURE 4A28. Tubular hanger details “U” shape for submarines.

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APPENDIX 4B – CABLEWAYS (SURFACE SHIPS)

B.1 SCOPE

B.1.1 Scope. This appendix establishes procedures for the installation of cableways on surface ships. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

B.2. APPLICABLE DOCUMENTS

B.2.1 General. The documents listed in this section are specified in this appendix. 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 this appendix, whether or not they are listed.

B.2.2 Government documents.

B.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-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-I-3064	-	Insulation, Electrical, Plastic-Sealer
MIL-PRF-23236	-	Coating Systems for Ship Structures
MIL-S-24149	-	Studs, Welding, and Arc Shields (Ferrules), General Specification for
MIL-S-24235	-	Stuffing Tubes, Metal, and Packing Assemblies for Electric Cables, General Specification for
MIL-S-24235/9	-	Stuffing Tubes, Metal, and Packing Assemblies for Electric Cables, Brass and Steel, for Decks and Bulkheads with Pipe Protection

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
MIL-STD-2003-1	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Cable)
MIL-STD-2003-3	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Penetrations)
MIL-STD-2003-5	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Connectors)
MIL-STD-2042-4	-	Fiber Optic Cable Topology Installation Standard Method for Surface Ships and Submarines (Cableways)

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-299	-	Cable Comparison Handbook Data Pertaining to Electrical Shipboard Cable

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

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B.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 - Insulation, Passive Fire Protection – Installation Details

(Copies of this document are available from the applicable repositories listed in S0005-AE-PRO-010/EDM, which can be obtained online via Technical Data Management Information System (TDMIS) at https://mercury.tdmis navy mil/. Copies of this document may also be obtained from the Naval Ships Engineering Drawing Repository (NSEDR) 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.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9086-CM-STM-020/078 - NSTM Chapter 078, Volume 2 - Gaskets and Packing

T9070-AN-DPC-010/100-1 - Reinforcement of Openings in Structure of Surface Ships, Other Than in Protective Plating

(Copies of these documents are available online via Technical Data Management Information System (TDMIS) at https://mercury.tdmis navy mil/ by searching for the document number without the suffix. Refer questions, inquiries, or problems to: DSN 296-0669, Commercial (805) 228-0669. These documents are available for ordering (hard copy) via the Naval Logistics Library at https://nll.navsup.navy.mil. For questions regarding the NLL, contact the NLL Customer Service at nllhelpdesk@navy.mil, (866) 817-3130, or (215) 697-2626/DSN 442-2626.)

B.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.

ASTM INTERNATIONAL

ASTM A36/A36M - Standard Specification for Carbon Structural Steel

ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

ASTM F1836M - Standard Specification for Stuffing Tubes, Nylon, and Packing Assemblies (Metric)

(Copies of these documents are available online at www.astm.org.)

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SAE INTERNATIONAL

SAE-AS23053/5 - Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Flexible, Crosslinked

SAE-AS23053/15 - Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Heavy-Wall, Coated, Flexible, Outer Wall Crosslinked

(Copies of these documents are available online at www.sae.org.)

B.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.

B.3 REQUIRED EQUIPMENT AND MATERIALS

B.3.1 Required equipment and materials. The equipment and materials referenced in the text of this section shall be used for the installation of cableways on surface ships. For fiber optic cable, refer to MIL-STD-2042-4. Refer to 5.7.3.7 for requirements regarding the use of mounting fasteners.

B.4 NOTES AND PROCEDURES

B.4.1 Dimensions. For figures and tables in this appendix, all dimensions are in inches unless otherwise noted.

B.4.2 Figures. Table 4BI provides information for the figures in this appendix.

TABLE 4BI. Figures for cableway installations on surface ships.

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TABLE 4BI. Figures for cable installations on surface ships – Continued.

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TABLE 4BI. Figures for cable installations on surface ships – Continued.

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TABLE 4BI. Figures for cable installations on surface ships – Continued.

B.4.3 Details for cableways for A.C. propulsion cables on surface ships.

B.4.3.1 Heat dissipation. Where cables enter propulsion electrical equipment, care shall be exercised to avoid bunching or closely grouping the cables in any manner that may restrict dissipation of heat from the cables. See 4.8.

B.4.3.2 Phase arrangements. Phase arrangements as shown in table 4BII shall apply to horizontal, vertical, or inclined wireway runs. Any arrangements of cables other than shown shall be specifically approved by NAVSEA.

NOTE: Where “Inverted T” type hangers are used, the downcomer shall not separate any of the phase groups.

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TABLE 4BII. Cable arrangement and phase relationship.
(see figures 4B1 through 4B13)

One group – one tier			Two groups – one tier					
A	B	C	A	B	C	C	B	A
One group – two tiers			Two groups – two tiers					
A	B	C	A	B	C	C	B	A
A	B	C	A	B	C	C	B	A
One group – three tiers			Two groups – three tiers					
A	B	C	A	B	C	C	B	A
C	A	B	C	A	B	B	A	C
B	C	A	B	C	A	A	C	B

B.4.3.3 Separation of propulsion cables. Propulsion cables in wireways shall be run separate from other cables.

B.4.3.4 End sealing. When non-watertight cable is approved for use, ends shall be water-sealed by terminating in water-seal solderless lugs in accordance with MIL-STD-2003-1, Appendix 1A, “Cable Preparation and End-Sealing”.

B.4.3.5 Use of stuffing tubes for propulsion cables. Where cables to propulsion equipment are required to enter through stuffing tubes, the cables and stuffing tubes shall be installed in accordance with MIL-STD-2003-3.

B.4.3.6 Phase marking of single conductor cables. In order to ensure that the proper arrangement of single conductor cables is maintained, the phase of single conductor cables shall be indicated at suitable intervals along the length of each cable and at the extremities.

B.4.3.7 Cable support mounting. Unless otherwise approved, no cable support shall be mounted in such a manner as to be directly connected to strength frames or beams, particularly where near the skin of the ship and at or below the waterline.

B.4.3.8 Temperature limit exposure. Avoid running propulsion cable wireways in locations where ambient temperatures exceed 50 °C during operation.

B.4.3.9 Hanger spacing. Hangers shall be spaced at intervals of not more than 16 inches on center.

B.4.3.10 Cable slack for shock and vibration. Cables shall have sufficient slack when entering equipment for shock excursion (MIL-DTL-901) and vibration (MIL-STD-167-1). Cable bend radii shall be in accordance with 5.2.

B.4.4 Detail cable arrangements for D.C. propulsion cables on surface ships.

B.4.4.1 Minimizing external magnetic fields. The methods shown indicate the recommended arrangements of direct current single-conductor propulsion cables in wireways to reduce, to a minimum, external magnetic fields due to the propulsion current. Each method illustrates the arrangement of cables for one circuit consisting of a positive and a negative leg, each leg containing two or more single conductor cables in parallel. Whenever practicable, each circuit should contain an even number of single conductor cables per leg in preference to an odd number per leg.

B.4.4.1.1 Arrangements. The detail arrangements apply to horizontal, vertical, or inclined wireways. When several propulsion circuits are installed in one wireway, each circuit shall be arranged as indicated. The circuits may be located adjacent on the same hanger or hangers, or separated on individual hangers.

B.4.4.1.2 Parallel cables. The external magnetic fields due to direct current in double conductor cables are relatively small if the two conductors in each cable are connected to carry current of opposite polarity. Accordingly, when several double-conductor cables are used in parallel, the two conductors in each cable shall be of opposite polarity.

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TABLE 4BIII. Maximum allowable current capacities for D.C. propulsion cables in wireways and racks – individual adjacent cables on each hanger without spacing.

Number of hangers (horizontal or vertical)	Percentage of current ratings specified in MIL-HDBK-299 (at 50 °C ambient) (see B.4.3.8)			
	Individual cables on each hanger adjacent without spacing			
	Cables in horizontal hangers next to bulkheads without insulation	Cables in horizontal hangers next to bulkheads with insulation	Cables in horizontal hangers under decks without insulation or in vertical hangers next to bulkheads without insulation	Cables in horizontal hangers under decks with insulation or in vertical hangers next to bulkheads with insulation
1	95	90	90	80
2	85	80	80	70
3	80	75	70	65

TABLE 4BIV. Maximum allowable current capacities for D.C. propulsion cables in wireways and racks – individual cables on each hanger spaced ½ inch apart.

Number of hangers (horizontal or vertical)	Percentage of current ratings specified in MIL-HDBK-299 (at 50 °C ambient) (see B.4.3.8)			
	Individual cables on each hanger spaced ½ inch apart			
	Cables in horizontal hangers next to bulkheads without insulation	Cables in horizontal hangers next to bulkheads with insulation	Cables in horizontal hangers under decks without insulation or in vertical hangers next to bulkheads without insulation	Cables in horizontal hangers under decks with insulation or in vertical hangers next to bulkheads with insulation
1	100	95	100	95
2	100	95	100	95
3	95	90	95	90

B.4.4.1.3 Connection to terminals. Cable connections to the terminals of electrical equipment shall be accomplished with a minimum amount of fanning of the individual conductors. Loops formed by conductors of opposite polarity should be reduced in area to a minimum and avoided wherever possible. When unavoidable, the plane of the loop formed by the conductors of opposite polarity in each circuit should lie vertical in preference to horizontal.

B.4.4.2 Polarity marking of single conductor cables. In order to ensure that the proper arrangement of single conductor cables is maintained, the polarity of single conductor cables shall be indicated at suitable intervals along the length of each cable and at the extremities.

B.4.4.3 Allowable current capacities. Tables 4BIII and 4BIV provide allowable current capacities for D.C. propulsion cables in wireways and racks. For propulsion cables in enclosed ducts, cables shall be rated at 50 percent of the values listed in the tables. The ratings in the tables are based on four or more cables on each hanger. For less than four cables per hanger, an additional 5 percent increase in the percentages specified in the tables is permissible.

B.4.4.4 Separation in wireways. Propulsion cables in wireways shall run separate from other cables, where practicable.

B.4.4.5 Retention in wireways. Propulsion cables shall be adequately clamped or strapped to avoid loosening or dislodgement due to vibration, shock, or magnetic stresses.

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B.4.4.6 Temperature limit exposure. Avoid running propulsion cable wireways in location where ambient temperatures exceed 122 °F (50 °C) during operation, as in the vicinity of boilers, evaporators, steam-pipes, etc.

B.4.4.7 Dissipation of heat. Where cables enter propulsion electrical equipment, care shall be exercised to avoid bunching or closely grouping the cables in any manner that may restrict dissipation of heat from the cables. See 4.8.

B.4.4.8 End sealing. When non-watertight cable is approved for use, the ends of propulsion cables shall be adequately sealed by approved methods to avoid the entrance of water or moisture.

B.4.4.9 Other details. Details not specifically covered in D.C. propulsion cableway installation methods covered in this standard shall be in accordance with the applicable standard methods.

B.4.4.10 Cable slack for shock and vibration. Cables shall have sufficient slack when entering equipment for shock excursion (MIL-DTL-901) and vibration (MIL-STD-167-1). Cable bend radii shall be in accordance with 5.2.

B.4.5 Hanger spacing, tiers, and weight. Spacing, number of tiers, and cable weight shall not exceed the values specified in 5.7.3.1. Downward extension to the lesser condition of fewer tiers for hanger assemblies (with cable load not exceeding the maximum per tier as specified in 5.7.3.1) is acceptable.

B.4.5.1 Corrosion protection. Contact areas between adapter, downcomer, and attaching bolts shall be painted with two coats of primer in accordance with MIL-PRF-23236.

B.4.5.2 Banding below cable support bar. Cables may be banded below cable support bars on overhead mounted cable hangers, provided they are banded separately from the banding for cables over the support bar and the total weight does not exceed the cable hanger tier weight limits in 5.7.3.1. See method 4B-20-5 in figure 4B20 for additional detail on bottom loading of hangers. Bottom loaded cables shall not come in contact with sharp surfaces that could cause damage to the cable.

B.4.6 Mounting aluminum hangers on steel decks. For mounting aluminum hangers on steel decks, the steel (ASTM A501/A501M) adapter, detailed on figure 4B33, shall be used. Contact areas between the adapter, downcomer, and attaching bolts shall be painted with two coats of primer in accordance with MIL-PRF-23236.

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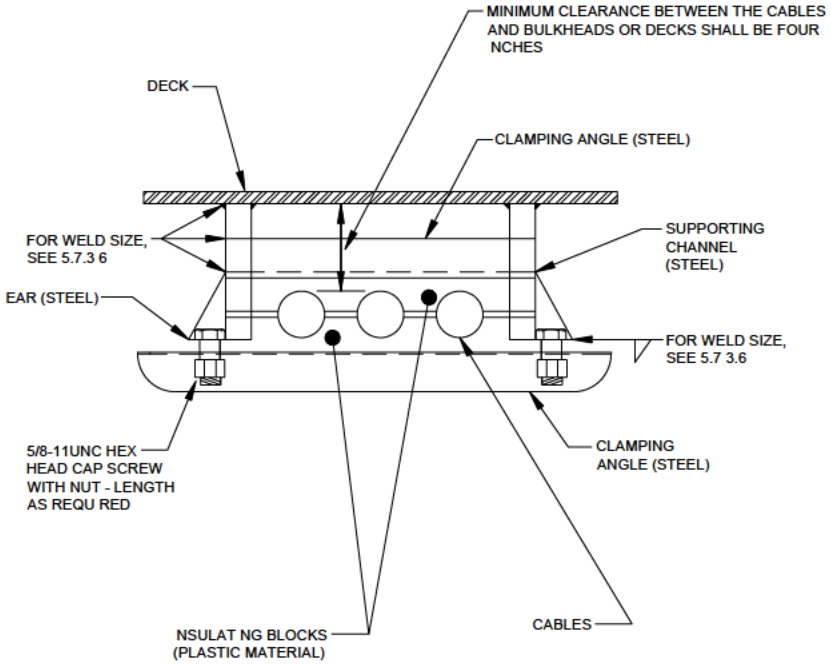
METHOD 4B-1-1
ONE GROUP AND ONE TIER OF CABLES
FROM STEEL DECKS OR BULKHEADS
(SEE NOTE 1 FOR CABLE ARRANGEMENTS AND PHASE RELATIONSHIP)



NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B1. Cableways for A.C. propulsion cables (surface ships) – one group and one tier.

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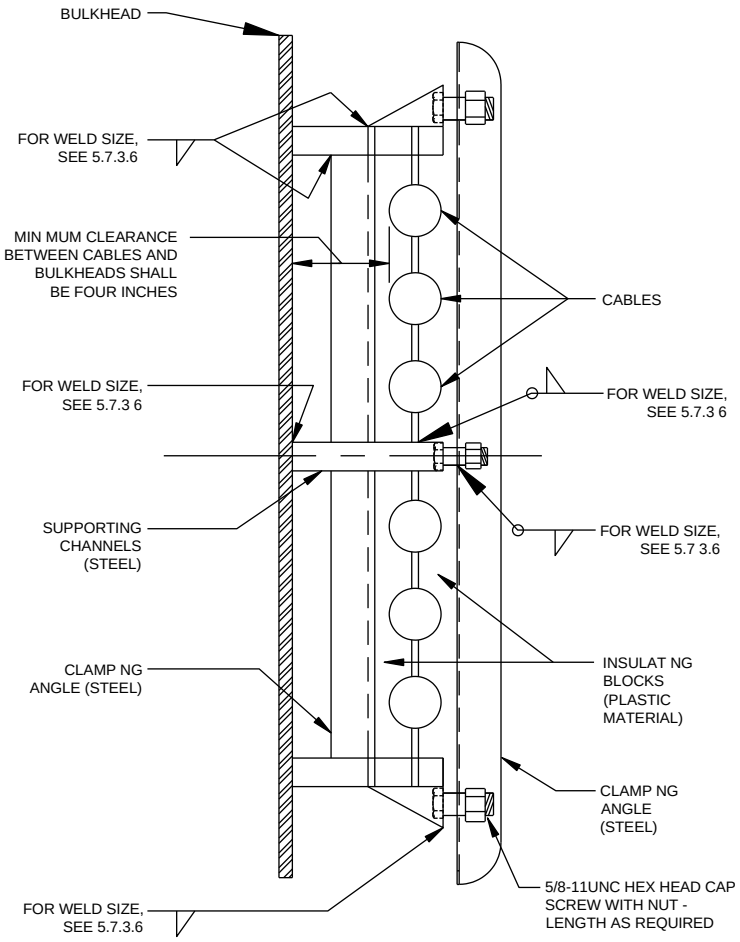
METHOD 4B-2-1
TWO GROUPS AND ONE TIER OF CABLES
FROM STEEL DECKS OR BULKHEADS
(SEE NOTE 1 FOR CABLE ARRANGEMENTS AND PHASE RELATIONSHIP)



NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B2. Cableways for A.C. propulsion cables (surface ships) – two groups and one tier.

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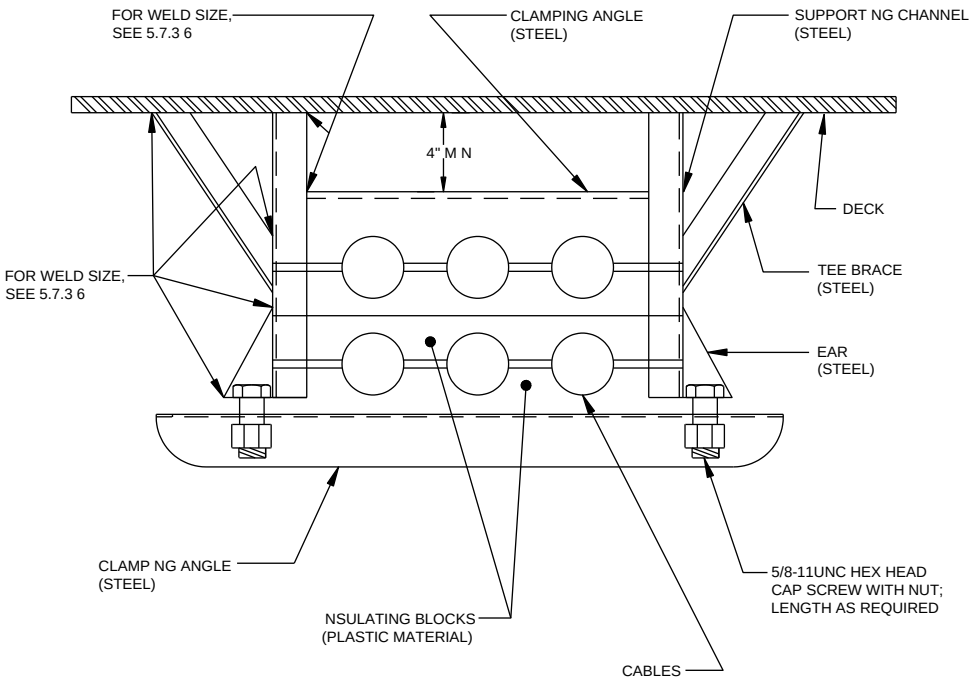
METHOD 4B-3-1
ONE GROUP AND TWO TIERS OF CABLES
FROM STEEL DECKS OR BULKHEADS
(SEE NOTE 1 FOR CABLE ARRANGEMENTS AND PHASE RELATIONSH P)



NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B3. Cableways for A.C. propulsion cables (surface ships) – one group and two tiers.

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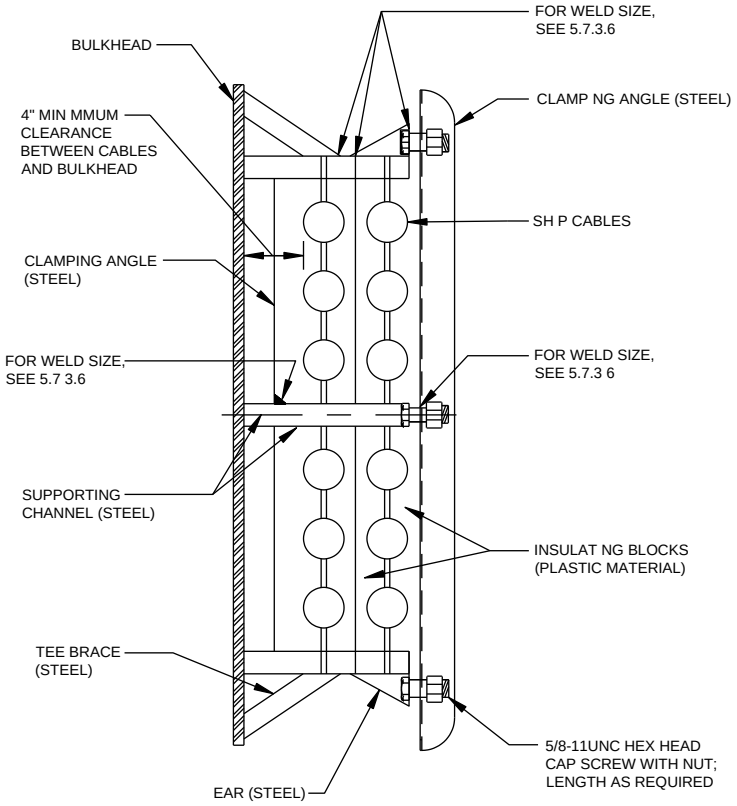
METHOD 4B-4-1
TWO GROUPS AND TWO TIERS OF CABLES
FROM STEEL DECKS OR BULKHEADS
(SEE NOTE 1 FOR CABLE ARRANGEMENTS AND PHASE RELATIONSHIP)



NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B4. Cableways for A.C. propulsion cables (surface ships) – two groups and two tiers.

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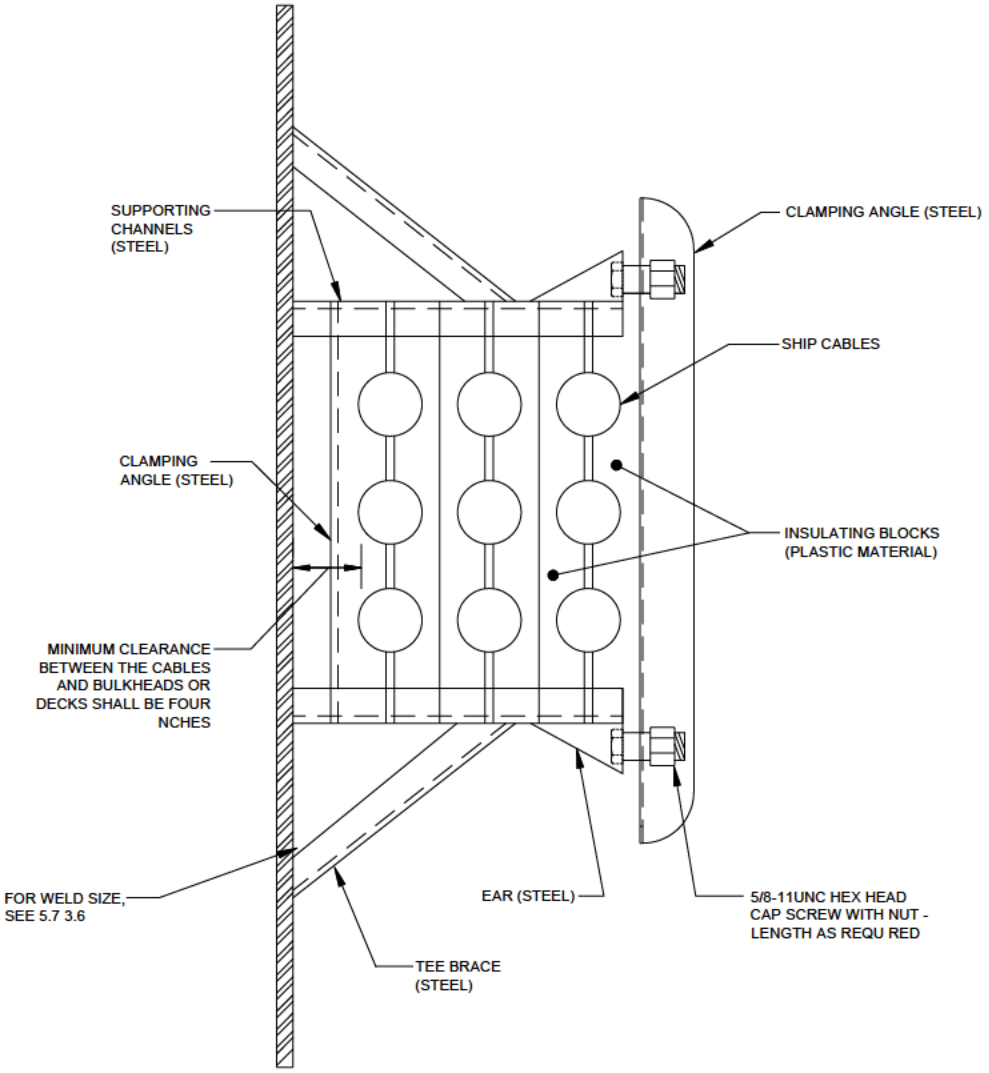
METHOD 4B-5-1
ONE GROUP AND THREE TIERS OF CABLES
FROM STEEL DECKS OR BULKHEADS



NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B5. Cableways for A.C. propulsion cables (surface ships) – one group and three tiers.

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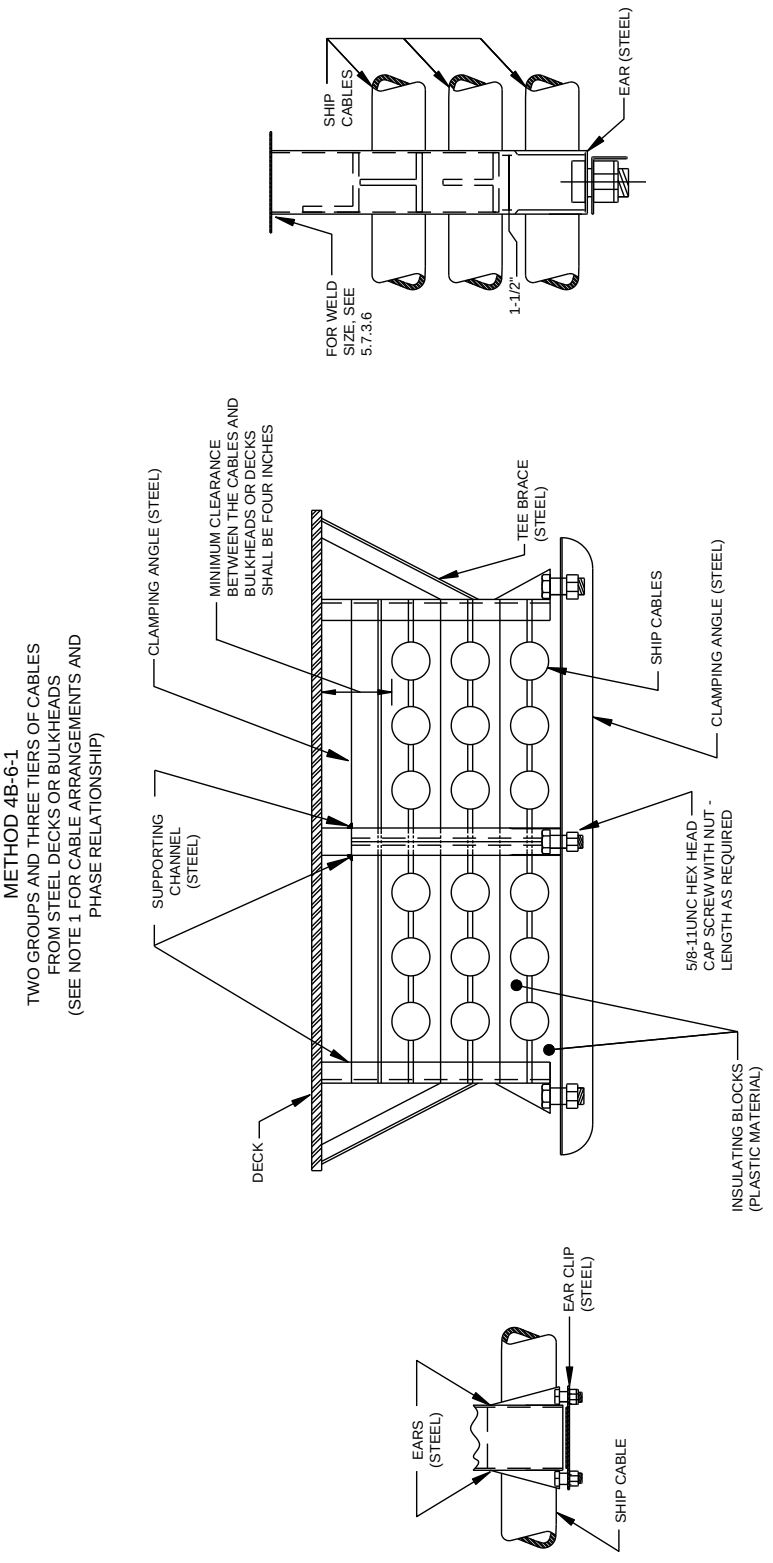

FIGURE 4B6. Cableways for A.C. propulsion cables (surface ships) – two groups and three tiers.

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NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B6. Cableways for A.C. propulsion cables (surface ships) – two groups and three tiers – Continued.

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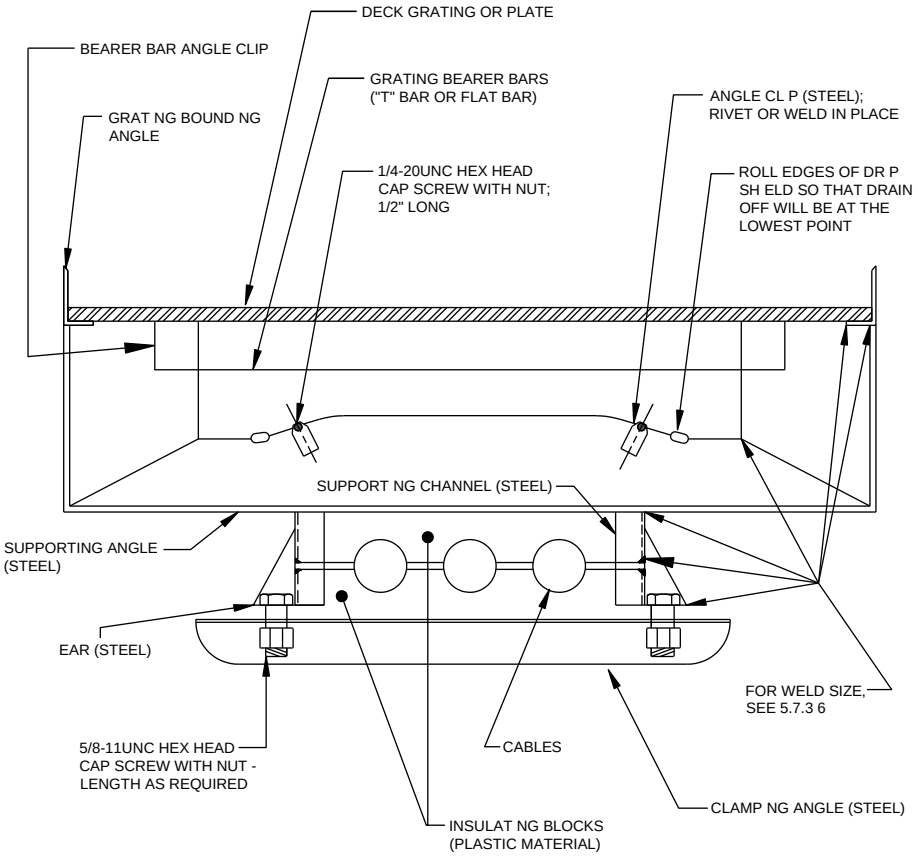
METHOD 4B-7-1
ONE GROUP AND ONE TIER OF CABLES
UNDER DECK GRATINGS
(SEE NOTE 1 FOR CABLE ARRANGEMENTS
AND PHASE RELATIONSHIP)



NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B7. Cableways for A.C. propulsion cables (surface ships).

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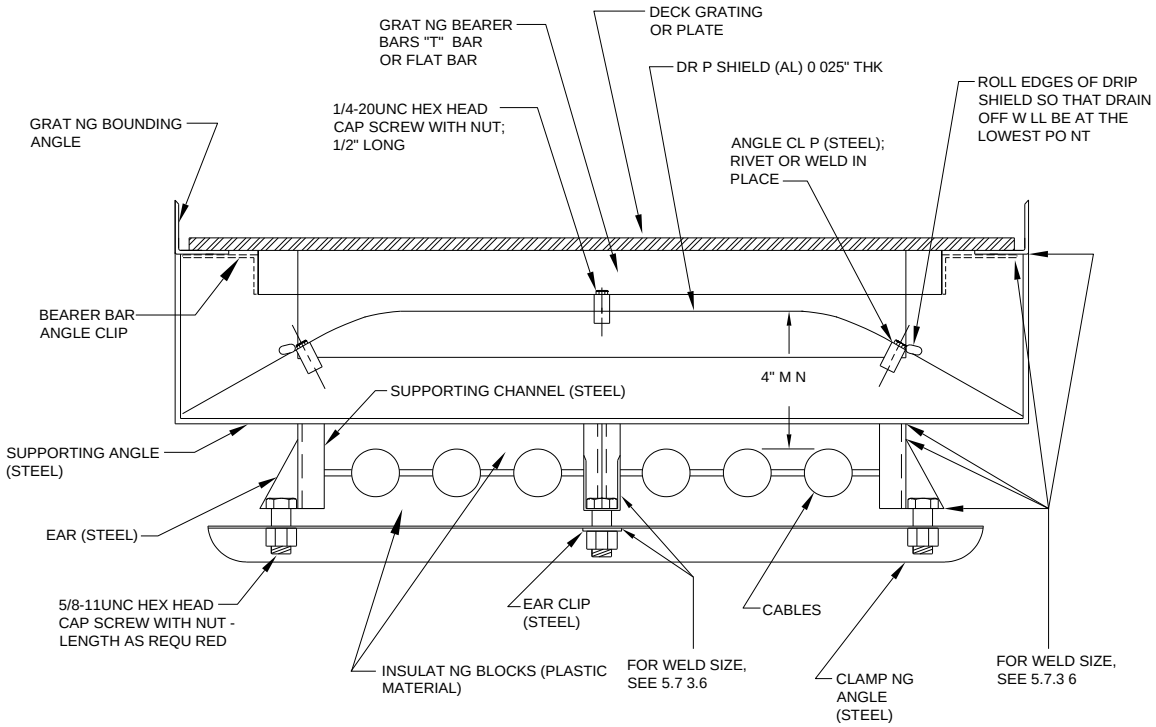
METHOD 4B-8-1
TWO GROUPS AND ONE T ER OF CABLES
UNDER DECK GRATINGS
(SEE NOTE 1 FOR CABLE ARRANGEMENTS
AND PHASE RELATIONSH P)



NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements

FIGURE 4B8. Cableways for A.C. propulsion cables (surface ships).

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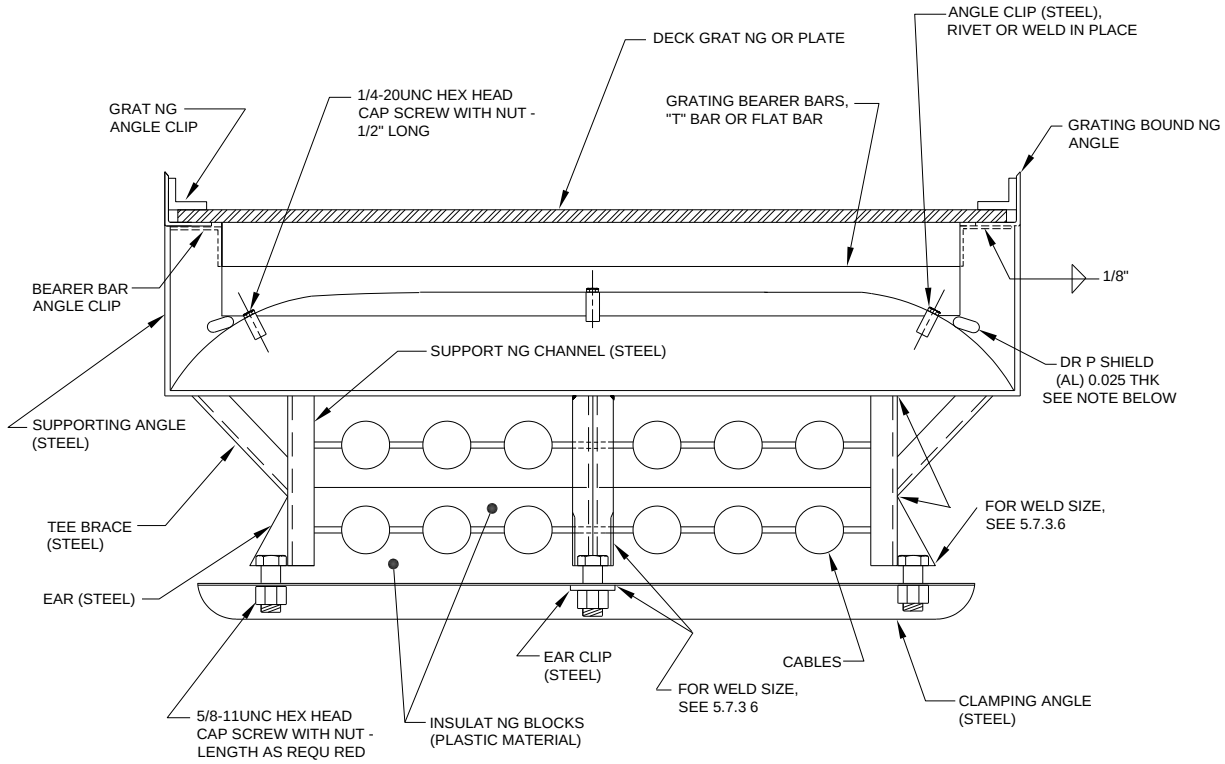
METHOD 4B-9-1
TWO GROUPS AND TWO TIERS OF CABLES
UNDER DECK GRATINGS
(SEE NOTE 1 FOR CABLE ARRANGEMENTS AND PHASE RELATIONSHIP)



NOTE: FOR DR P SH ELD, ROLL EDGES OF DR P SH ELD SO THAT THE DRAIN OFF W LL BE AT THE LOWEST PO NT.

NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B9. Cableways for A.C. propulsion cables (surface ships) – two groups and two tiers.

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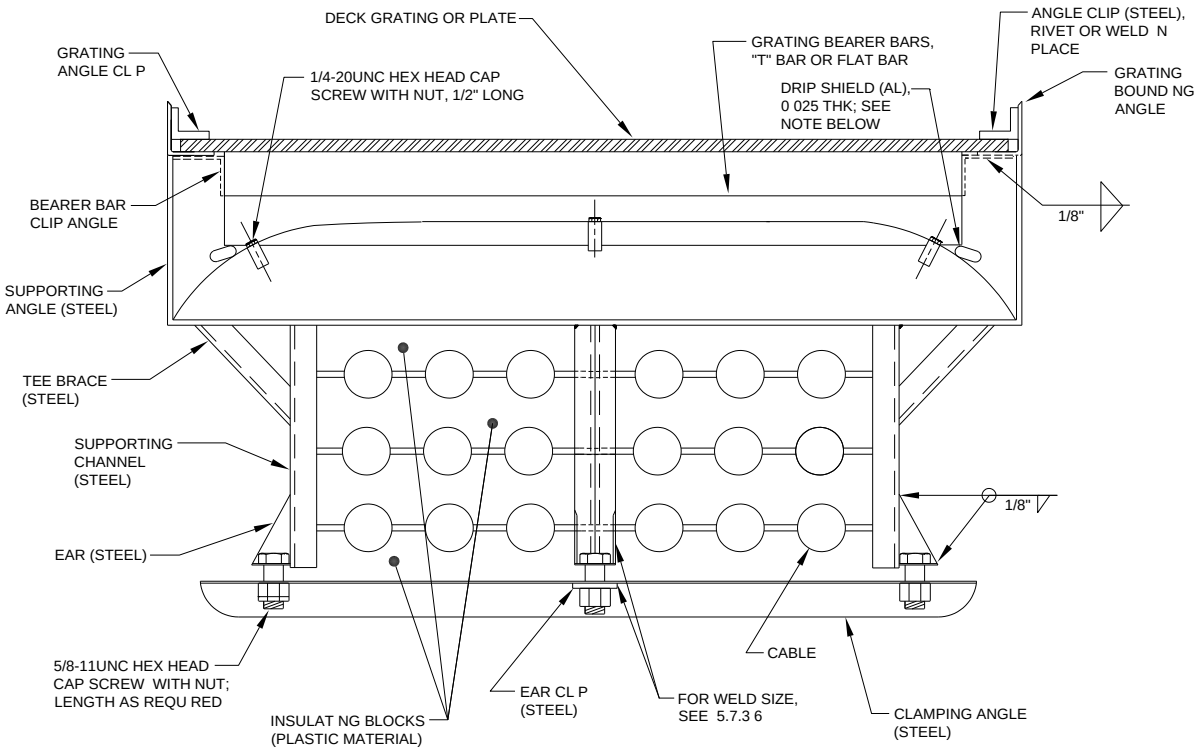
METHOD 4B-10-1
TWO GROUPS AND THREE T ERS OF CABLES
UNDER DECK GRATINGS
(SEE NOTE 1 FOR CABLE ARRANGEMENTS AND PHASE RELATIONSHIP)



NOTE FOR DRIP SHIELD: ROLL EDGES OF DR P SHIELD SO THAT DRAIN OFF WILL BE AT LOWEST POINT.

NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B10. Cableways for A.C. propulsion cables (surface ships) – two groups and three tiers.

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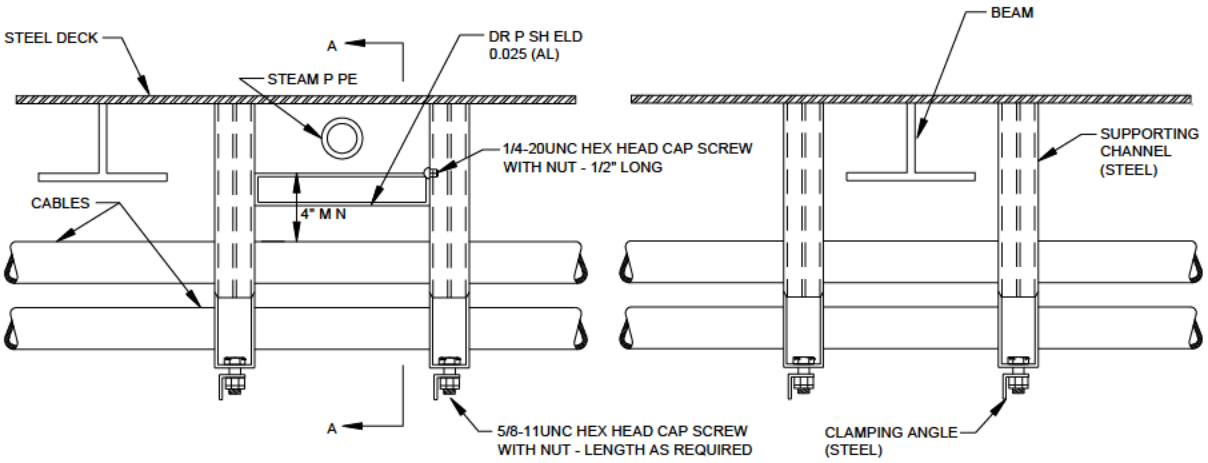
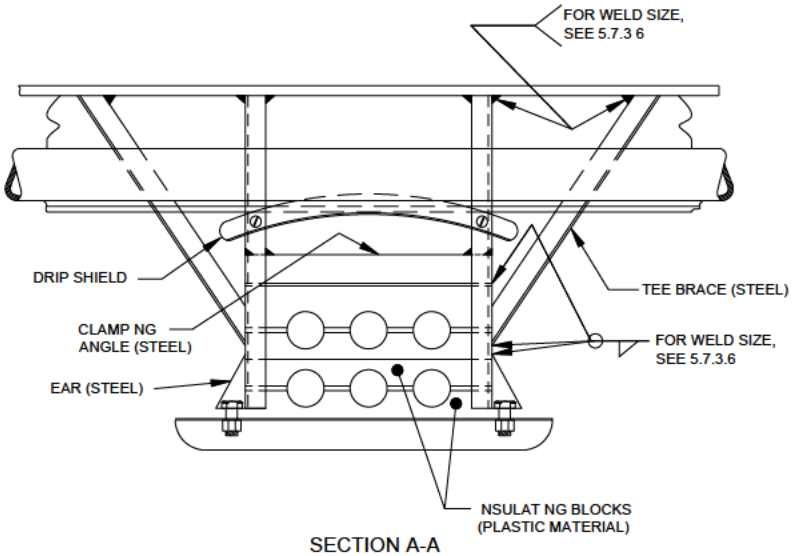
METHOD 4B-11-1
CABLE RUNS ACROSS STEEL BEAMS
SHOWING DR P SHIELD UNDER STEAM P PE





SECTION A-A

NOTES:

1. Cable arrangements and phase relationships are in accordance with table 4BII.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B11. A.C. propulsion cableway across steel beams (surface ships).

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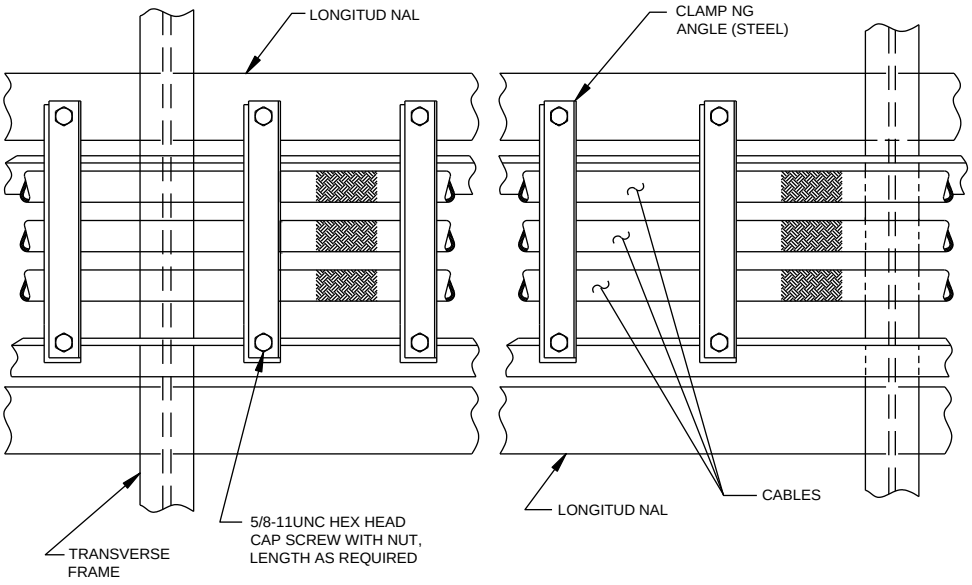
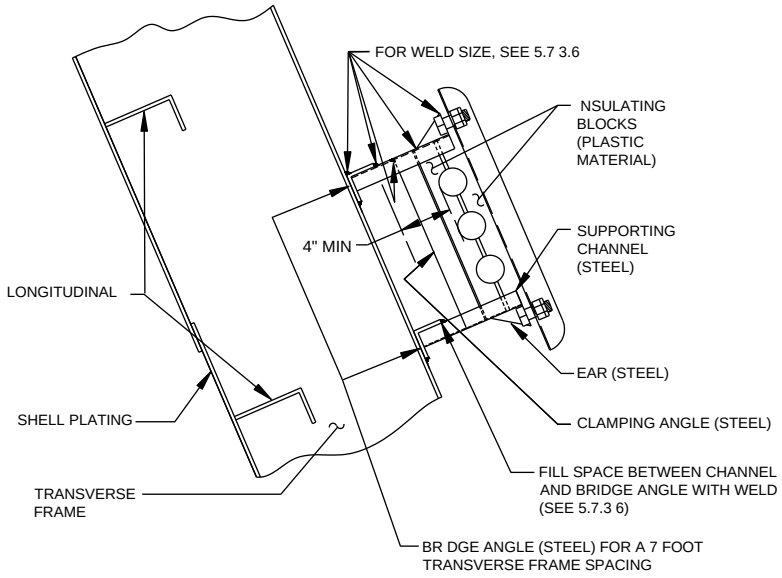
METHOD 4B-12-1
THREE CABLES ON TRANSVERSE FRAMES



END VIEW FOR METHOD 4B-12-1
THREE CABLES ON TRANSVERSE FRAMES



NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. Cable arrangements and phase relationships are in accordance with table 4BII.

FIGURE 4B12. A.C. propulsion cableway (surface ships) – three cables on transverse frames.

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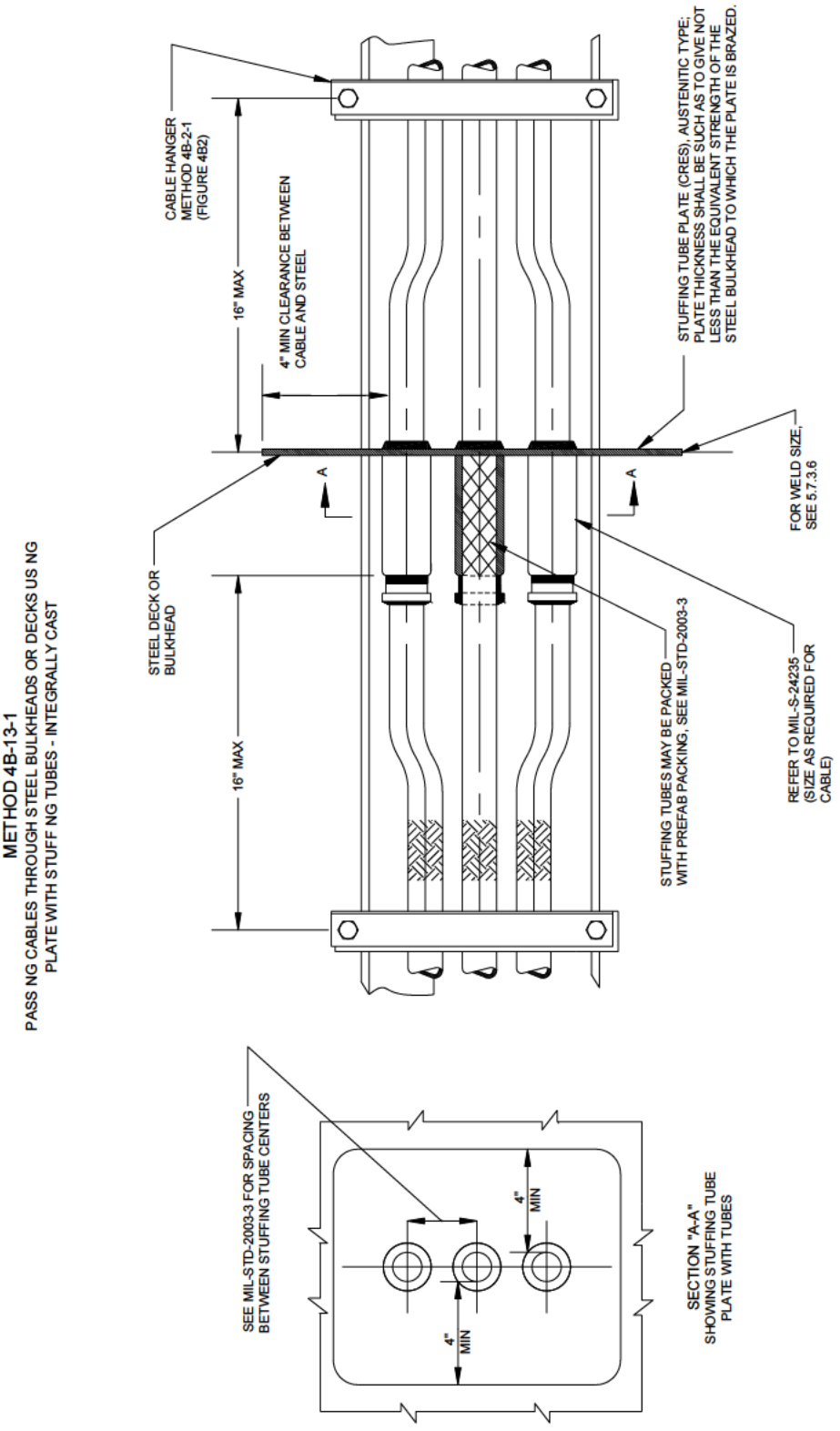

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B13. Cableways for A.C. propulsion cables – using stuffing tubes, integrally cast.

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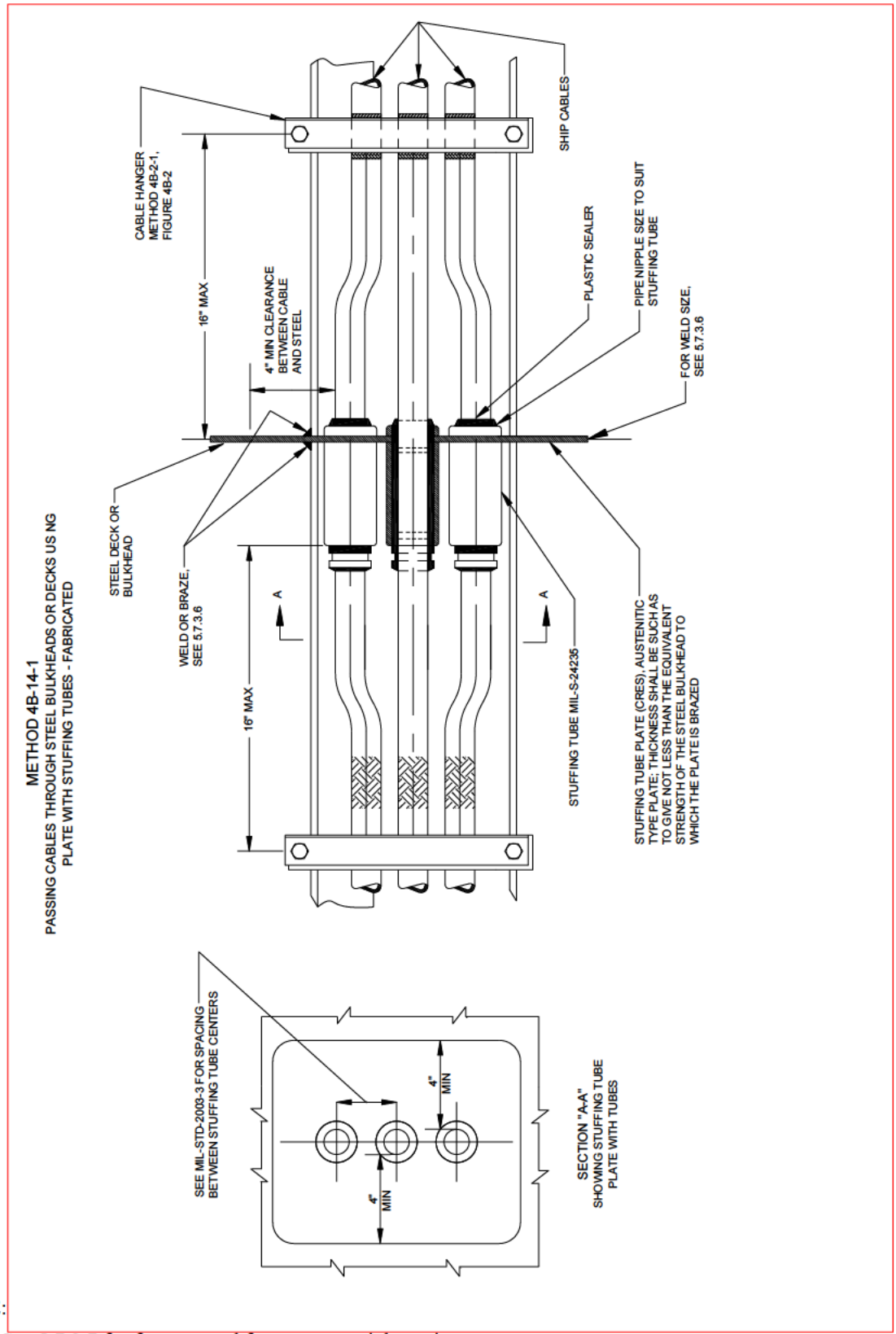

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B14. Cableways for A.C. propulsion cables – using stuffing tubes, fabricated.

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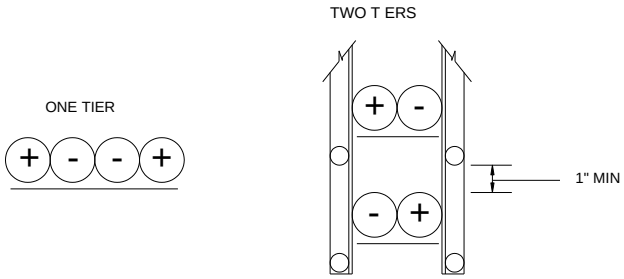
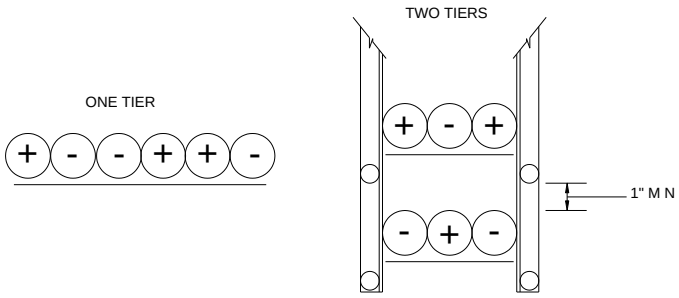
METHOD 4B-15-1
ARRANGEMENTS FOR TWO SINGLE CONDUCTOR CABLES PER LEG



METHOD 4B-15-2
ARRANGEMENTS FOR THREE S NGLE CONDUCTOR CABLES PER LEG



METHOD 4B-15-3
ARRANGEMENTS FOR FOUR SINGLE CONDUCTOR CABLES PER LEG

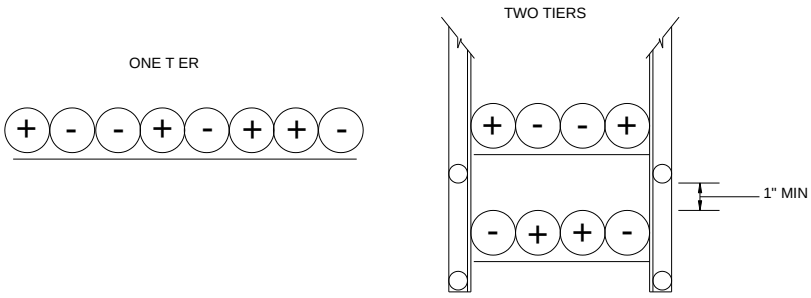


FIGURE 4B15. Cableways for D.C. propulsion cables (surface ships).

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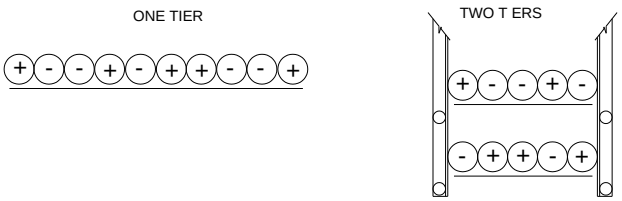
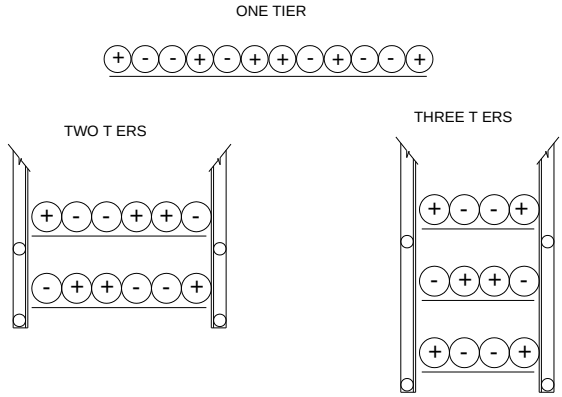
METHOD 4B-16-1
ARRANGEMENTS FOR FIVE SINGLE CONDUCTOR CABLES PER LEG



METHOD 4B-16-2
ARRANGEMENTS FOR SIX S NGLE CONDUCTOR CABLES PER LEG



METHOD 4B-16-3
ARRANGEMENTS FOR SEVEN S NGLE CONDUCTOR CABLES PER LEG

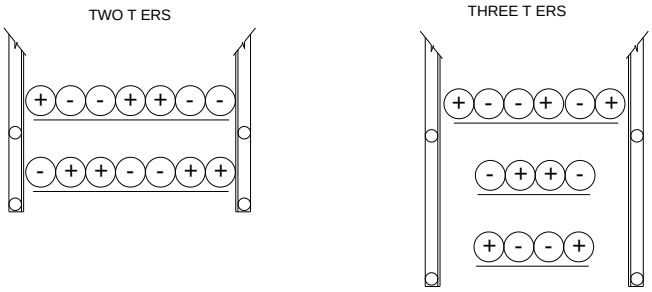


FIGURE 4B16. Cableways for D.C. propulsion cables (surface ships).

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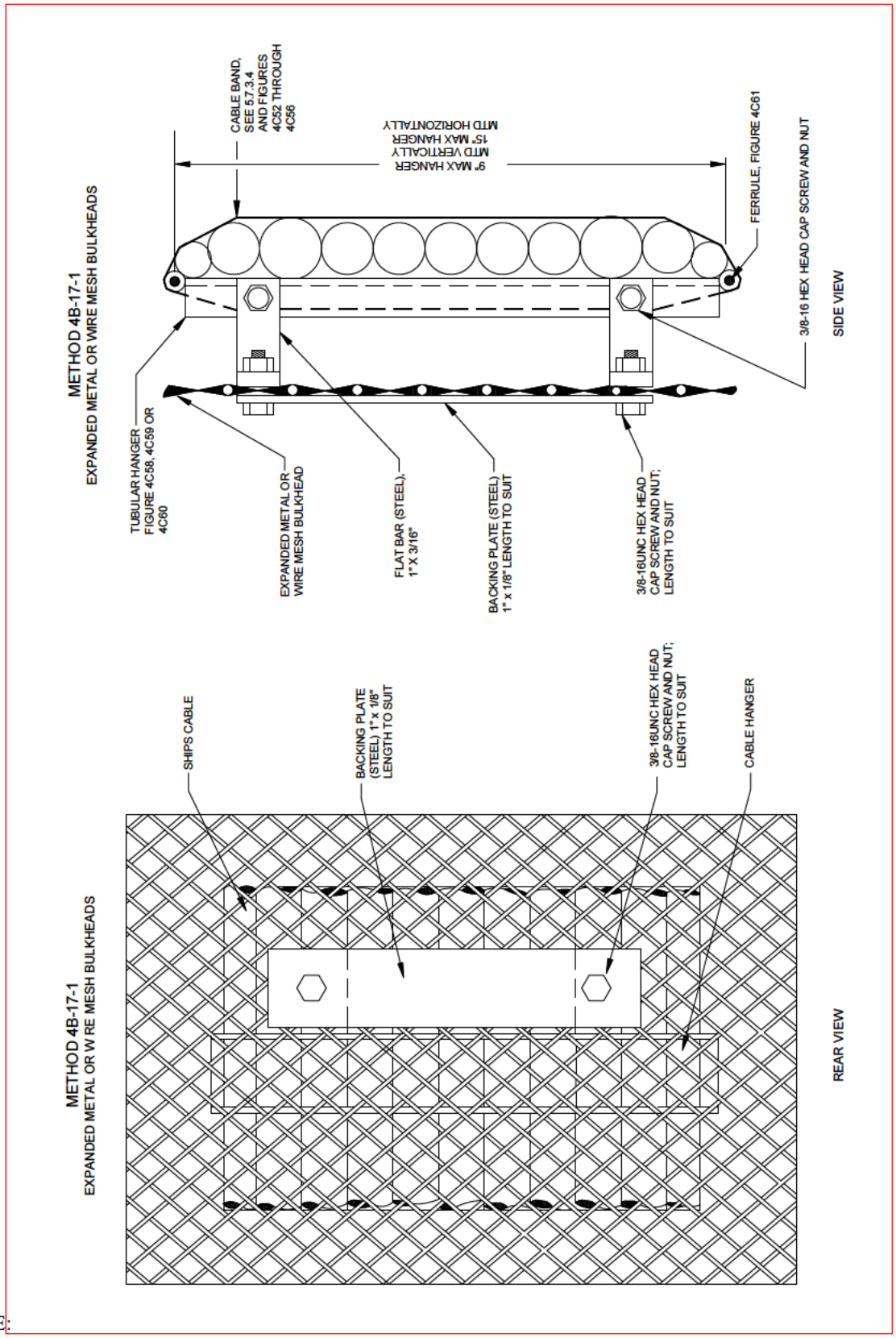

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B17. Single cableways on non-structural bulkhead (surface ships).

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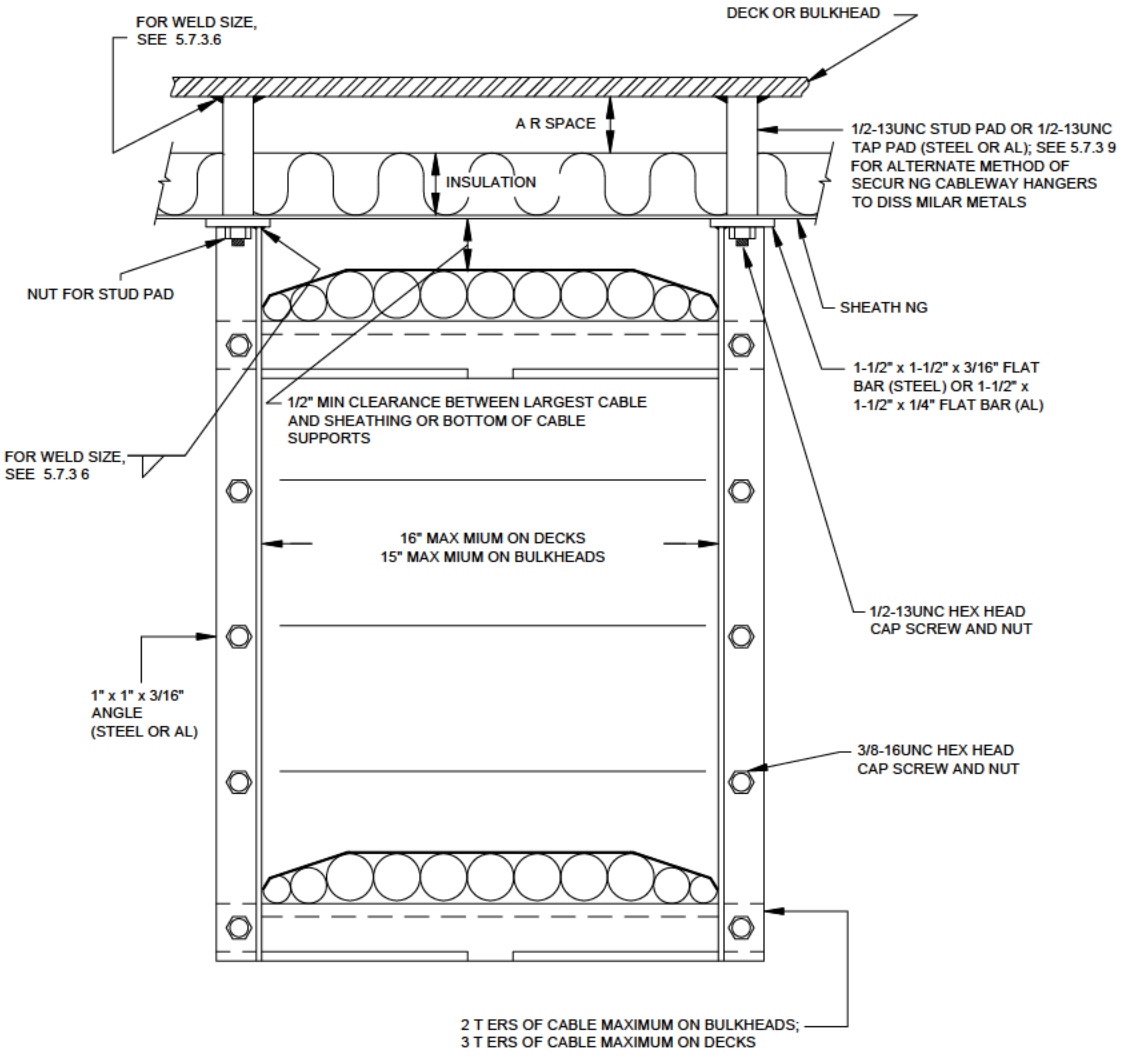
METHOD 4B-18-1
WATERTIGHT DECK OR BULKHEAD WITH NSULATION AND SHEATHING
CABLES SECURED TO STUD PADS OR TAP PADS



NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4B18. Cableways in acoustical locations (surface ships).

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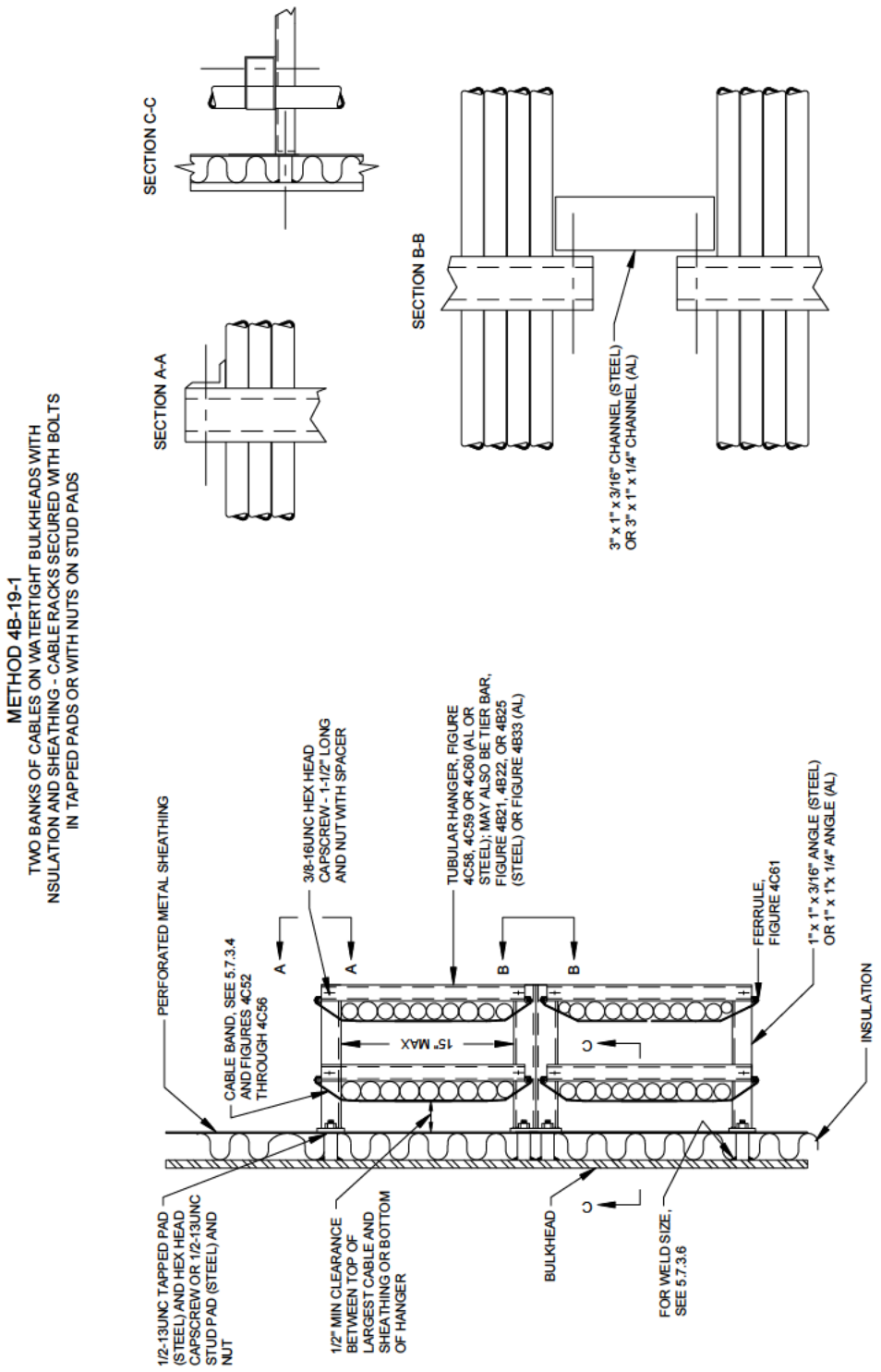

NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4B19. Cableways in acoustical locations (surface ships).

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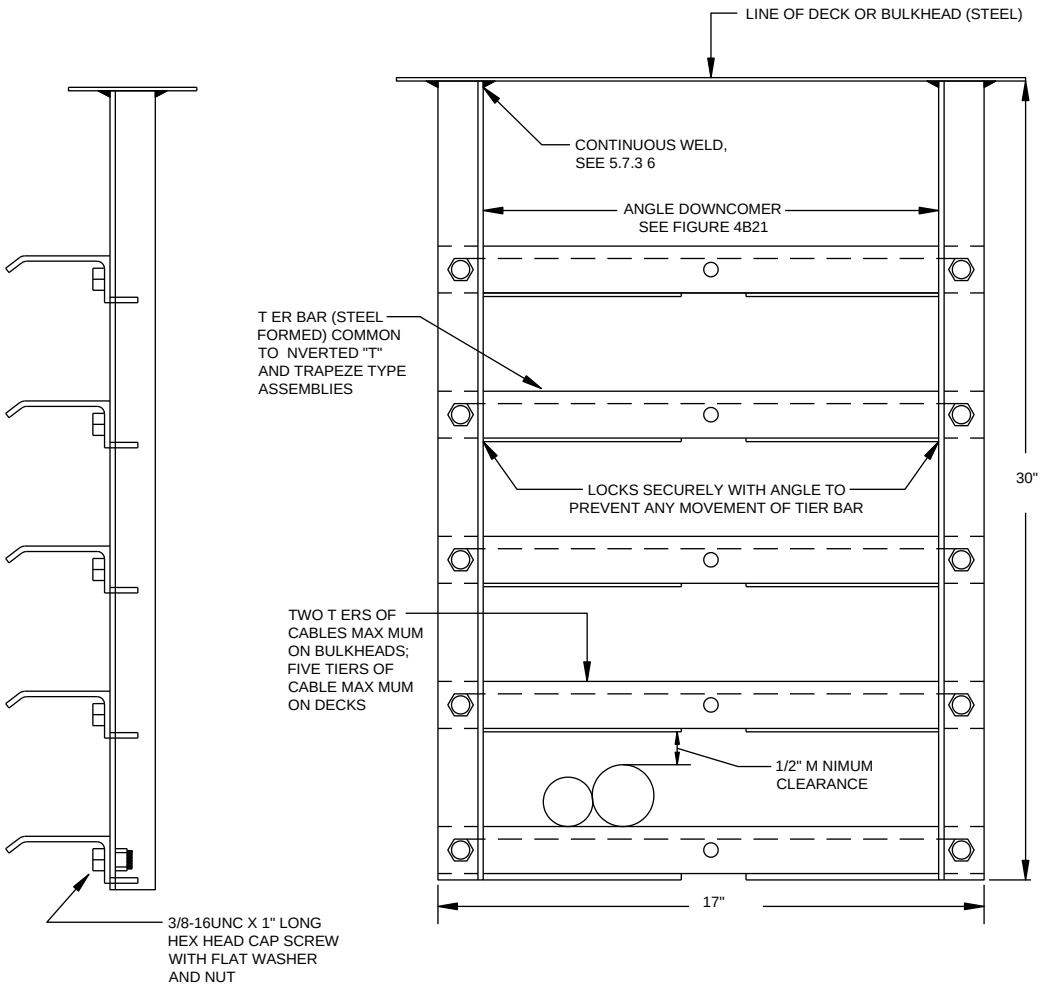
METHOD 4B-20-1
TRAPEZE TYPE CABLE HANGER FOR MA N WIREWAYS (STEEL)
SEE FIGURE 4B21 FOR ATTACHING STEEL HANGERS TO ALUMINUM DECKS OR BULKHEADS



NOTES:

1. Spacing, number of tiers, and cable weight shall not exceed the values specified in 5.7.3.1. Downward extension to the lesser condition of fewer tiers for hanger assemblies (with cable load not exceeding the maximum per tier as specified) is acceptable.
2. Sharp corners shall be slightly rounded. All parts shall have smooth surfaces.
3. Contact areas between adapter, downcomer, and attaching bolts shall be painted with two coats of MIL-PRF-23236 primer.
4. See 5.7.3.9 for an alternate method of securing cableway hangers to dissimilar metals.
5. Cables may be banded below cable support bars on overhead mounted cable hangers. See B.4.5.2 for specific requirements for installing cables below cable support bars. See method 4B-20-5 for additional detail on bottom loading of hangers.
6. See 5.7.3.7 for fastener and fastener material requirements.
7. See figure 4B21 for tier bar and downcomer design. See figure 4B22 for an alternate tier bar design.

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships).

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Method 4B-20-2
Trapeze Cableway Hanger Extensions

NOTES:

1. Purpose: This method is applicable to the extension of previously installed trapeze type cableway hangers with width of 6 to 17 inches. This method is intended to be used during ship overhauls when cables need to be added or during ship construction when scheduling or construction limitations preclude installation of replacement hangers.
2. Where bolting is impractical, extensions may be welded in place. Welding shall meet the requirements of 5.7.3.6.
3. The outside corner of the existing hanger may require grinding to accept extension. The exposed metal surfaces shall be primed and painted.
4. The total number of tiers and the cable weight of the original hanger and extension, combined, shall not exceed the limits of 5.7.3.1.
5. If the existing hanger does not have pre-drilled holes, use the extension as a template and drill 7⁄16 inch diameter clear holes for bolting.
6. This method shall not be used for previously extended hangers.
7. See 5.7.3.7 for fastener and fastener material requirements.
8. Hanger extensions shall be of the same material as the original hanger.

TABLE 4B20-I. List of material for trapeze cableway hanger extensions.

Item	Description
1	Angle downcomer extension
2	Cross tier, 12-gauge steel
3	Hex head capscrew, 3⁄8-16UNC – length to suit
4	Self-locking nut, 3⁄8-16UNC
5	Hex head cap screw, 3⁄8-16UNC - length 3⁄4

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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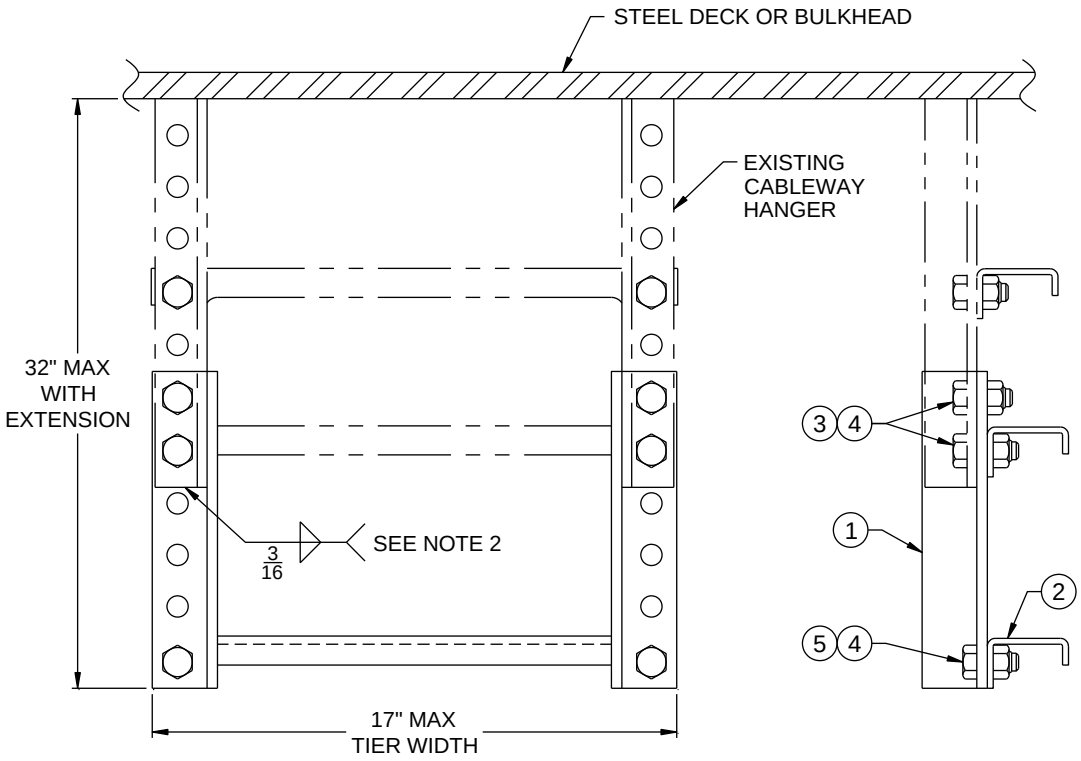

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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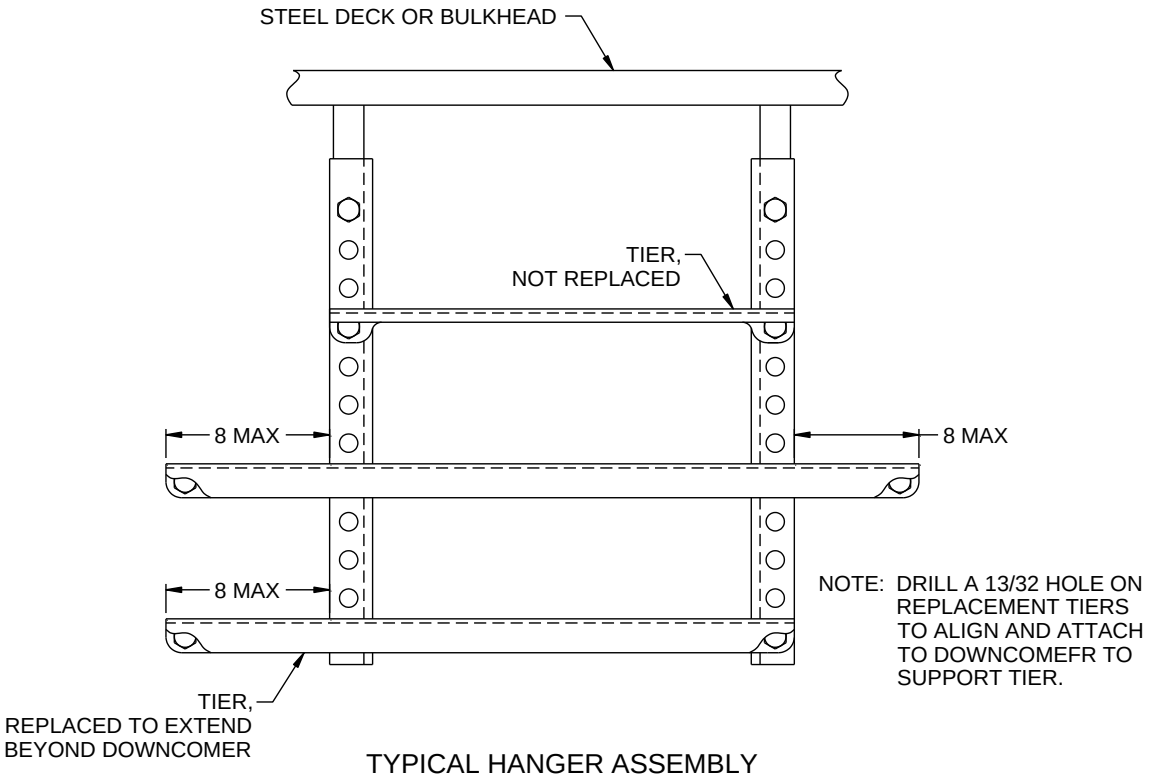
Method 4B-20-3
Trapeze Cableway Hanger Tier Extension

General Notes:

1. This method is applicable to the modification of method 4B-20-1 trapeze cableway hangers using figure 4B21 cableway hanger tiers. This method allows tiers to be installed such that they extend past the downcomer to gain additional cableway volume without widening the hanger points of attachment.
2. Only hangers installed in accordance with method 4B-20-1 may utilize this method.
3. This method shall only be used in cableway hangers that have three or less tiers. Once this method has been used, the cableway hanger must remain at a maximum of three tiers.
4. Tier extensions may be installed in any configuration provided that the overhang from the edge of the downcomer to the end of the tier does not exceed eight inches.
5. See 5.7.3.7 for fastener and fastener material requirements.
6. Hanger extensions shall be of the same material as the original hanger.
7. See figure 4B22 for an alternate tier bar design.



TYPICAL HANGER ASSEMBLY
2 TIERS REPLACED
(CABLES NOT SHOWN)

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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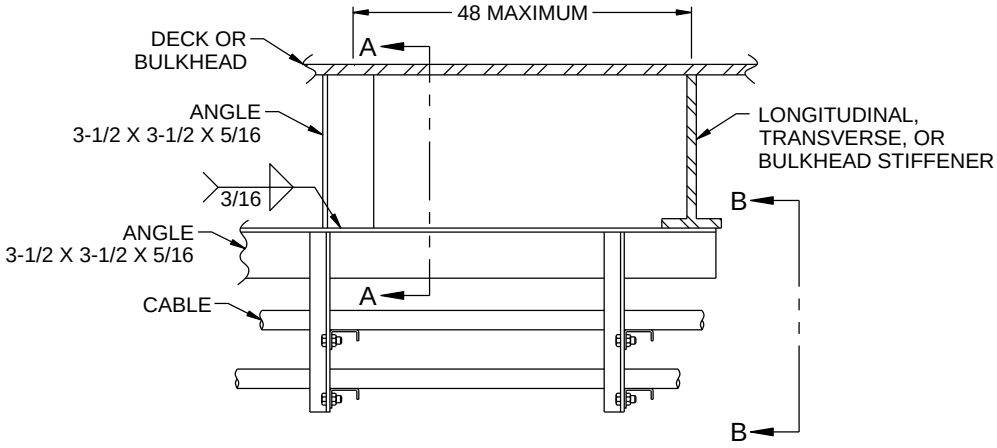
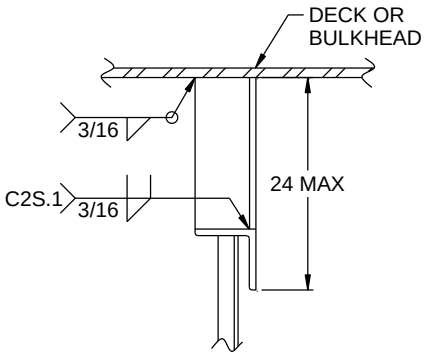
Method 4B-20-4
Cableway on Running Angle

NOTES:

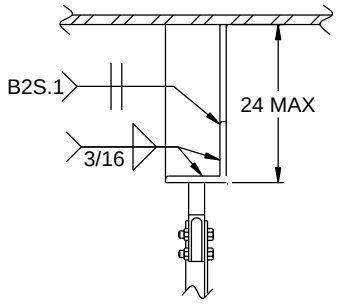
1. Purpose: This method is applicable to supporting method 4B-20-1 cable hangers from structural bulkheads and decks to clear various ship system interferences in way of routing of hangers.
2. See 5.7.3.7 for fastener and fastener material requirements.
3. See 5.7.3.6 for welding requirements.



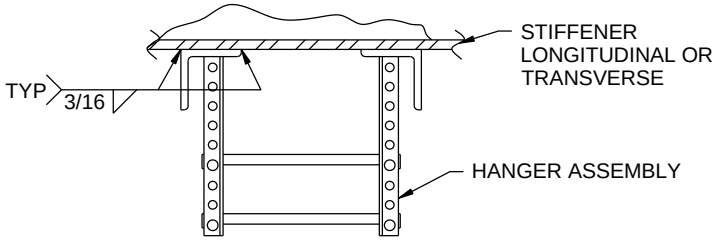
TYPICAL INSTALLATION DETAIL



SECTION A-A



SECTION A-A (ALT)



SECTION B-B

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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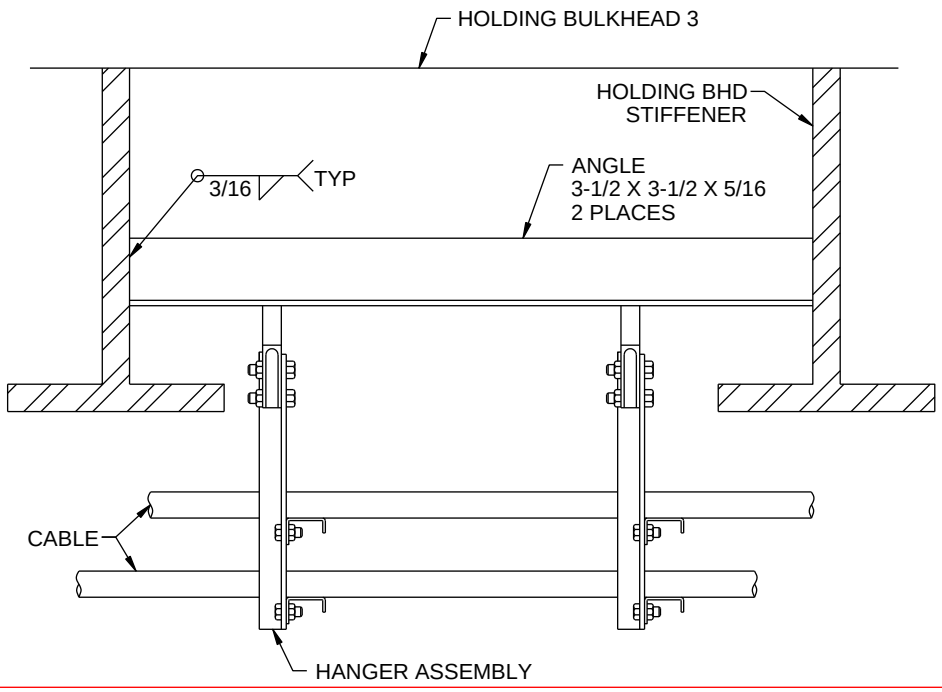
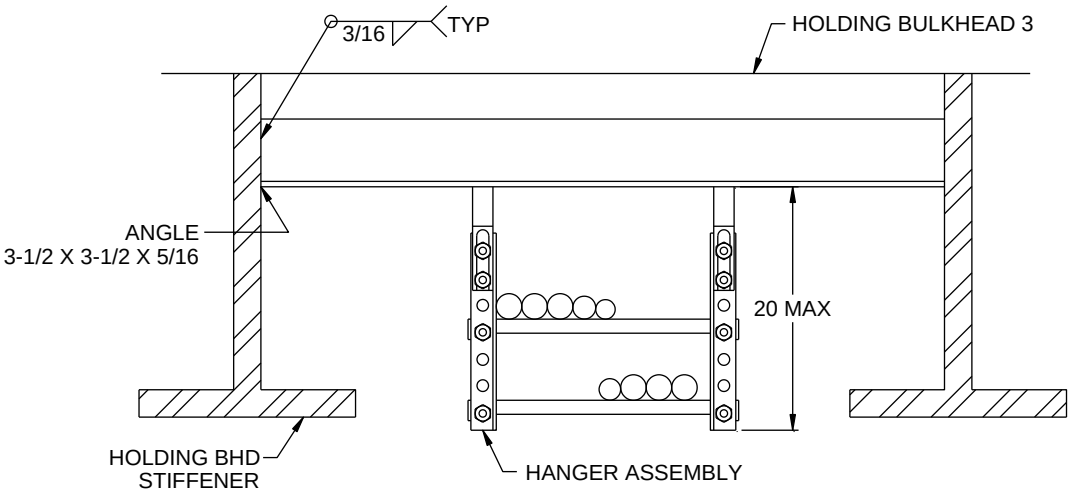


PLAN VIEW
HORIZONTAL CABLEWAY



PLAN VIEW
VERTICAL CABLEWAY

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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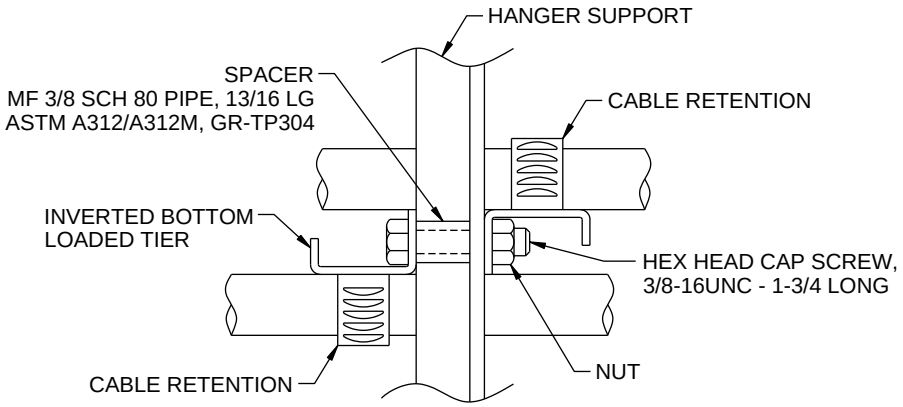
Method 4B-20-5
Bottom Loading of Cableway Tiers

NOTES:

1. Purpose: This method allows bottom loading of cableway tiers in congested areas.
2. This method shall be used with the cableway supports shown in method 4B-20-1.
3. Observe the maximum number of tiers and tier loading of 5.7.3.1.
4. Cableway tiers shall be banded with retention devices in accordance with 5.7.3.4.
5. See 5.7.3.7 for fastener and fastener material requirements.



TYPICAL INSTALLATION DETAIL

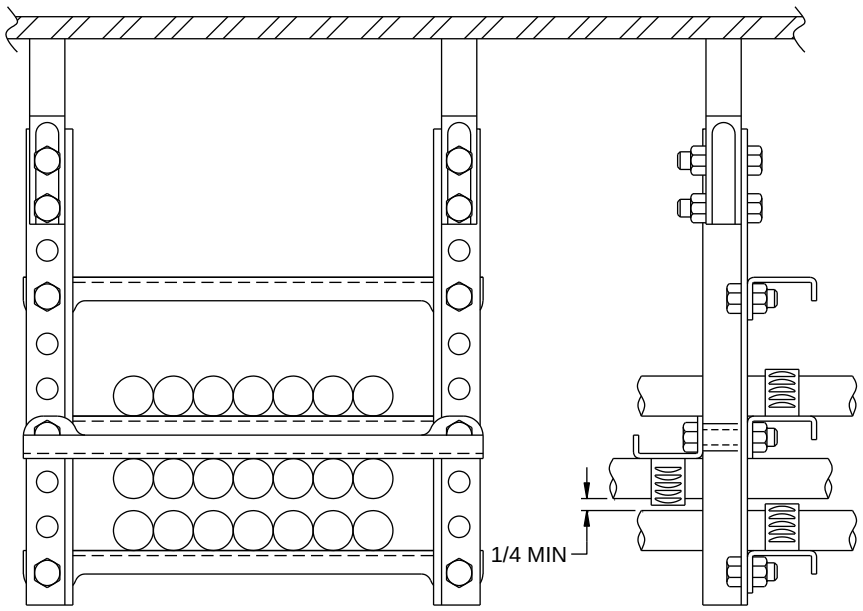


FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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Method 4B-20-6
Overhead Trapeze Hangers, One Leg Suspended by a Beam

NOTES:

1. Purpose: The purpose of this method is to provide installation instructions for an overhead trapeze hanger where one leg is supported by a ship structural beam.
2. A maximum of three tiers may be used for this cable hanger.
3. Orientation restriction: parallel to the ship fore/aft axis.
4. Hanger spacing requirements shall be in accordance with 5.7.3.1.
5. Cable retention in accordance with 5.7.3.4.
6. See 5.7.3.7 for fastener and fastener material requirements.
7. See figure 4B22 for an alternate tier bar design.
8. See 5.7.3.8 for collar and welding stud requirements.

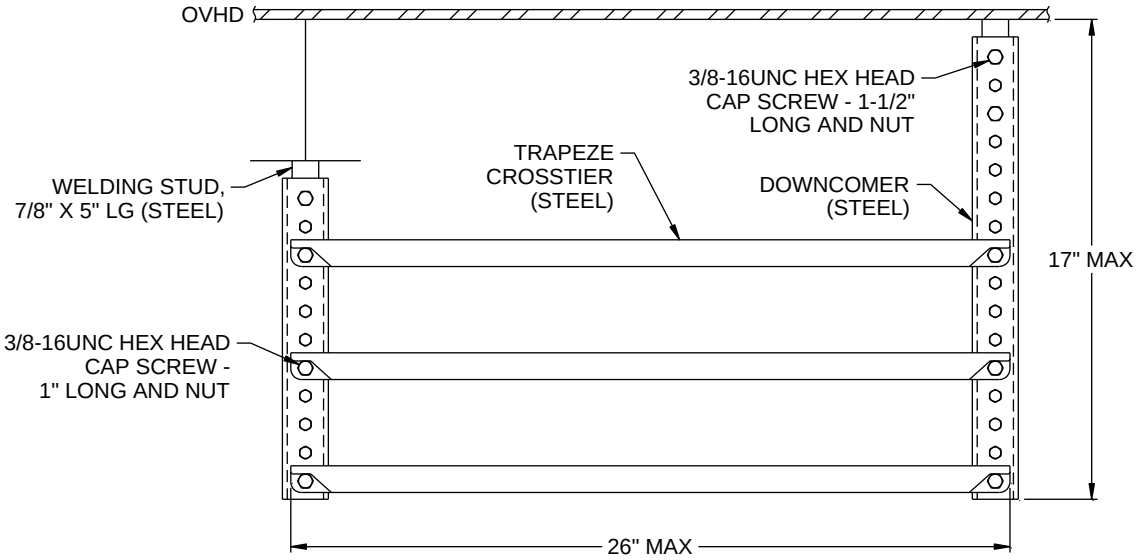

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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Method 4B-20-7
Eight Tier Overhead Trapeze Hanger – Steel

NOTES:

1. Number of hanger tiers is limited to eight. Since this hanger includes eight tiers, in accordance with 5.7.3.1.c, NAVSEA approval is required to use this method.
2. Hanger orientation is unrestricted.
3. Maximum spacing shall be in accordance with 5.7.3.1.
4. Weld directly to structure.
5. Limited to attachment to overhead.
6. Cable retention in accordance with 5.7.3.4.
7. See 5.7.3.7 for fastener and fastener material requirements.
8. See figure 4B22 for an alternate tier bar design.
9. See 5.7.3.6 for welding requirements.

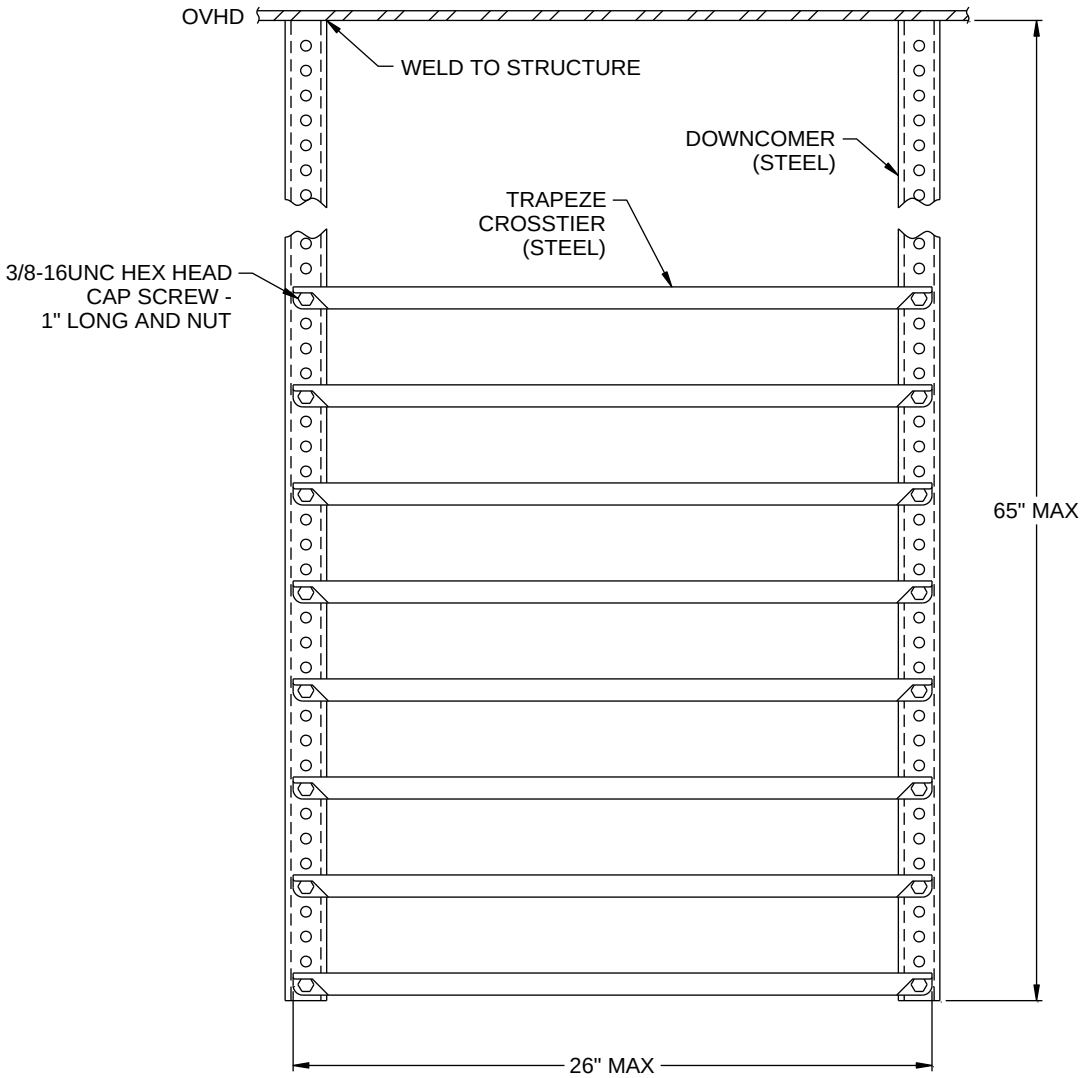

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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Method 4B-20-8
Five Tier Overhead Trapeze Hanger – Aluminum

NOTES:

1. This method includes instructions for installing a five tier aluminum overhead cableway hanger welded directly to the overhead. Since this hanger includes five tiers, in accordance with 5.7.3.1.b, NAVSEA approval is required to use this method.
2. A maximum of five tiers are allowed for this hanger installation.
3. Cable orientation is unrestricted.
4. A bottom cross-tier is required; see illustration below.
5. The maximum hanger spacing shall be in accordance with 5.7.3.1.
6. Weld directly to plating in the overhead.
7. Cable retention in accordance with 5.7.3.4.
8. See 5.7.3.7 for fastener and fastener material requirements.
9. See 5.7.3.6 for welding requirements.

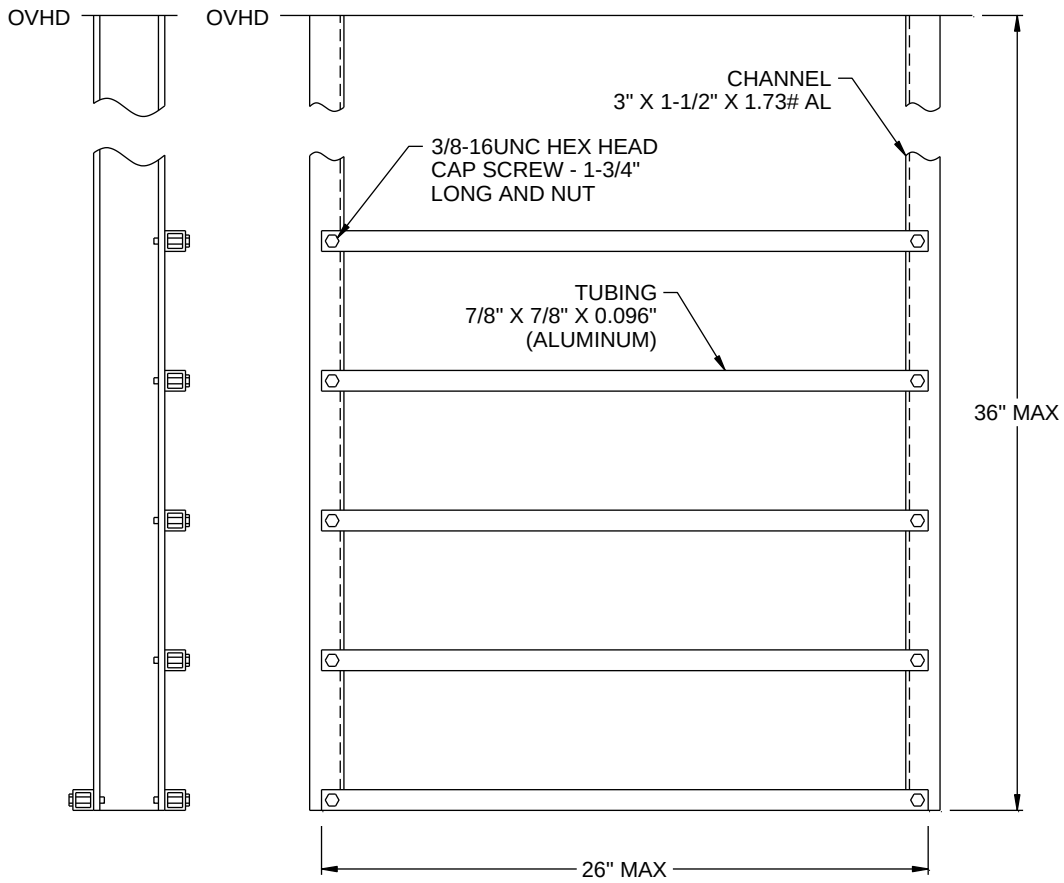

FIGURE 4B20. Multiple cableways on decks and bulkheads (surface ships) – Continued.

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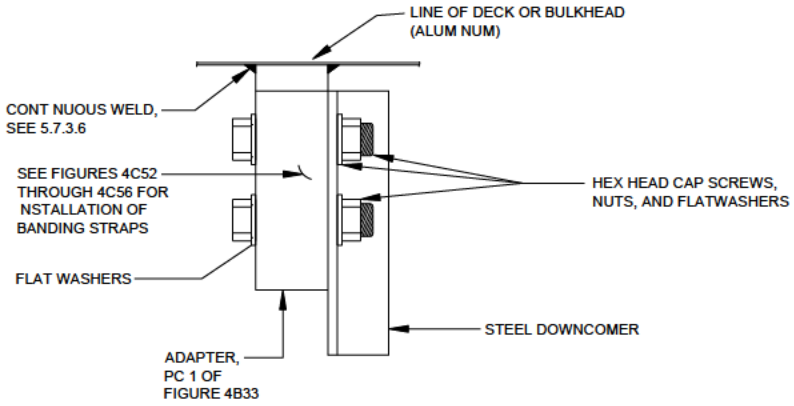
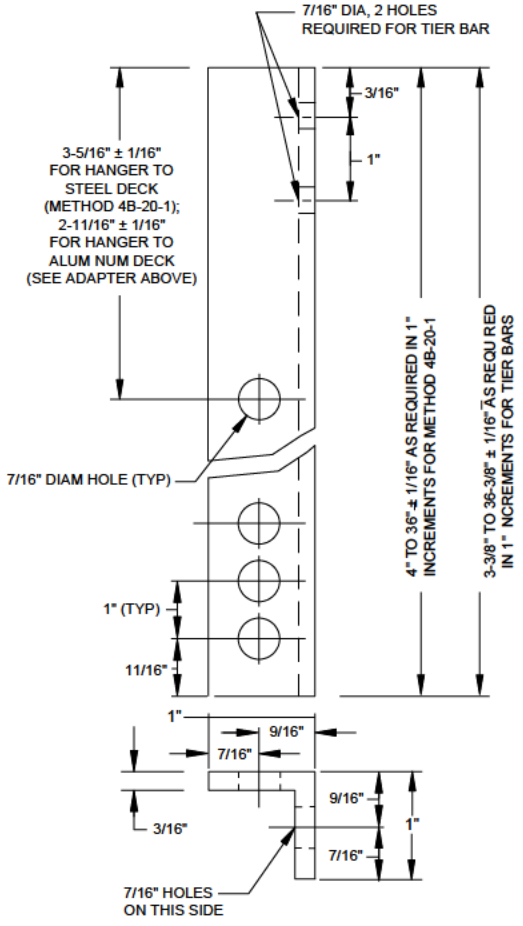
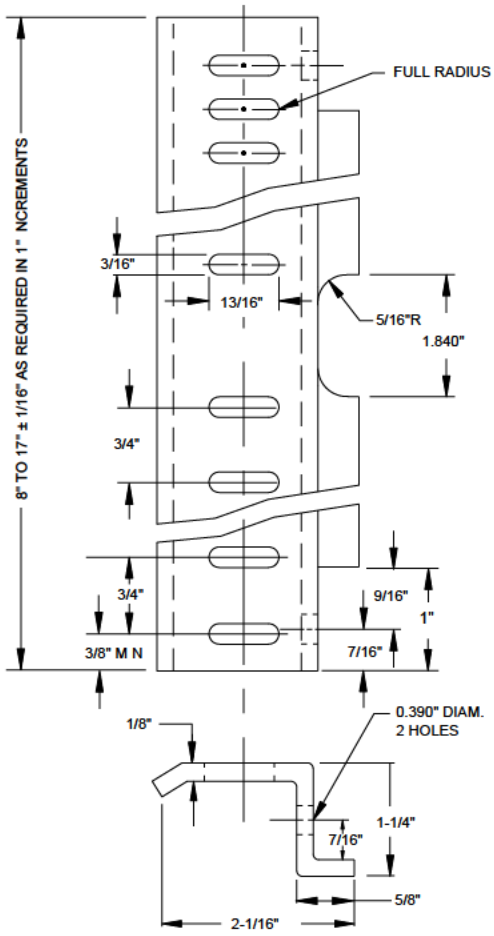
THIS METHOD SHALL BE USED FOR ATTACHING STEEL HANGERS TO ALUMINUM DECKS OR BULKHEADS



ANGLE DOWNCOMER FOR METHOD 4B-20-1
MATERIAL - STEEL, ASTM A36/A36M



TIER BAR FOR METHOD 4B-20-1
MATERIAL - STEEL, ASTM A36/A36M



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B21. Multiple cableways on decks and bulkheads (surface ships).

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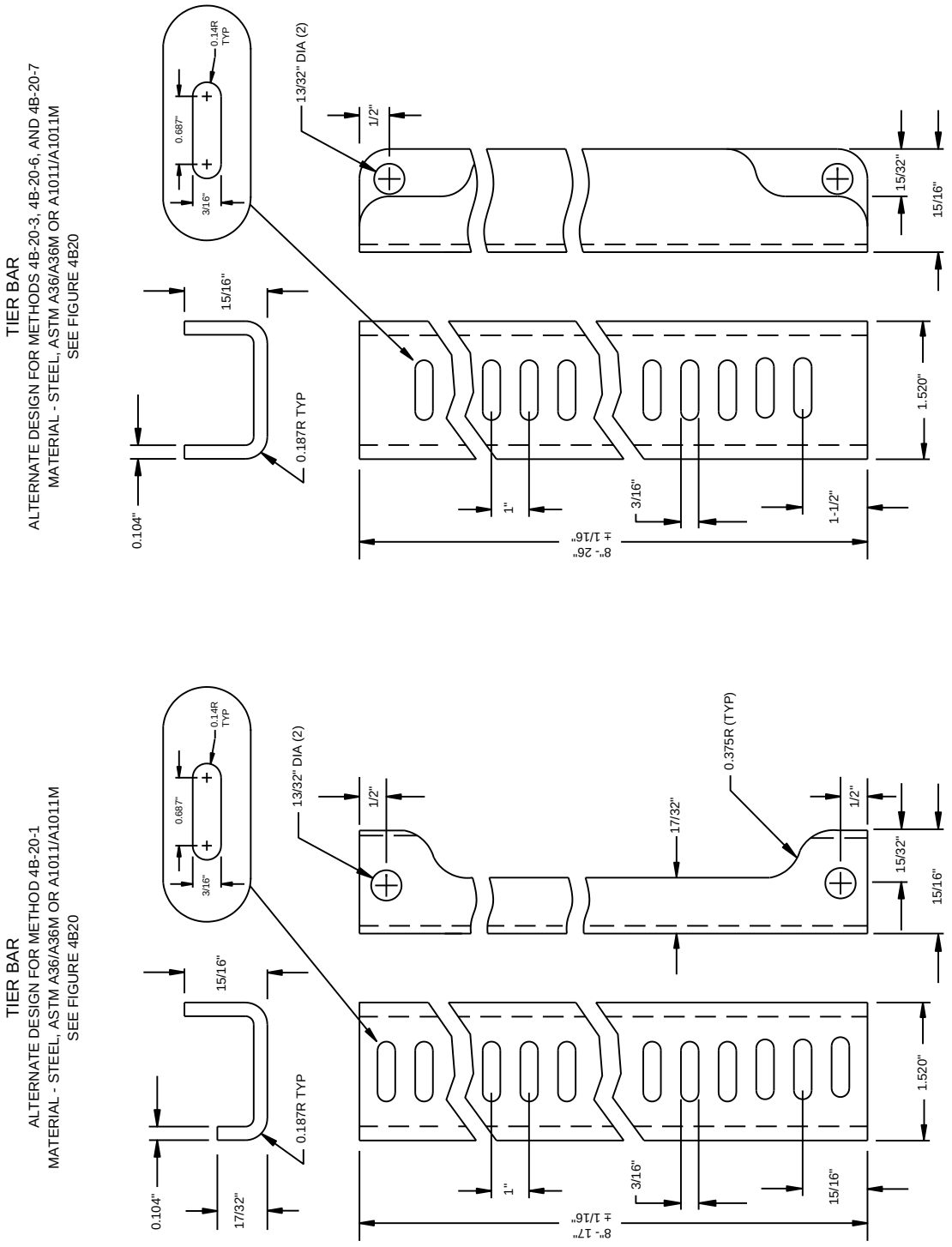

FIGURE 4B22. Tier bar (alternate design) for figure 4B20.

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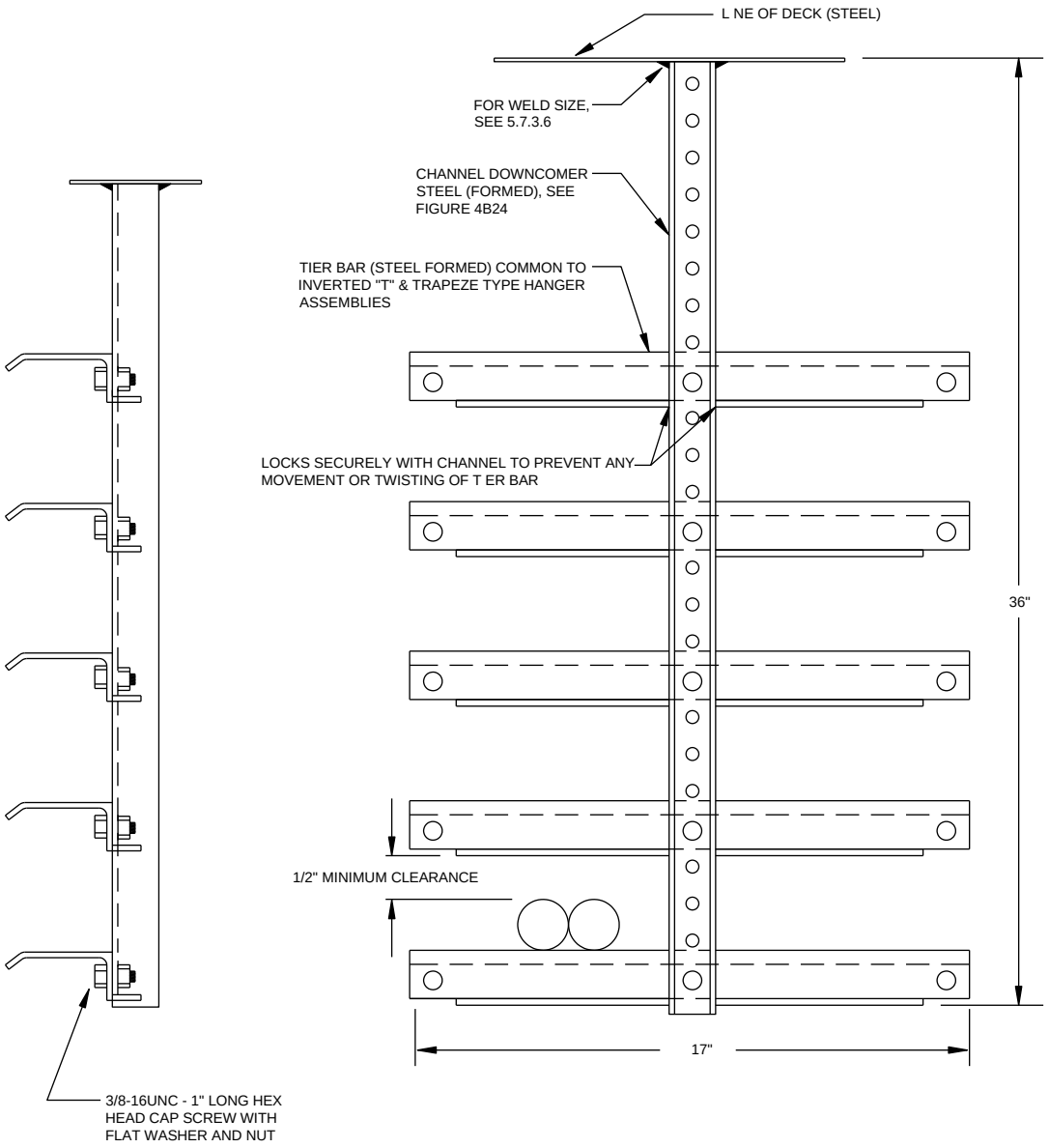
METHOD 4B-23-1
INVERTED "T" TYPE CABLE HANGER FOR MA N WIREWAYS (STEEL)



NOTES:

1. Spacing, number of tiers, and cable weight shall not exceed the values specified in 5.7.3.1. Downward extension to the lesser condition of fewer tiers for hanger assemblies (with cable load not exceeding the maximum per tier as specified) is acceptable.
2. Sharp corners shall be slightly rounded. All parts shall have smooth surfaces.
3. Contact areas between adapter, downcomer, and attaching bolts shall be painted with two coats of MIL-PRF-23236 primer.

FIGURE 4B23. Multiple cableways on steel decks and bulkheads (surface ships).

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NOTES (continued):

4. See 5.7.3.9 for alternate method of securing cableway hangers to dissimilar metals.
5. Cables may be banded below cable support bars on overhead mounted cable hangers. See B.4.5.2 for specific requirements for installing cables below cable support bars. See method 4B-20-5 for additional detail on bottom loading of hangers.
6. See 5.7.3.7 for fastener and fastener material requirements.
7. See figure 4B24 for the tier bar and downcomer design. See figure 4B25 for an alternate tier bar design.

FIGURE 4B23. Multiple cableways on steel decks and bulkheads (surface ships) – Continued.

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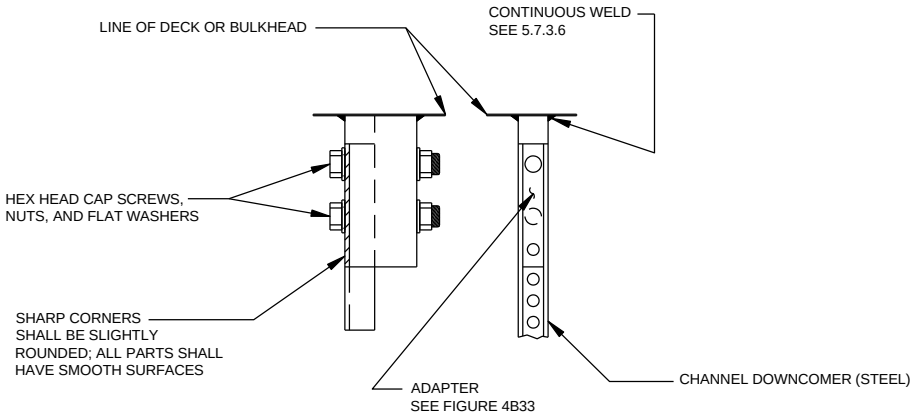
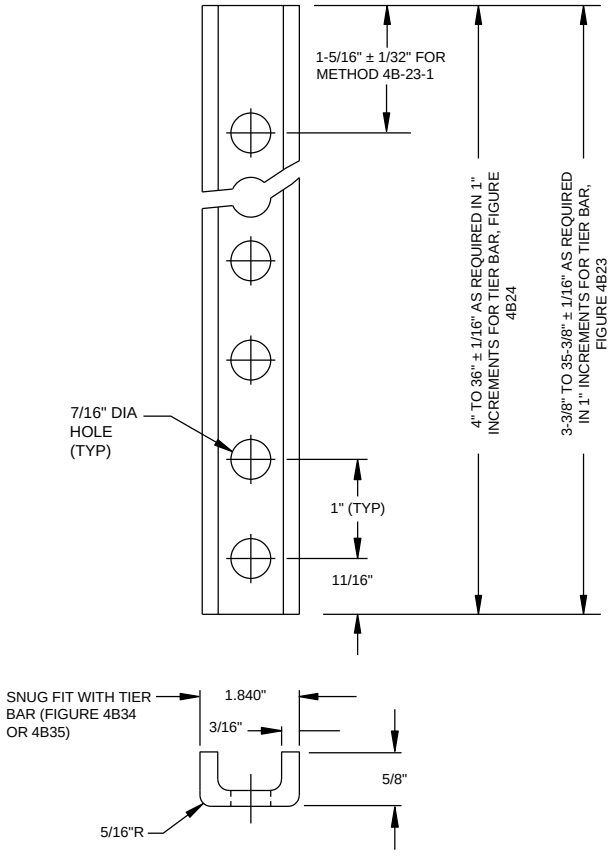
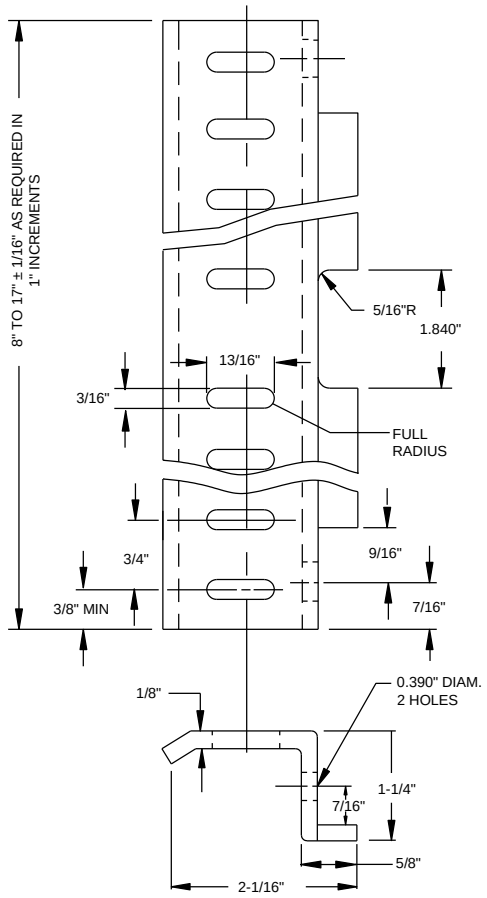
METHOD 4B-24-1
THIS METHOD SHALL BE USED FOR ATTACHING STEEL HANGERS TO ALUMINUM DECKS



CHANNEL DOWNCOMER FOR METHOD 4B-23-1
STEEL, ASTM A36/A36M



TIER BAR FOR METHOD 4B-23-1
STEEL, ASTM A36/A36M



NOTES:

1. Contact areas between adapter, downcomer, and attaching bolts shall be painted with two coats of MIL-PRF-23236 primer.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B24. Multiple cableways on decks (surface ships).

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TIER BAR
ALTERNATE DESIGN
STEEL, ASTM A36/A36M OR A1011/A1011M
SEE FIGURE 4B23

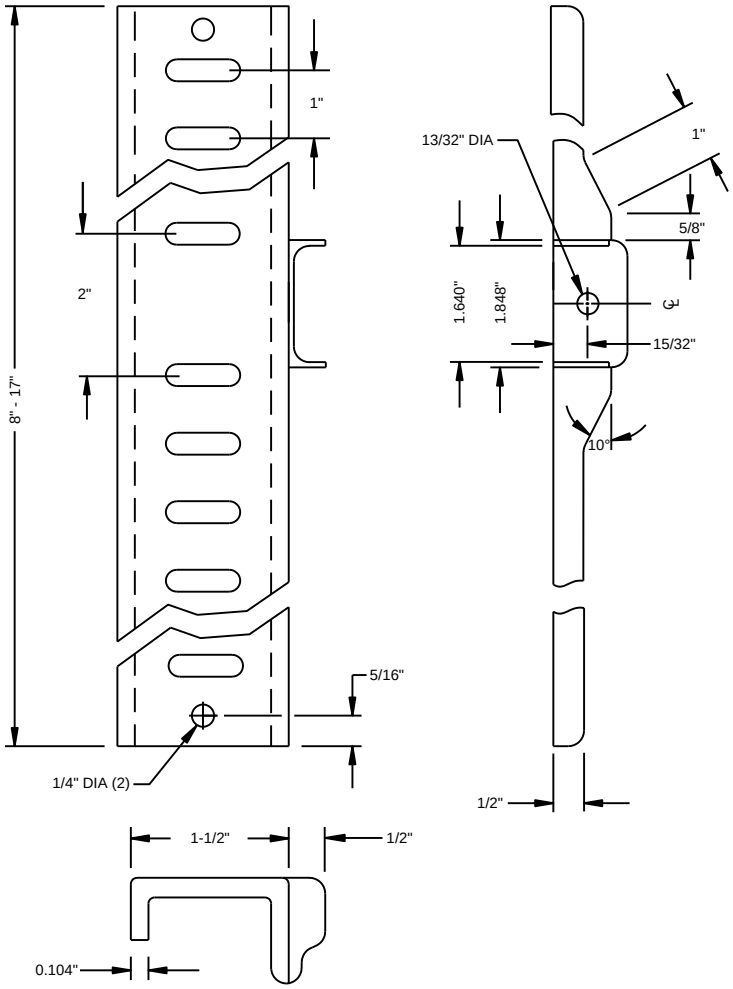

FIGURE 4B25. Tier bar (alternate design for figure 4B23).

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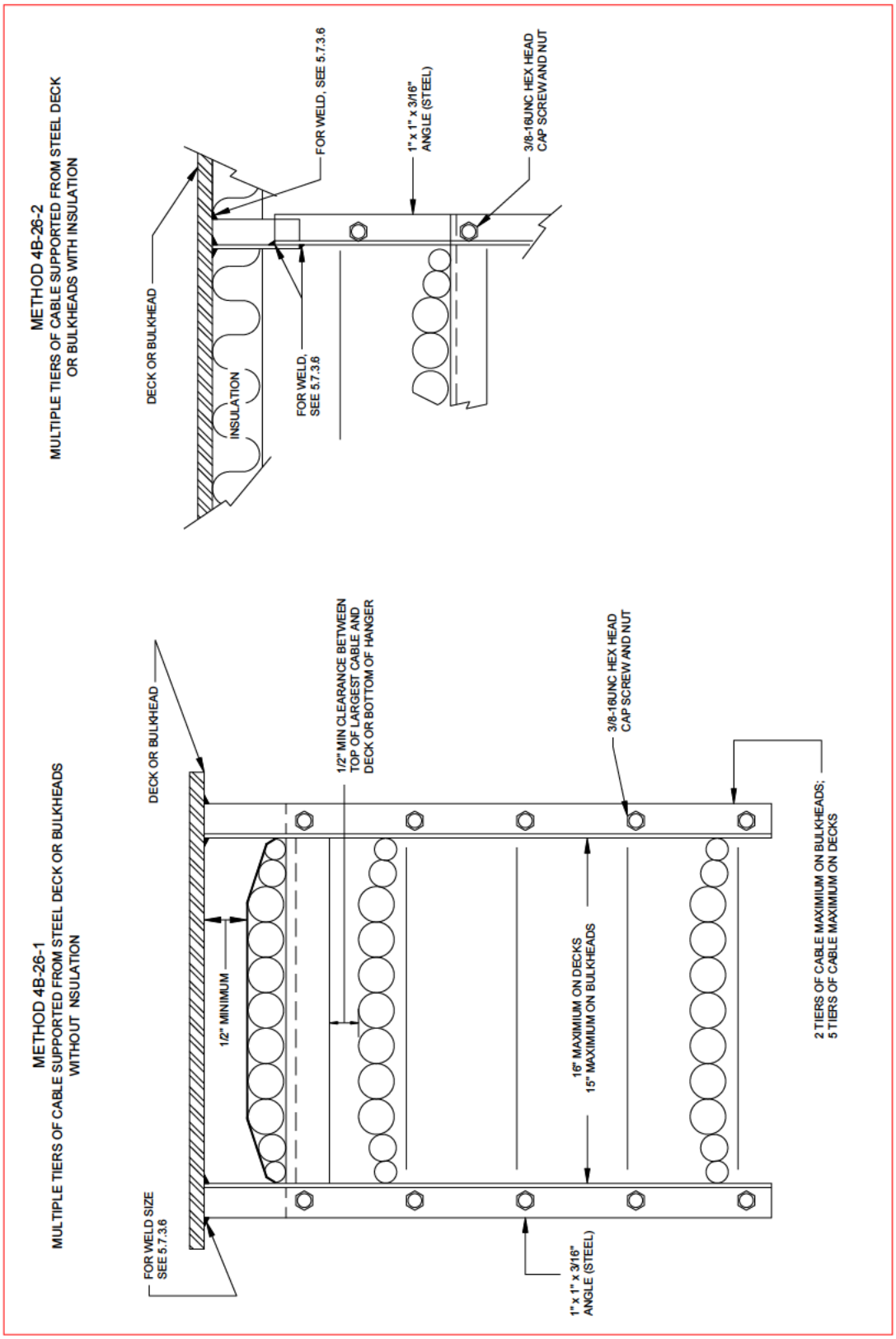

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B26. Multiple cables on steel decks and bulkheads (surface ships).

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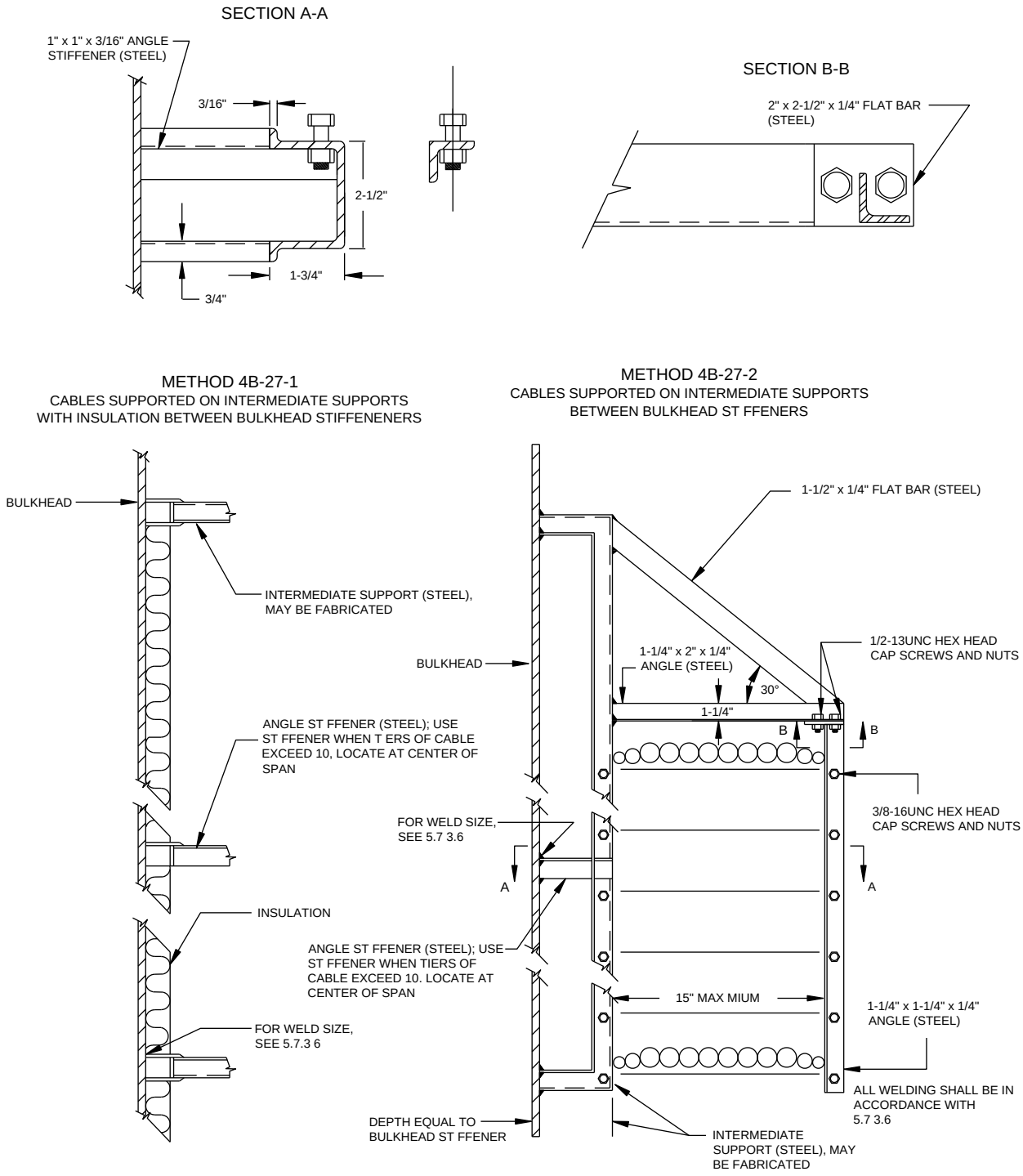

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B27. Multiple cables on steel bulkheads (surface ships).

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METHOD 4B-28-1
CABLES SUPPORTED ON STIFFENER

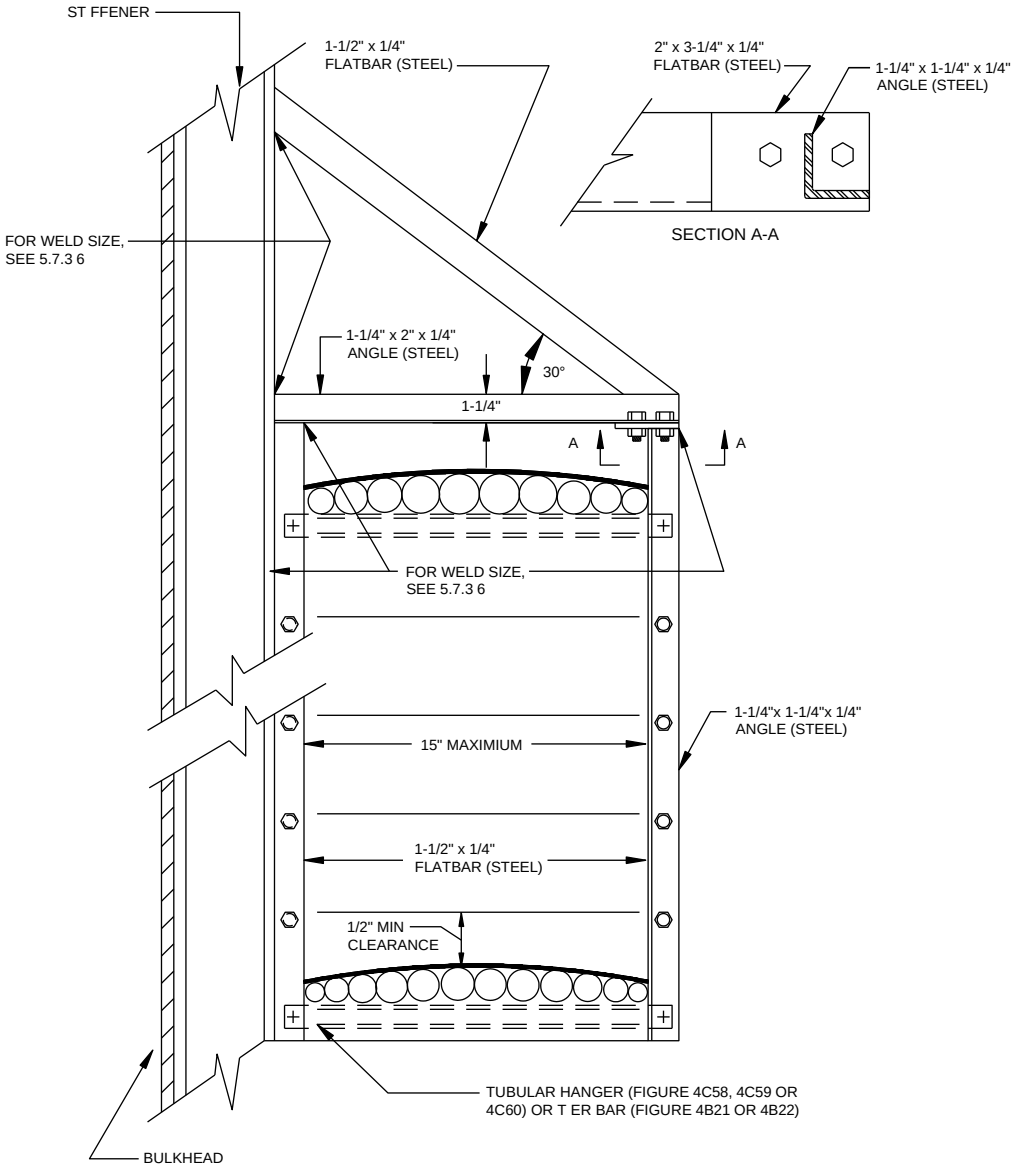

FIGURE 4B28. Multiple cables on steel bulkheads – cables supported on stiffener (surface ships).

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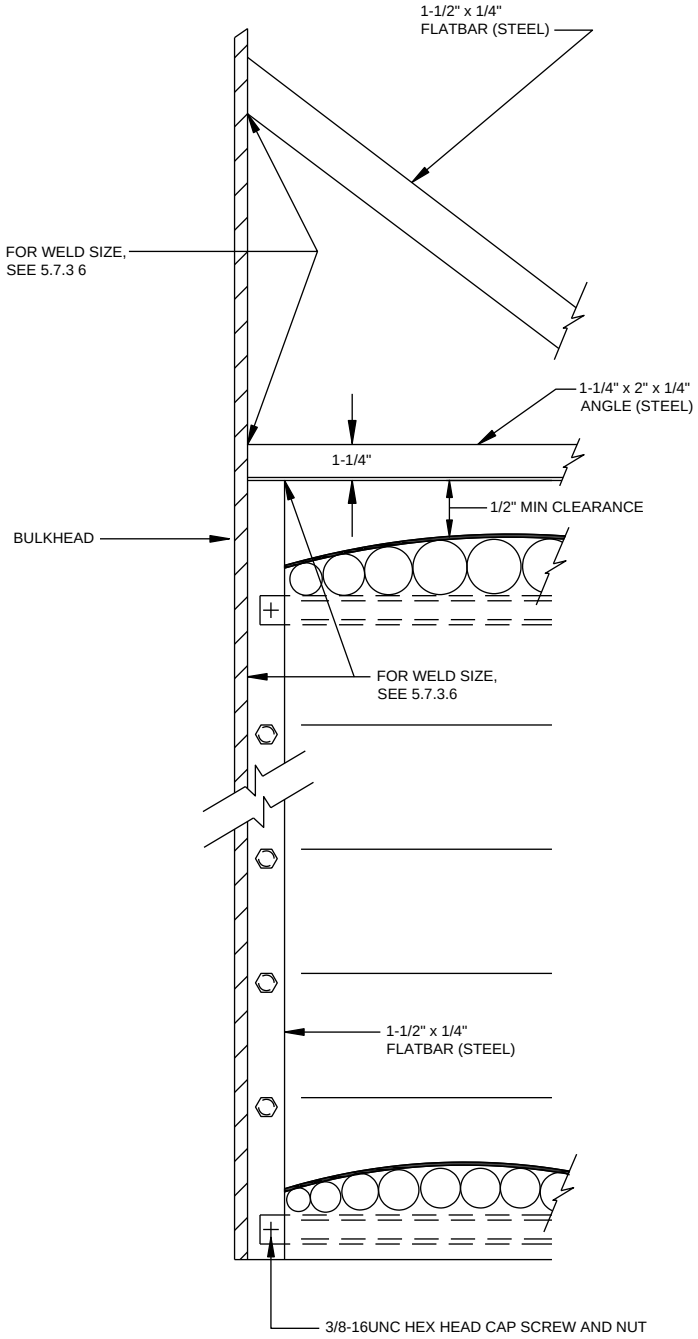
METHOD 4B-29-1
CABLES SUPPORTED ON BULKHEAD WITHOUT INSULATION
(SEE FIGURE 4B28 FOR ADDITIONAL DETAILS)



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B29. Multiple cables on steel bulkheads without insulation (surface ships).

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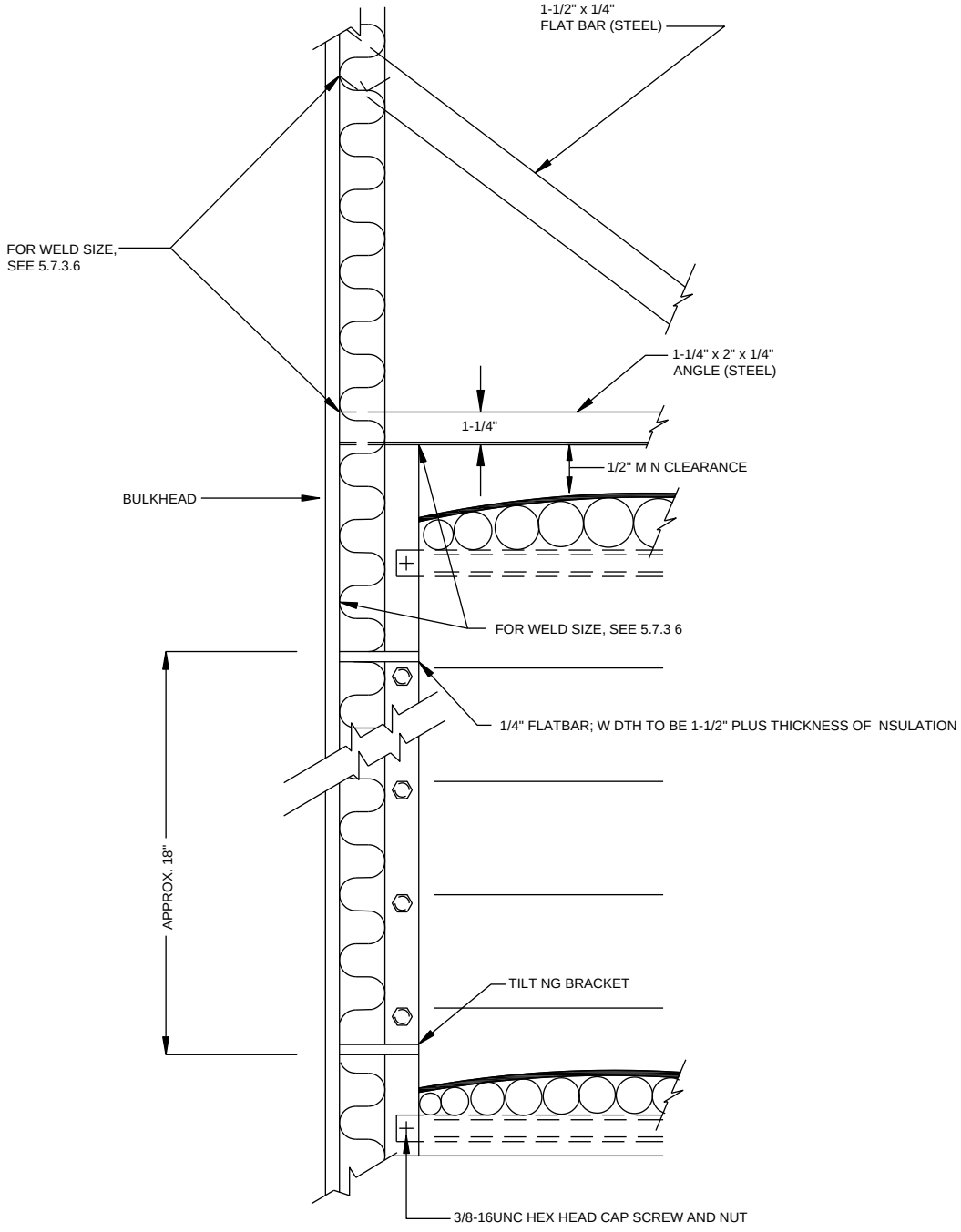
METHOD 4B-30-1
CABLES SUPPORTED ON BULKHEAD WITH INSULATION
(SEE FIGURE 4B28 FOR ADDITIONAL DETAILS)



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B30. Multiple cables on steel bulkheads with insulation (surface ships).

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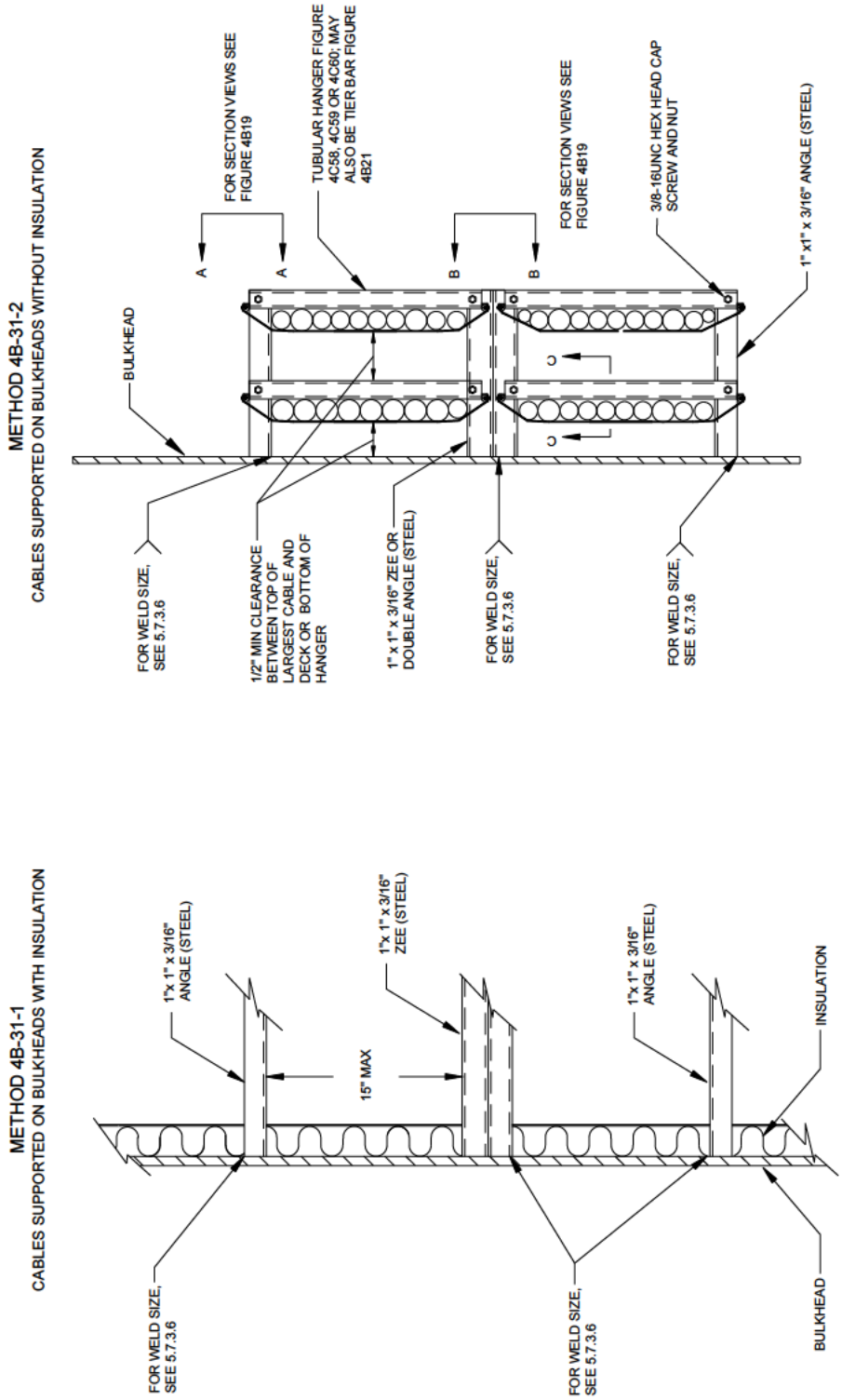

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B31. Multiple cables on steel bulkheads (surface ships).

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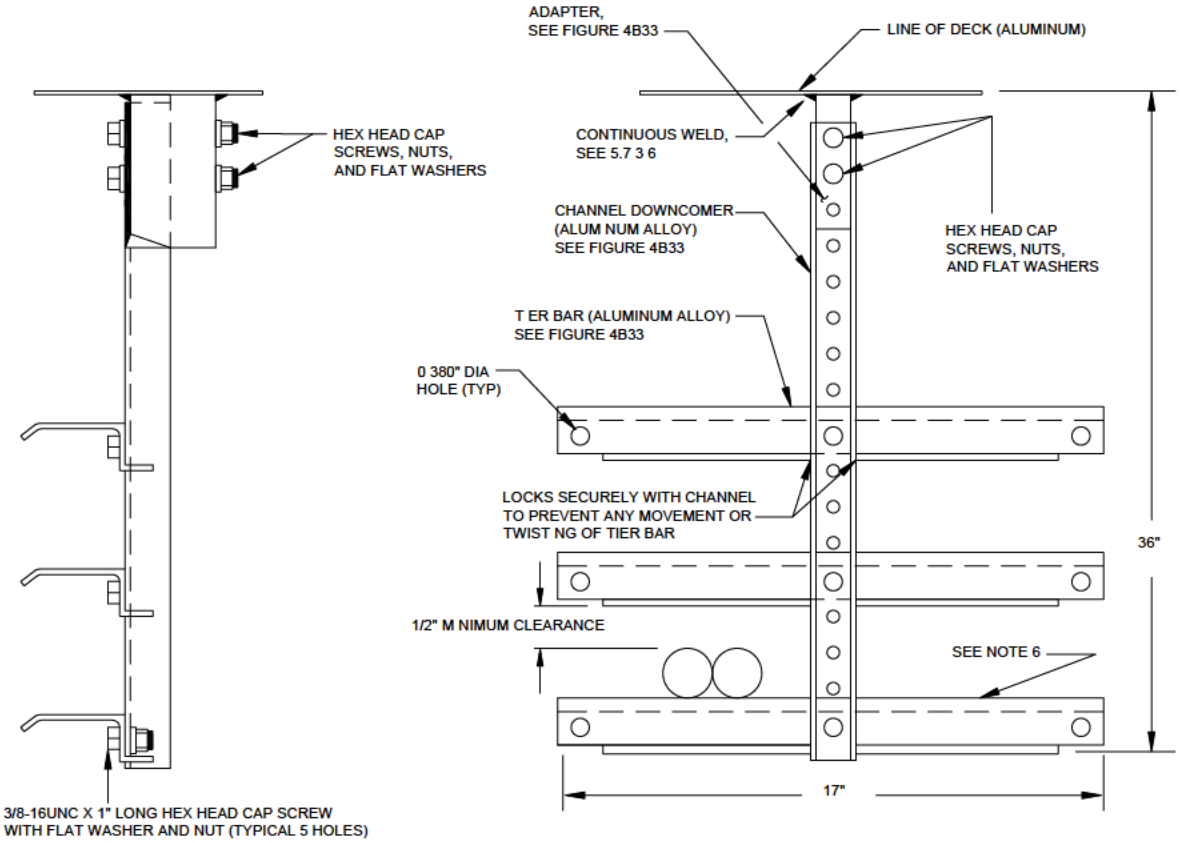
SIDE VIEW FOR METHOD 4B-32-1
INVERTED "T" TYPE CABLE HANGER FOR
MAIN WIREWAYS (ALUMINUM)

METHOD 4B-32-1
INVERTED "T" TYPE CABLE HANGER (ALUMINUM)
FOR MAIN WIREWAYS
(SEE NOTES)



NOTES:

1. Spacing, number of tiers, and cable weight shall not exceed the values specified in 5.7.3.1. Downward extension to the lesser condition of fewer tiers for hanger assemblies (with cable load not exceeding the maximum per tier as specified) is acceptable.
2. Sharp corners shall be slightly rounded. All parts shall have smooth surfaces.
3. Contact areas between adapter, downcomer, and attaching bolts shall be painted with two coats of MIL-PRF-23236 primer.
4. See 5.7.3.9 for an alternate method of securing cableway hangers to dissimilar metals.
5. Banding of cabling is required on each inverted "T" cableway hangar.
6. Cables may be banded below cable support bars on overhead mounted cable hangers. See B.4.5.2 for specific requirements for installing cables below cable support bars. See method 4B-20-5 for additional detail on bottom loading of hangers.
7. See 5.7.3.7 for fastener and fastener material requirements.
8. See figure 4B33 for the downcomer and tier bar design.

FIGURE 4B32. Multiple cableways supported from aluminum or steel decks (surface ships).

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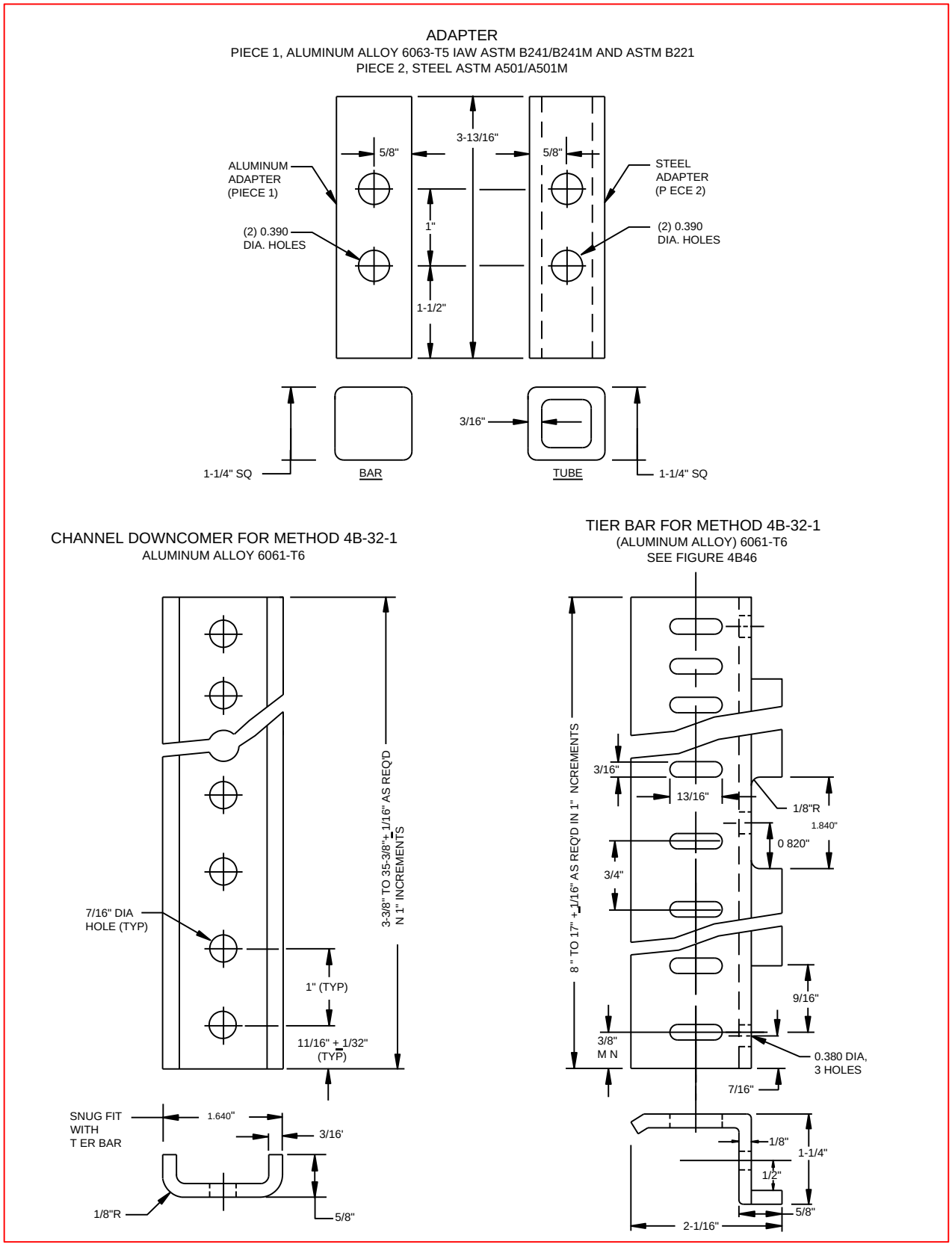

FIGURE 4B33. Multiple cableways supported from aluminum or steel decks (surface ships).

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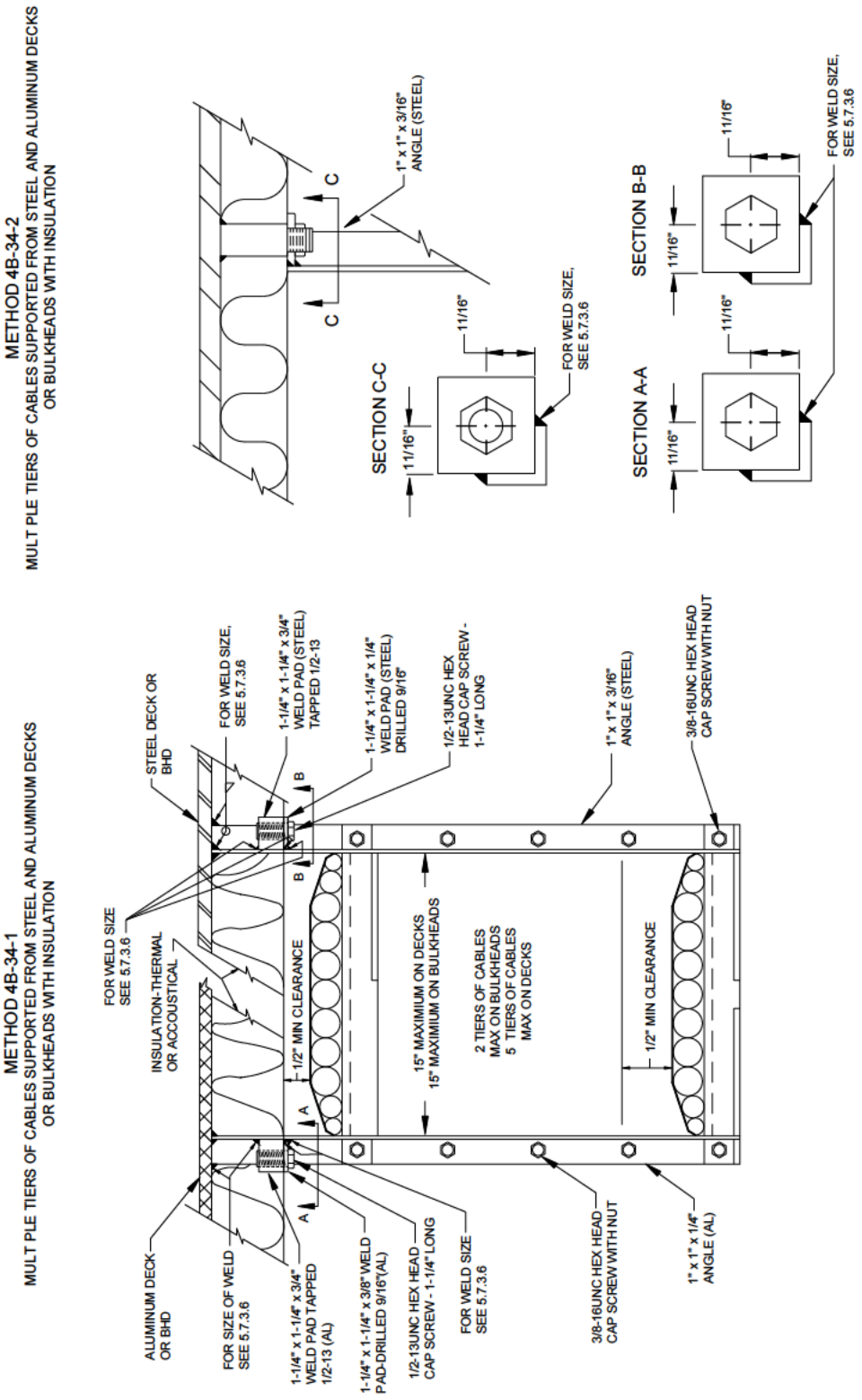

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B34. Multiple cableways on insulated steel or aluminum decks or bulkheads (surface ships).

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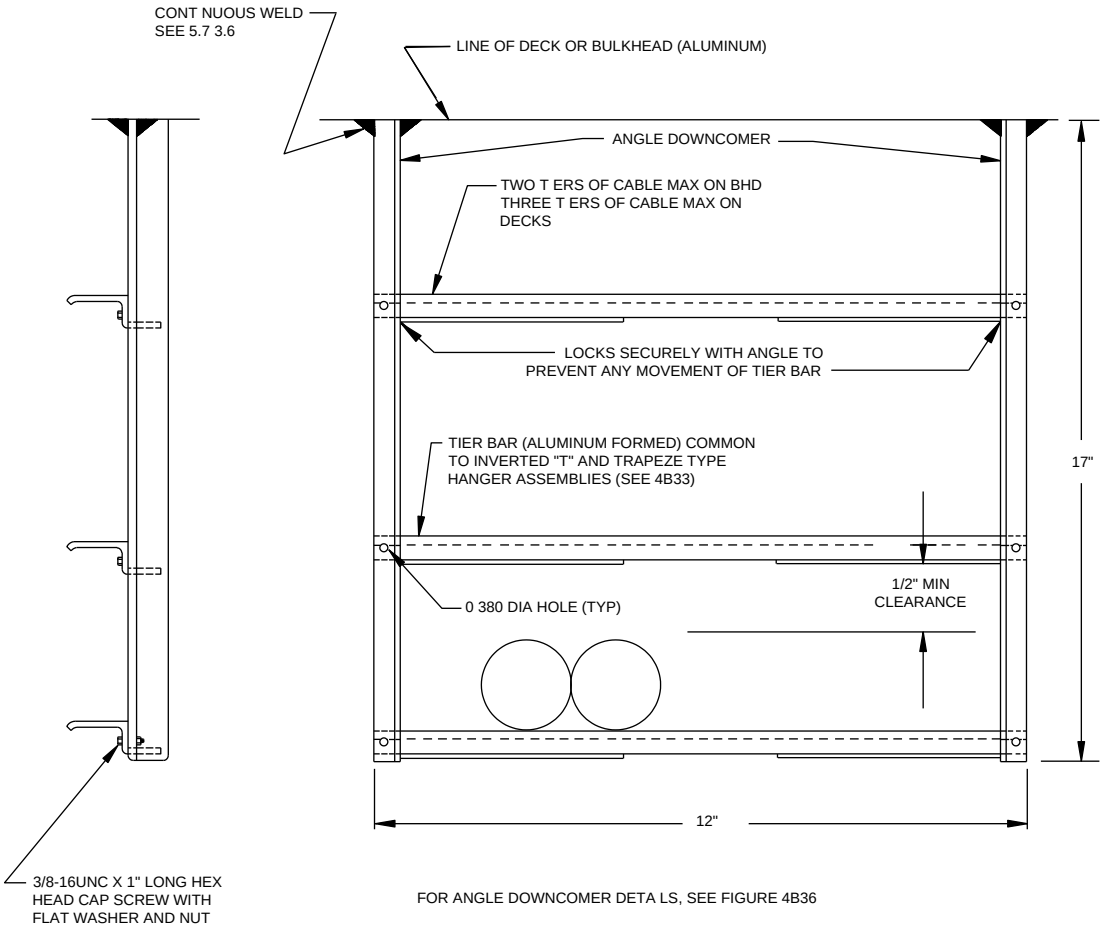
METHOD 4B-35-1
TRAPEZE TYPE CABLE HANGER
FOR MAIN WIREWAYS
(ALUMINUM)



NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. See figure 4B36 for the downcomer and tier bar design.

FIGURE 4B35. Multiple cableway supports on aluminum decks or bulkheads (surface ships only).

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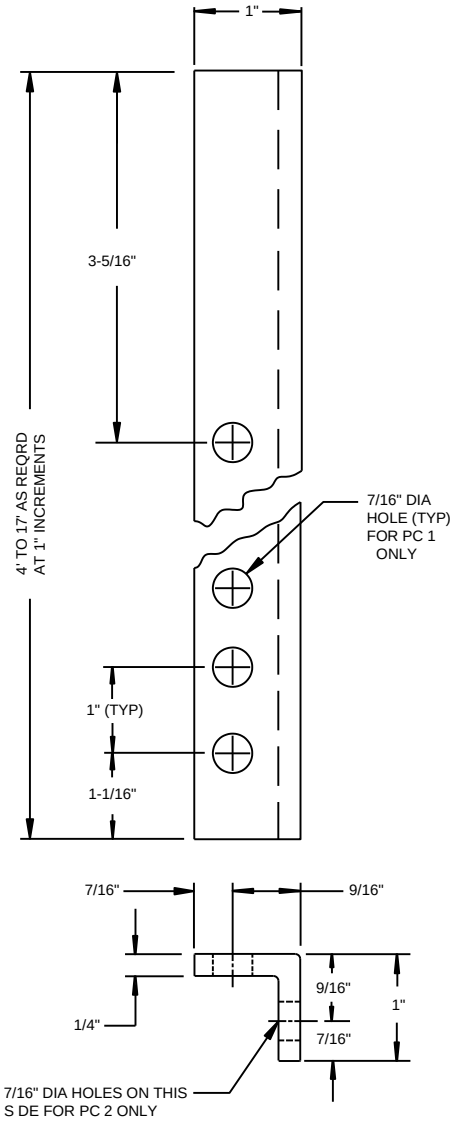
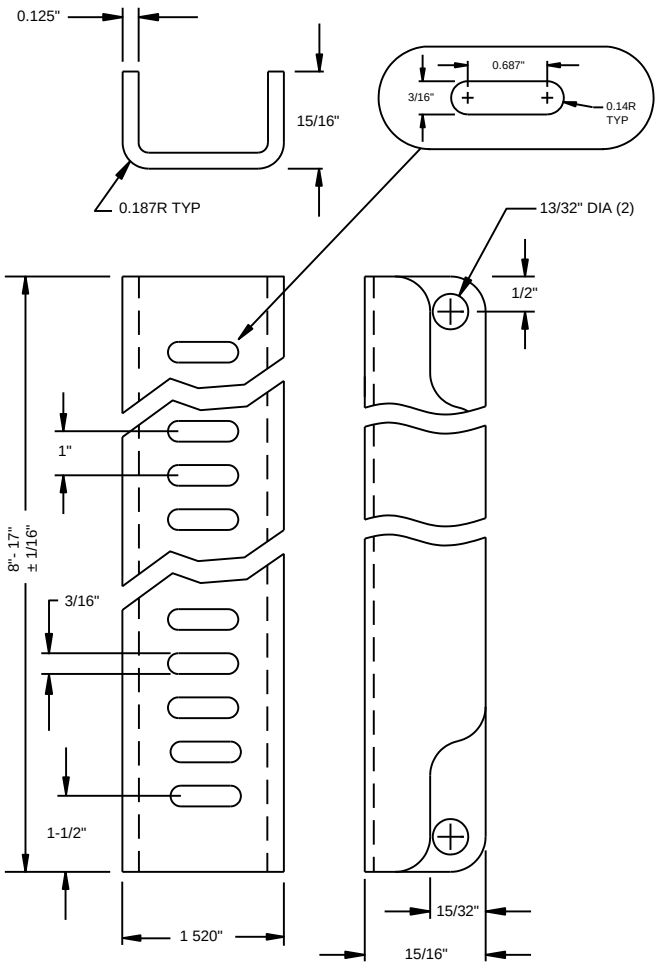
ANGLE DOWNCOMER DETAILS
FOR METHOD 4B-35-1
ALUMINUM ALLOY 6061-T6



TIER BAR
FOR HANGER IN FIGURE 4B35
ALUM NUM ALLOY 6061



NOTE:

1. See figure 4B33 for piece numbers in this figure.

FIGURE 4B36. Angle downcomer and tier bar for figure 4B35.

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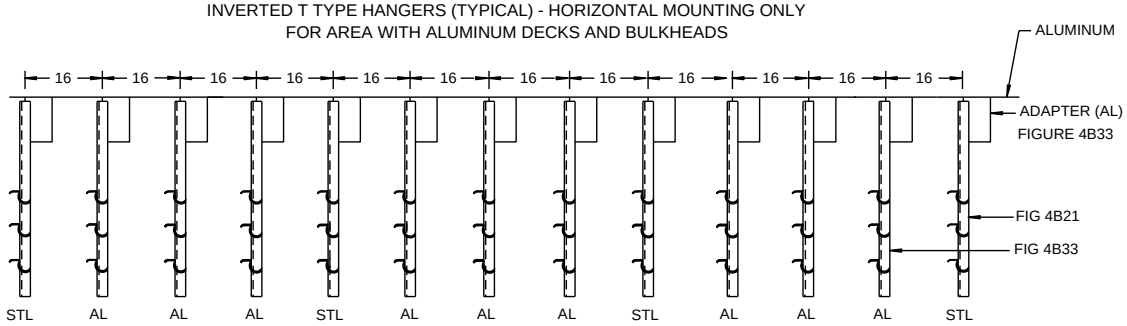
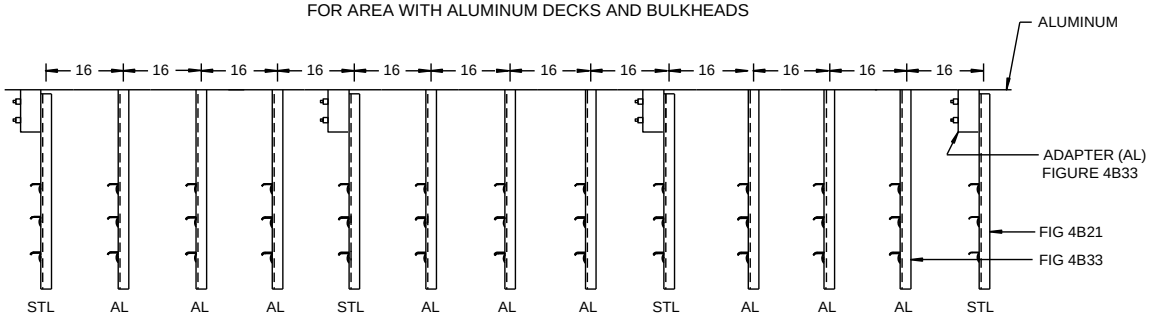
METHOD 4B-37-1
INVERTED T TYPE HANGERS (TYPICAL) - HORIZONTAL MOUNTING ONLY
FOR AREA WITH ALUMINUM DECKS AND BULKHEADS



METHOD 4B-37-2
TRAPEZE TYPE HANGERS (TYPICAL) - HORIZONTAL OR VERTICAL MOUNTING
FOR AREA WITH ALUMINUM DECKS AND BULKHEADS



SEE PARAGRAPH 5.7 3 9 FOR ALTERNATE METHOD OF SECURING CABLEWAY HANGERS TO DISS M LAR METALS

NOTE:

1. See 5.7.3.1 for hanger spacing requirements.

FIGURE 4B37. Spacing of multiple cableway supports for aluminum decks and bulkheads (surface ships only).

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METHOD 4B-38-1
(TYPICAL FOR ALUMINUM DECKS AND BULKHEADS)
SEE 5.7.3 9 FOR ALTERNATE METHODS OF SECURING CABLEWAY HANGERS TO DISS MILAR METALS

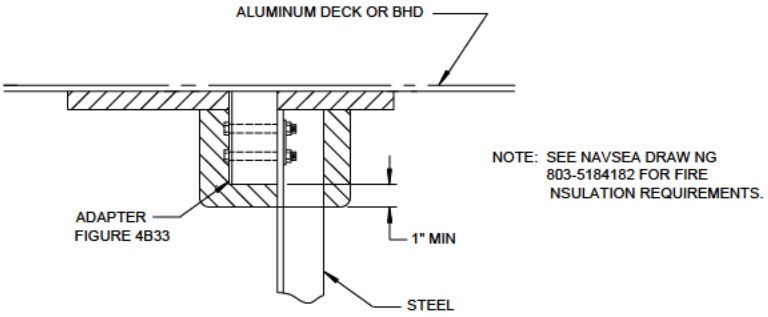

FIGURE 4B38. Detail of fire protection installation.

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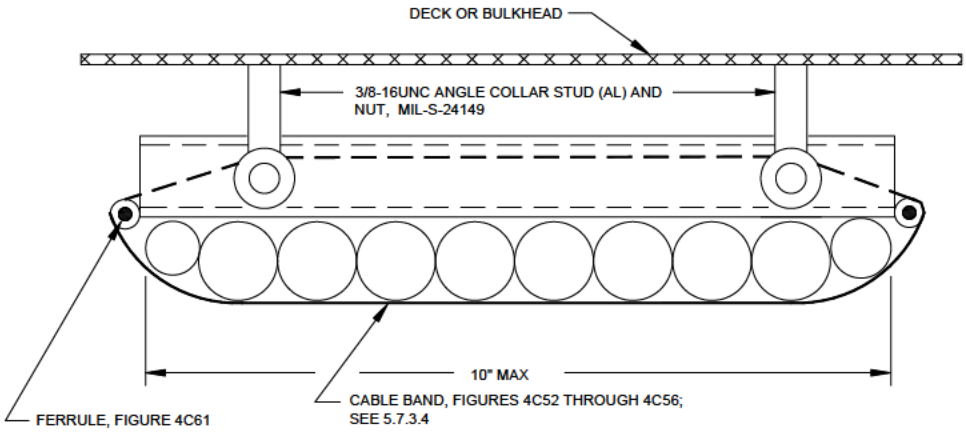
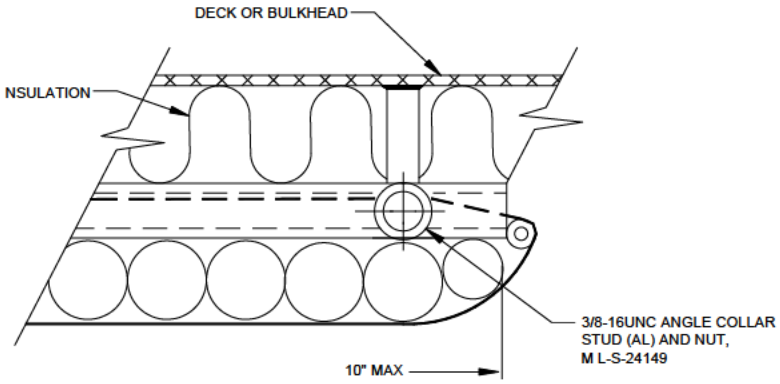
METHOD 4B-39-1
SINGLE TIER SUPPORTED WITH ANGLE COLLAR STUDS
ON UNINSULATED DECKS OR BULKHEADS
CABLE - ONE INCH DIAMETER MAXIMUM
MAXIMUM CABLE WEIGHT: THREE POUNDS PER STUD



METHOD 4B-39-2
SINGLE TIER SUPPORTED WITH ANGLE COLLAR STUDS
ON NSULATED DECKS OR BULKHEADS
CABLE - ONE INCH DIAMETER MAXIMUM
MAXIMUM CABLE WEIGHT: THREE POUNDS PER STUD



NOTES:

1. See 5.7.3.8 for collar and welding stud requirements.
2. See 5.7.3.7 for fastener and fastener material requirements.
3. See 5.7.3.6 for welding requirements.

FIGURE 4B39. Single cableway on aluminum structures – local runs (surface ships).

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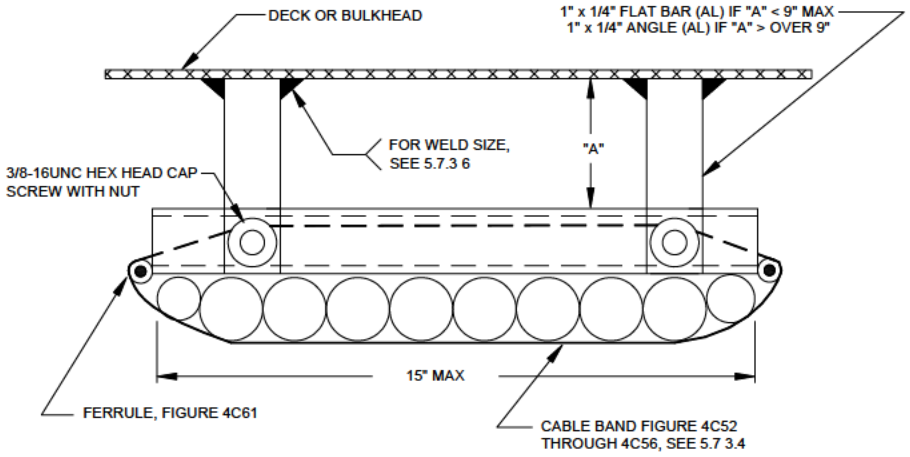
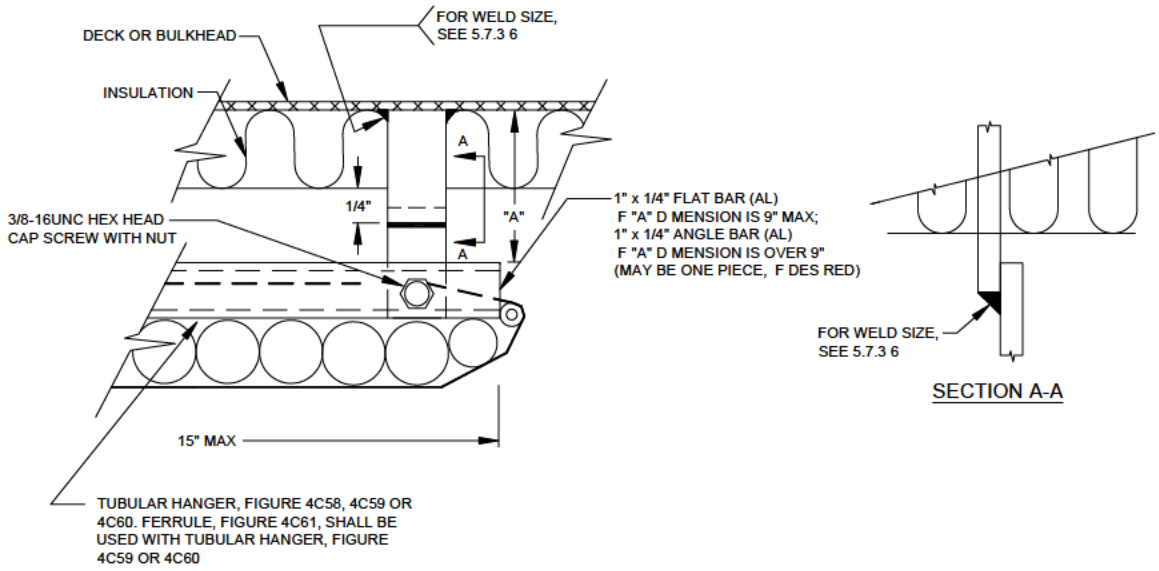
METHOD 4B-40-1
SINGLE TIER SUPPORTED WITH FLAT BAR OR ANGLE
ON UNINSULATED DECKS OR BULKHEADS
SEE FIGURE 4B41 FOR OPTIONAL METHOD



METHOD 4B-40-2
S NGLE T ER SUPPORTED WITH FLAT BAR OR ANGLE
ON INSULATED DECKS OR BULHEADS



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B40. Single cableway on aluminum structures – local runs (surface ships).

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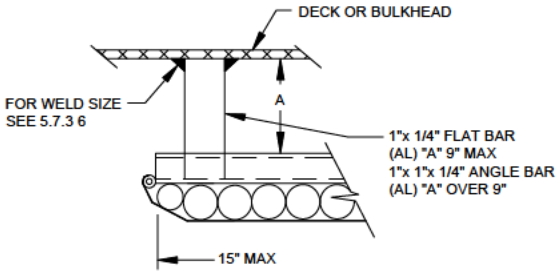
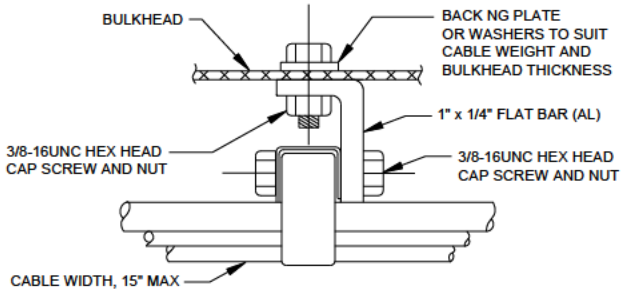
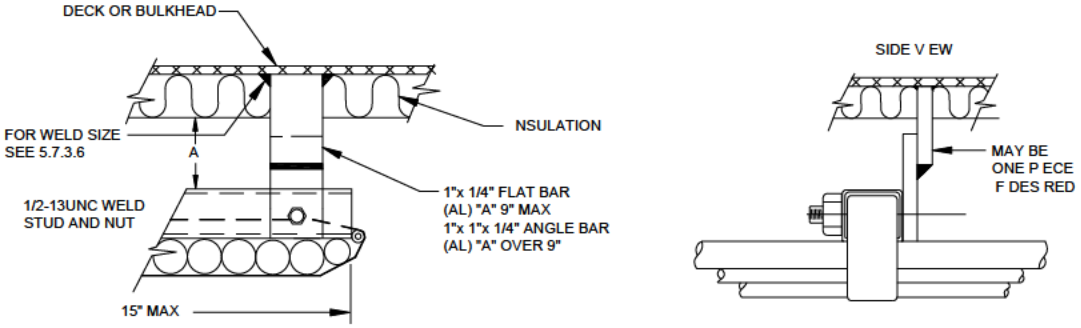
METHOD 4B-41-1
SINGLE TIER SECURED WITH FLAT BAR OR ANGLE AND WELD STUD
OPTION TO METHOD 4B-40-1



METHOD 4B-41-2
SINGLE TIER ON NON-WATERTIGHT BULKHEAD
SECURED BY BOLTING



METHOD 4B-41-3
SINGLE TIER SECURED WITH WELD STUDS
OPTION TO METHOD 4B-40-2



NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4B41. Single cableway on aluminum structures – local runs (surface ships).

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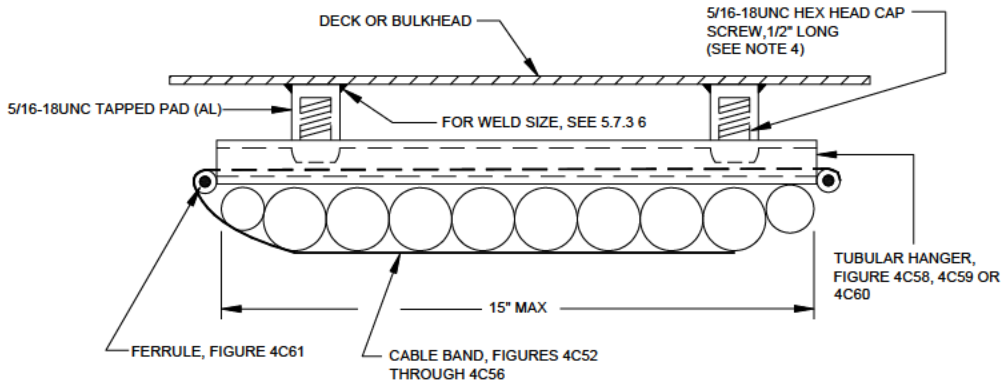
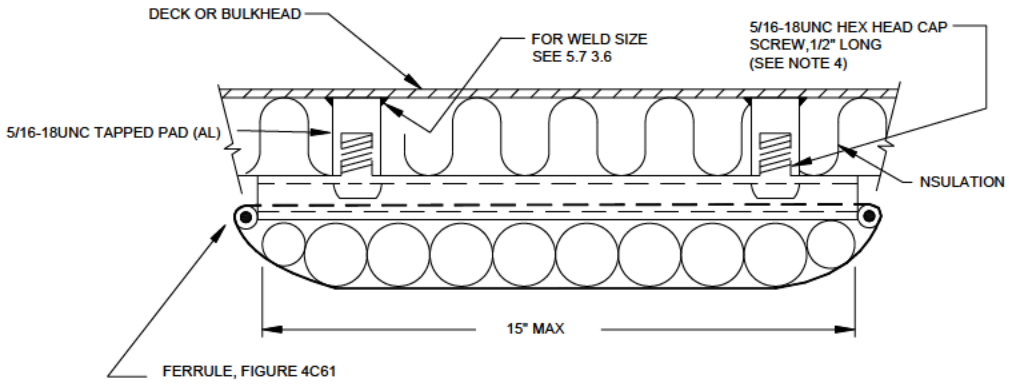
METHOD 4B-42-1
SINGLE T ER SECURED WITH TAPPED PADS
ON ALUM NUM DECKS AND BULKHEADS



METHOD 4B-42-2
SINGLE TIER SECURED WITH TAPPED PADS
ON NSULATED ALUM NUM DECKS AND BULKHEADS



METHOD 4B-42-3
SINGLE T ER SECURED WITH A SINGLE WELD STUD
ON ALUMINUM DECKS AND BULKHEADS
(MAXIMUM CABLE WEIGHT: THREE POUNDS PER SUPPORT)

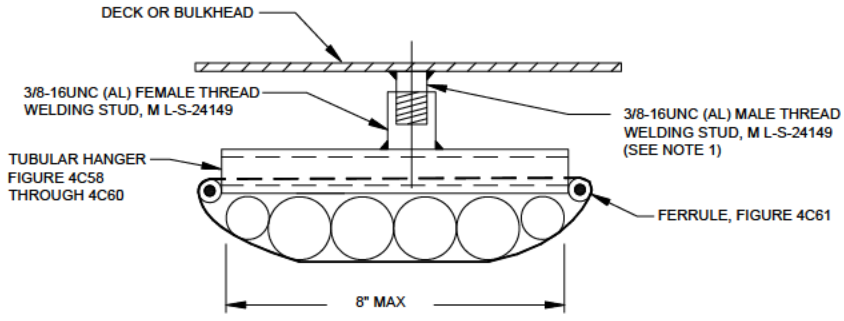


FIGURE 4B42. Single cableway on aluminum structures (surface ships).

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NOTES:

1. See table 4CV for National Stock Numbers for ⅜-16UNC external thread welding studs.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.
4. If a low profile head is required, button head screws may be substituted for hex head cap screws.
5. See 5.7.3.6 for welding requirements.

FIGURE 4B42. Single cableway on aluminum structures (surface ships) – Continued.

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METHOD 4B-43-1
CABLES SUPPORTED BETWEEN SHIPS LONGITUDINALS AND
THROUGH SH PS TRANSVERSE FRAMING
FOR SIDE VIEW, SEE FIGURE 4B44

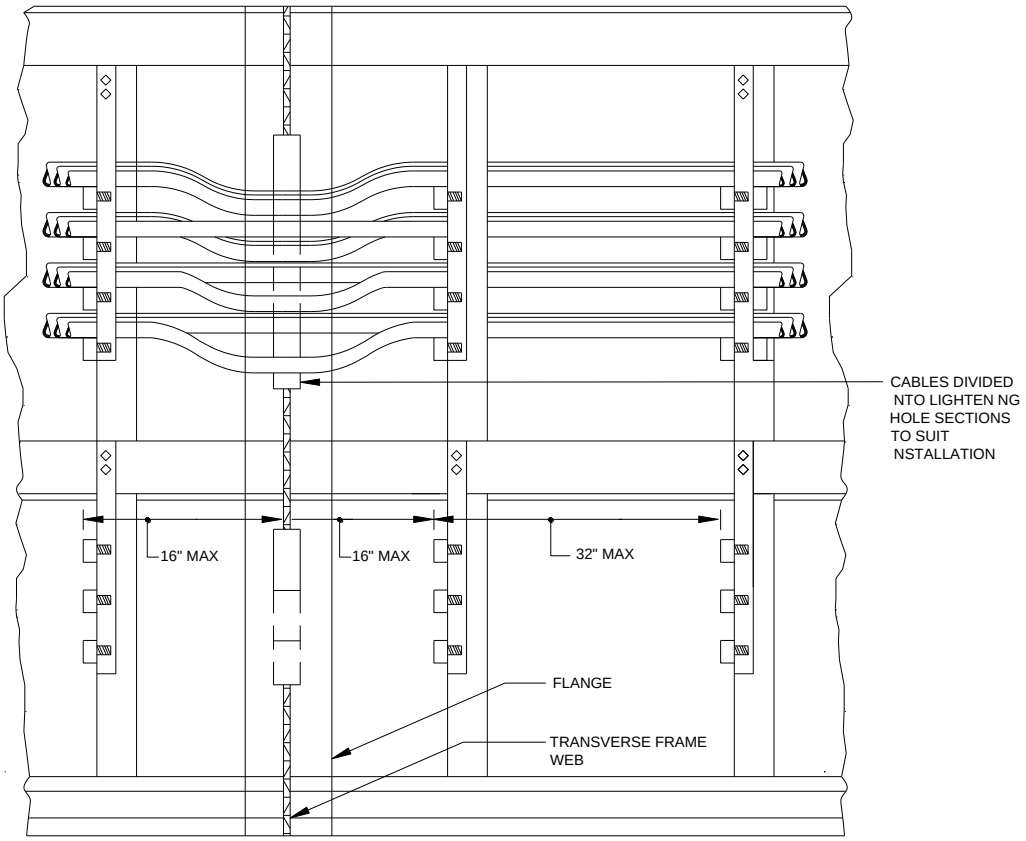

FIGURE 4B43. Multiple cableways in machinery spaces (surface ships).

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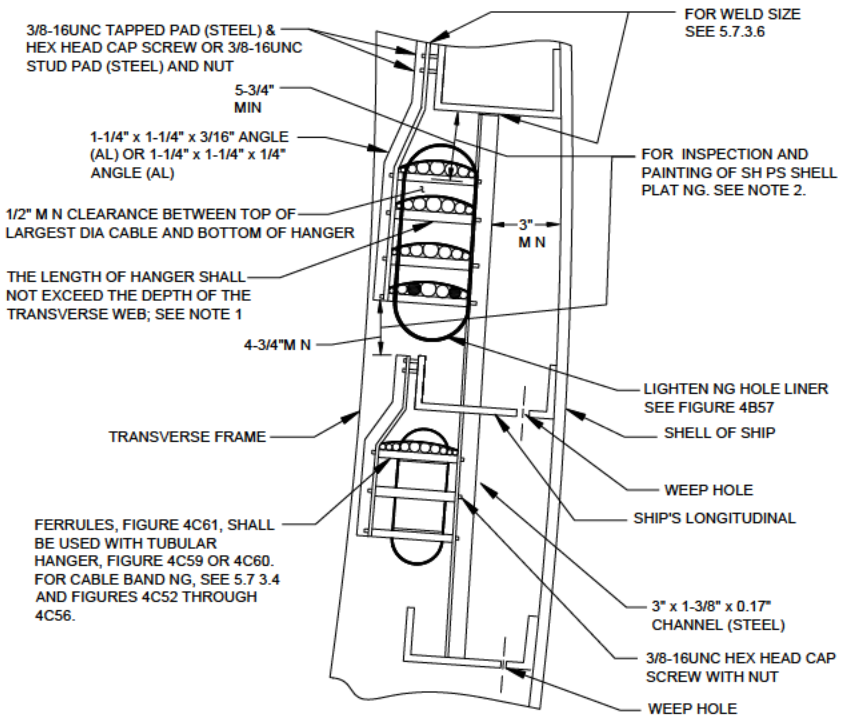
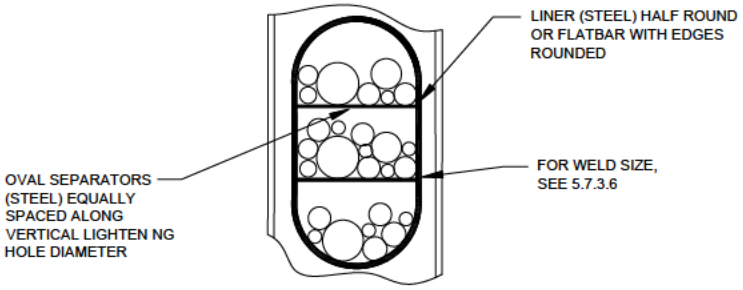
SIDE VIEW FOR METHOD 4B-43-1
CABLES SUPPORTED BETWEEN SHIPS LONGITUD NALS
THROUGH SHIPS TRANVERSE FRAMING - SIDE VIEW



LIGHTENING HOLE VIEW FOR METHOD 4B-43-1
VIEW SHOWING LIGHTENING HOLE LINER ASSEMBLY
WITH CABLE GROUPING



NOTES:

1. The number of hangers in groups between longitudinals shall be determined on a basis of the number of cables that can be suitably carried through lightening holes in the transverse webs.
2. For the inspection and painting of the ship's shell plating, clearance shall be provided between the top of the hanger and the ship's longitudinal above the hanger installation and between the hanger and the ship's longitudinal below the hanger installation.
3. Three cableway rows may be installed in congested locations on request and are subject to specific approval by NAVSEA.
4. See 5.7.3.7 for fastener and fastener material requirements.
5. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4B44. Multiple cableways in machinery spaces (surface ships).

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METHOD 4B-45-1

CABLES THROUGH CONDUIT; WATERTIGHT INSTALLATIONS IN NON-HAZARDOUS LOCATIONS

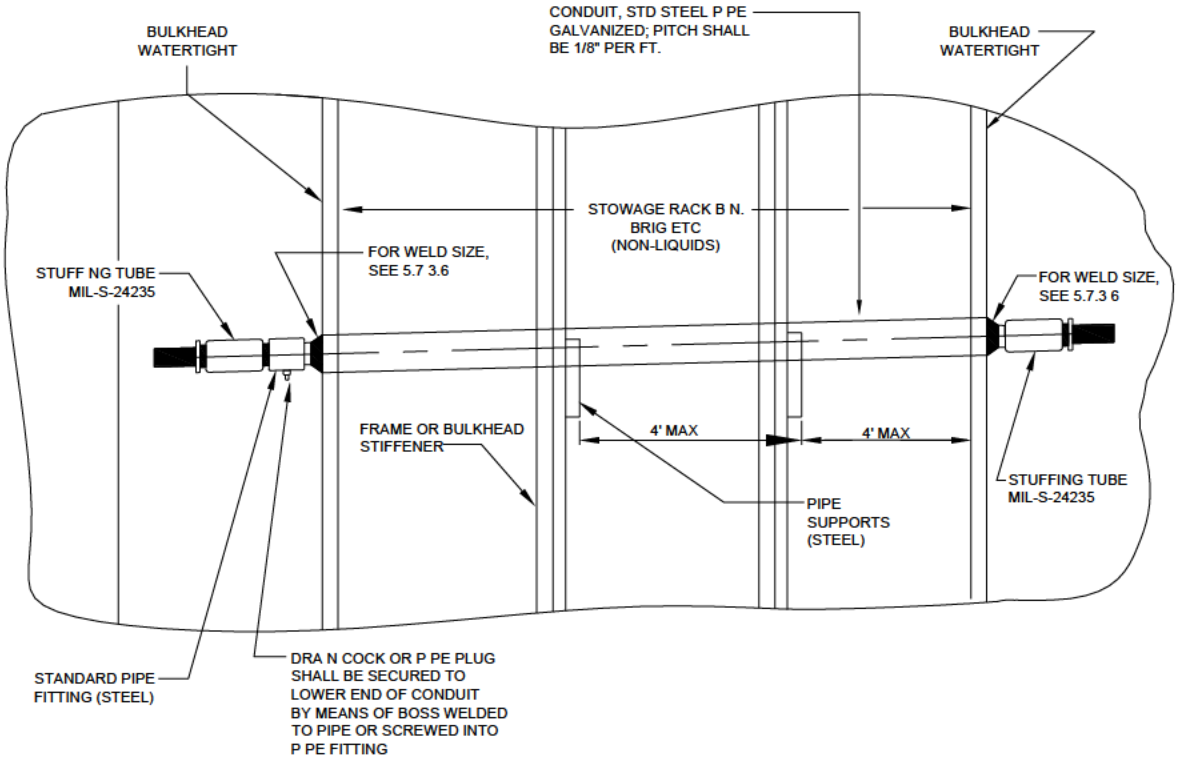

FIGURE 4B45. Cableways through storage spaces and tanks (surface ships).

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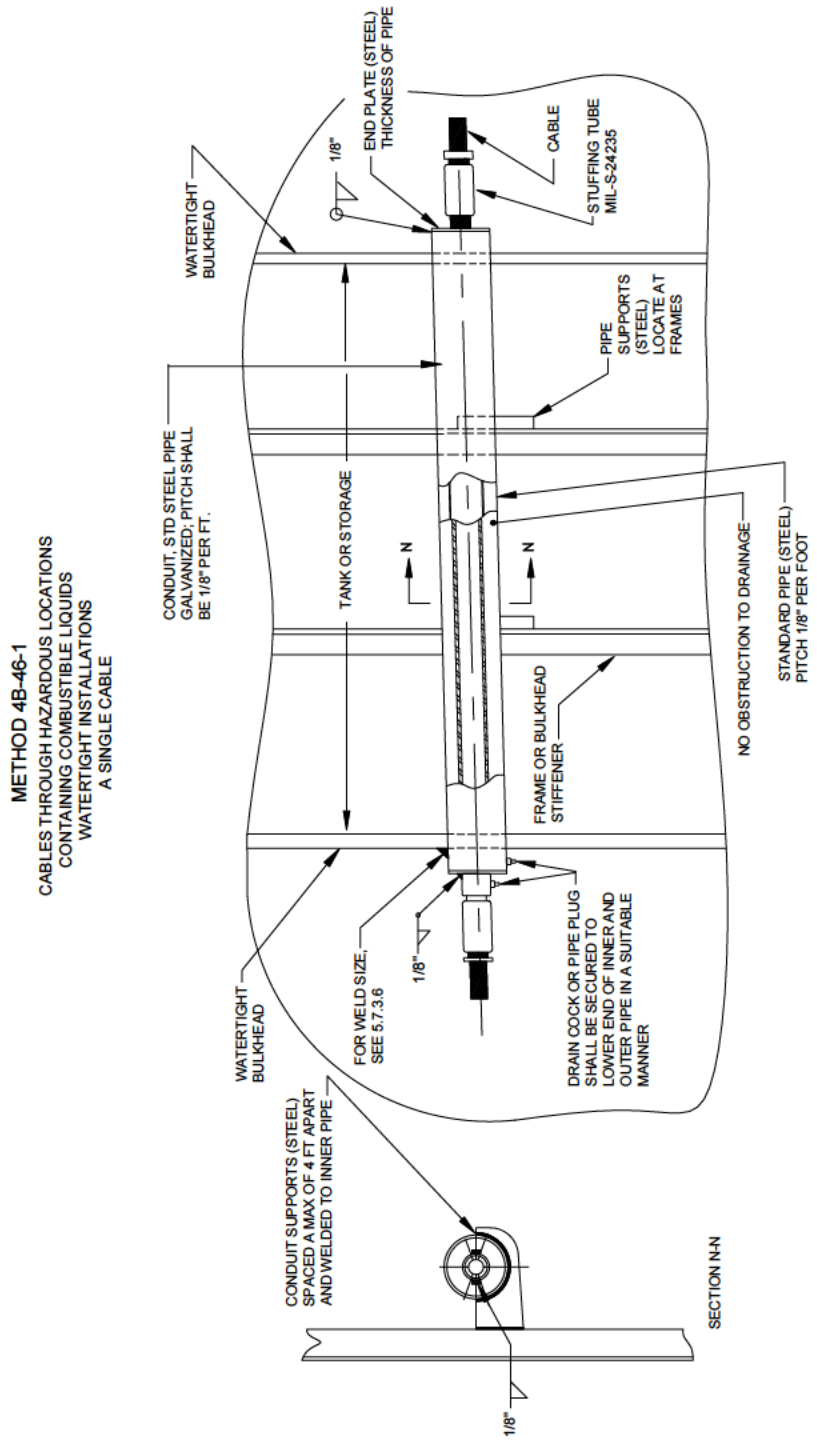

FIGURE 4B46. Cableways through storage spaces and tanks (surface ships).

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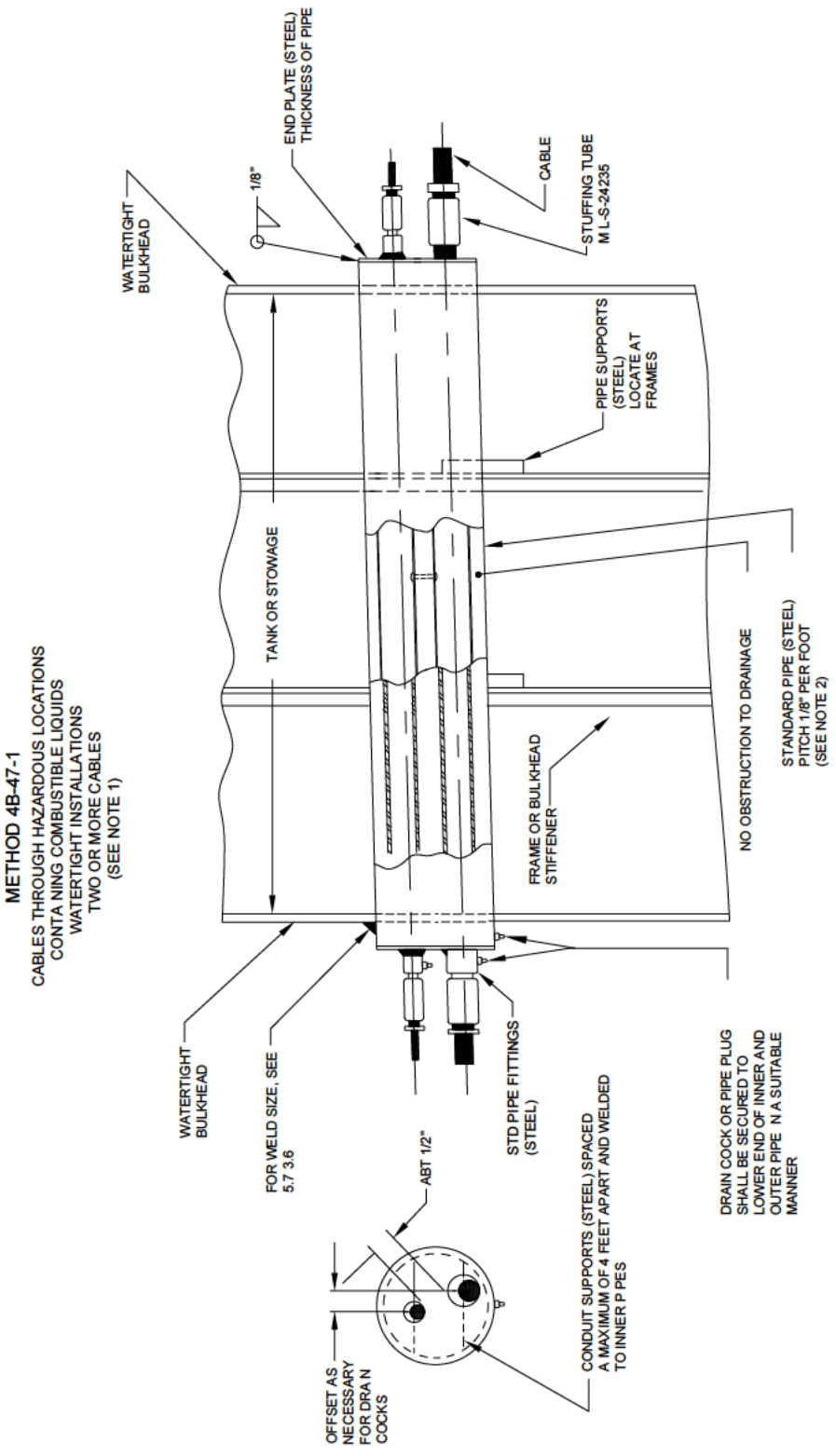

FIGURE 4B47. Cableways through storage spaces and tanks (surface ships).

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NOTES:

1. Up to three cables may be used in the inner pipe, provided no more than two simultaneously loaded cables are contiguous to each other. The protruding inner pipe with the riser tops shall be welded directly to the end plate as shown in this figure.
2. The standard pipe for this figure shall be clean and free of all foreign contamination.

FIGURE 4B47. Cableways through storage spaces and tanks (surface ships) – Continued.

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METHOD 4B-48-1
CABLES THROUGH CONDUIT; NON-WATERTIGHT INSTALLATIONS N NON-HAZARDOUS LOCATIONS

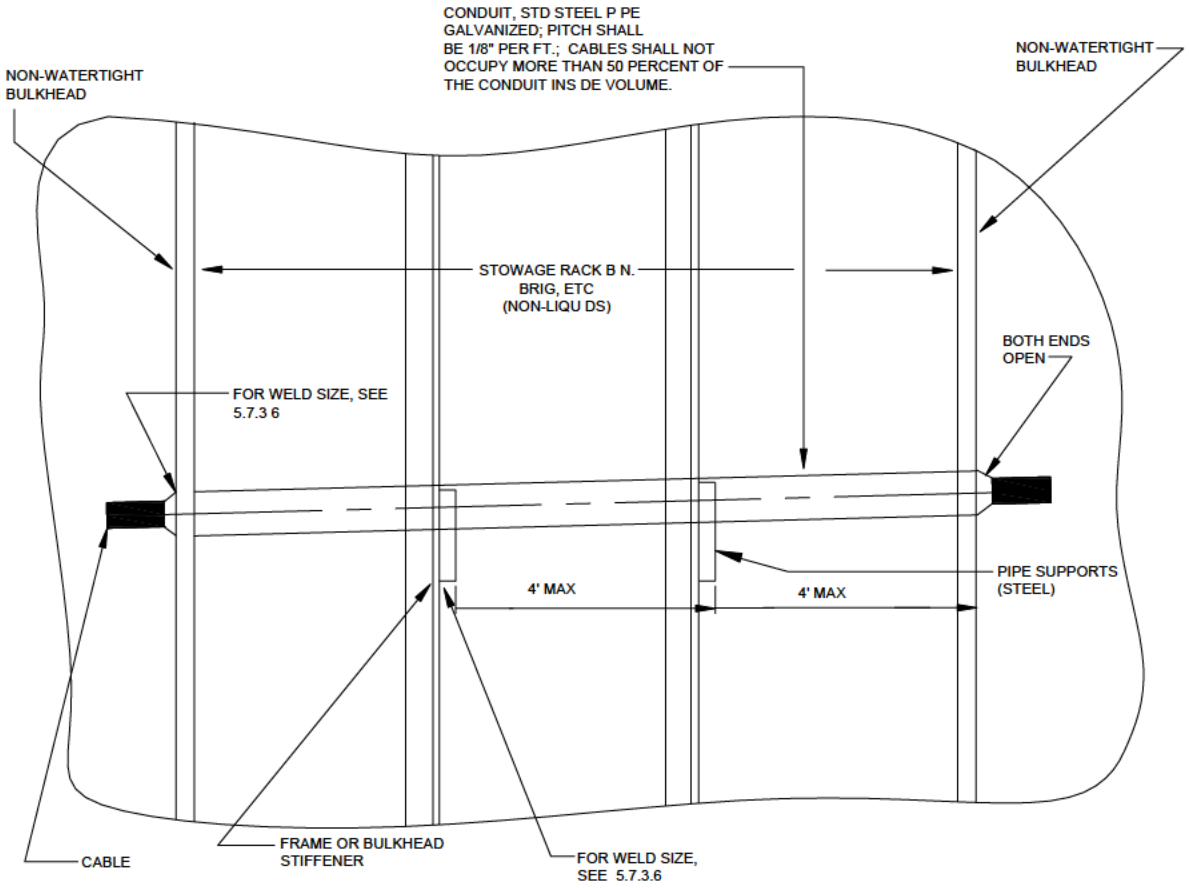

FIGURE 4B48. Cableways through storage spaces and tanks (surface ships).

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METHOD 4B-49-1
CABLES IN TRUNKS (W.T. OR O LTIGHT)
MAY BE USED FOR F RE PROTECTION

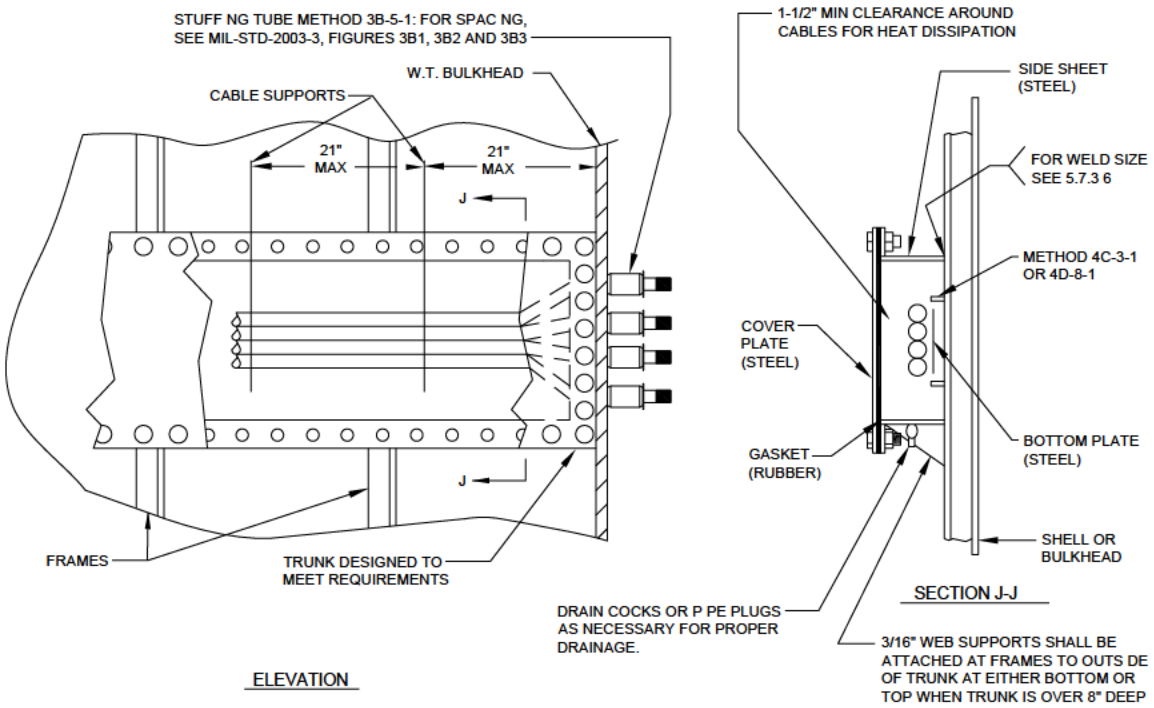

FIGURE 4B49. Cableways through trunks and channels (surface ships).

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METHOD 4B-50-1
CABLES N CHANNEL

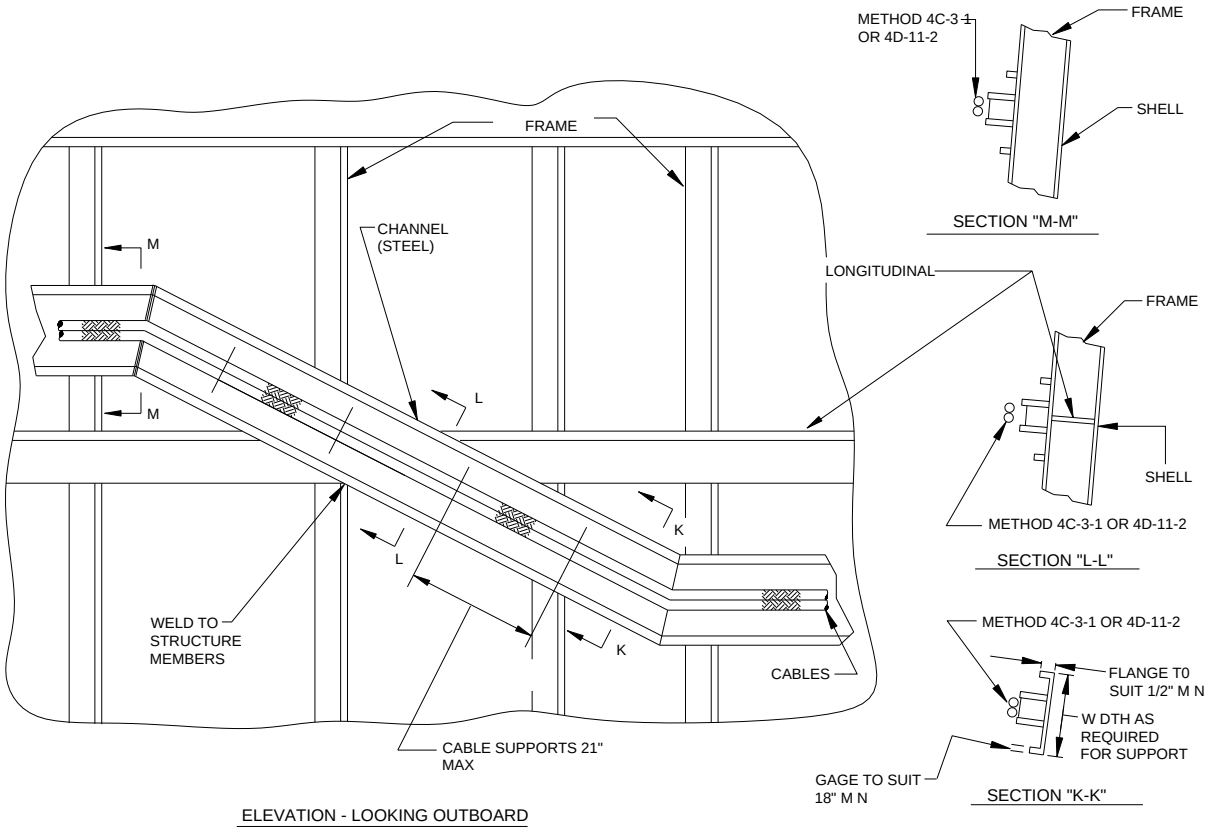

FIGURE 4B50. Cableways through trunks and channels (surface ships).

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METHOD 4B-51-1
CABLES THROUGH VOID SPACES NOT SUBJECT TO FLOODING

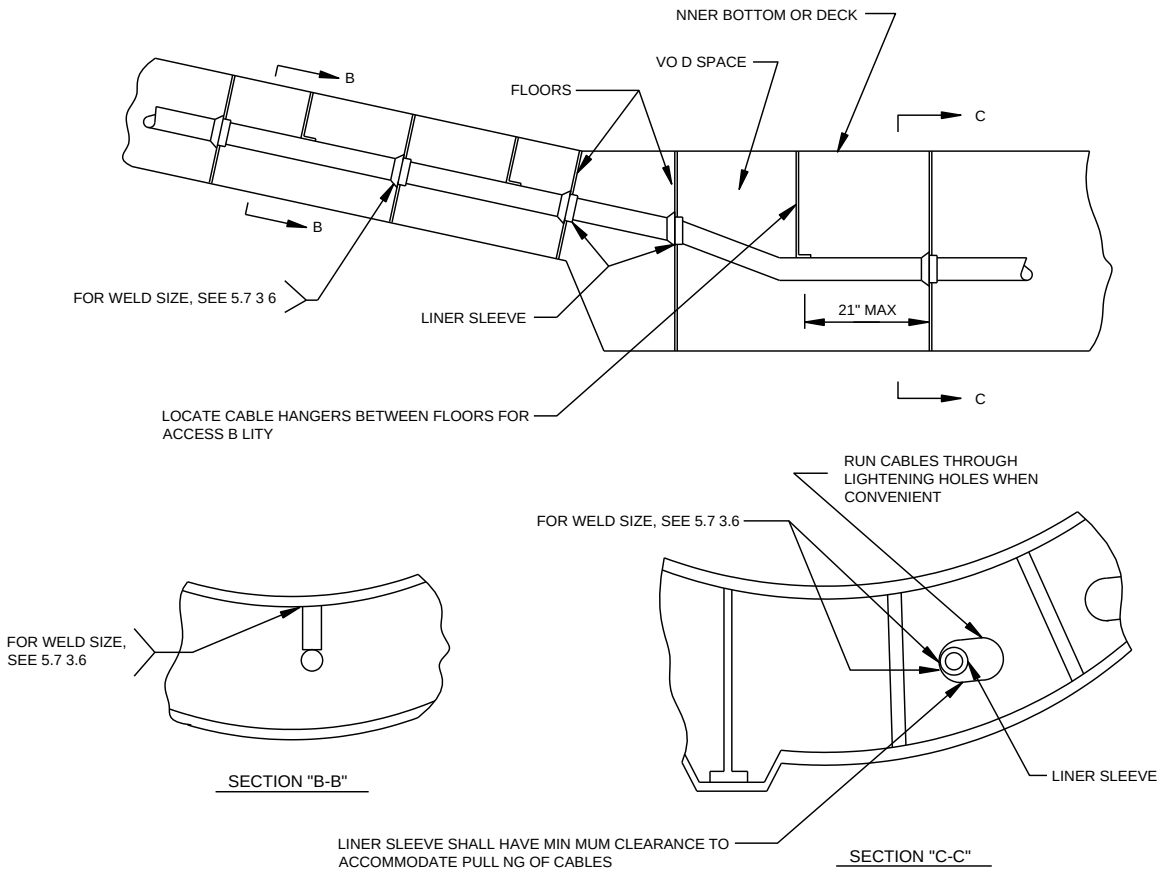

FIGURE 4B51. Cables through trunks and channels (surface ships).

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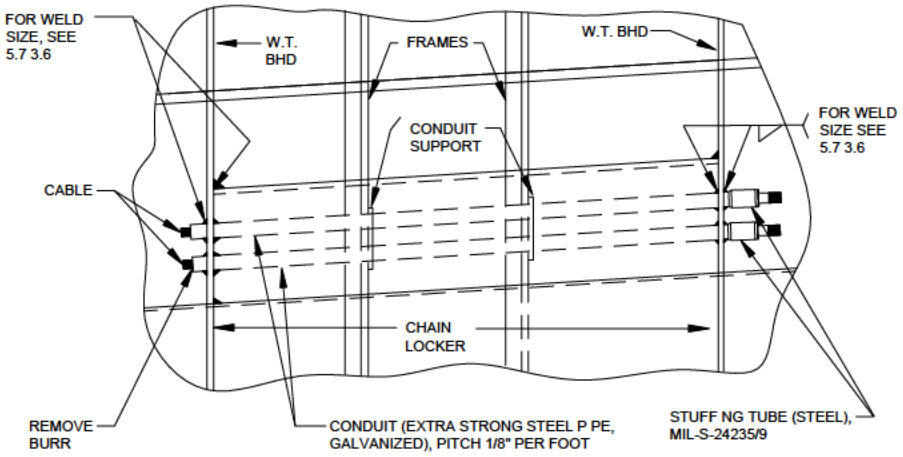
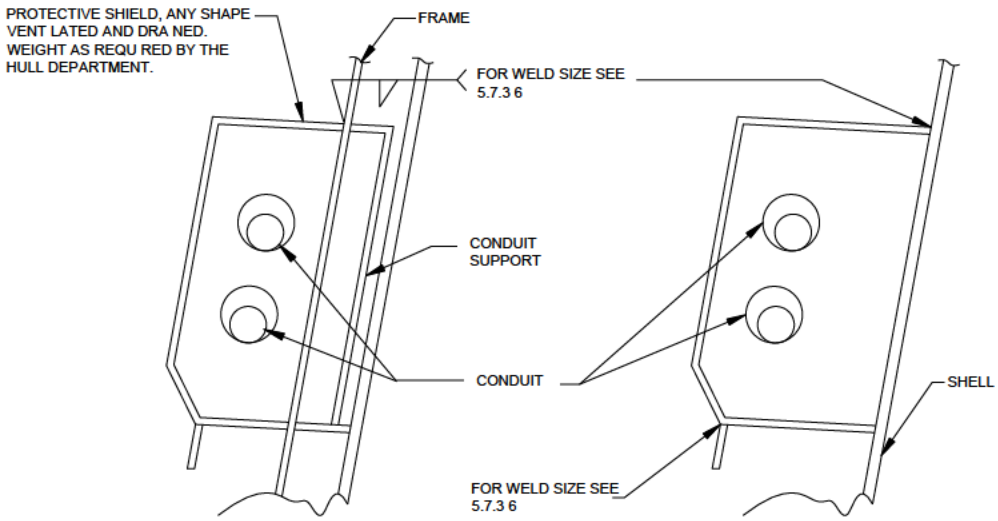
METHOD 4B-52-1
CABLES THROUGH CHAIN LOCKERS
(SEE NOTE 1)



ELEVATION LOOKING OUTBOARD

SECTION VIEWS
CABLES THROUGH CHA N LOCKERS



SECTION AT FRAME

SECTION BETWEEN FRAMES

ELEVATION LOOK NG OUTBOARD

NOTE:

1. Up to three cables may be used in the inner pipe, provided no more than two simultaneously loaded cables are contiguous to each other. The protruding inner pipe with the riser tops shall be welded directly to the end plate as shown in this figure.

FIGURE 4B52. Cableways through trunks and channels (surface ships).

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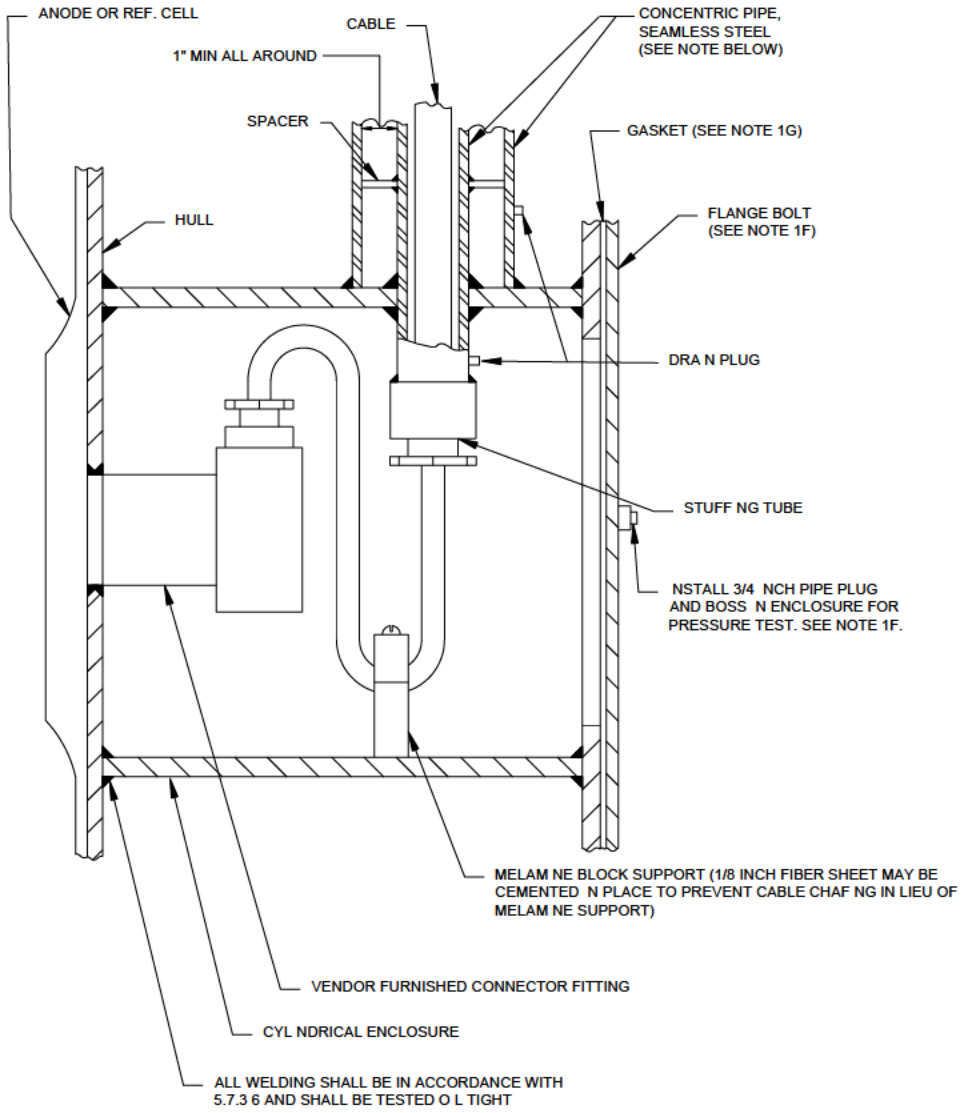
METHOD 4B-53-1
CABLE THROUGH CONDUIT IN FUEL OIL TANKS
WATERTIGHT NSTALLATION - SINGLE CABLE
(SEE NOTE 1)



NOTES:

1. For cableways through fuel oil tanks for cathodic protection system:
   a. Install ¾-inch pipe plug and boss in enclosure for pressure test.
   b. All welding shall be in accordance with 5.7.3.6 and shall be tested oiltight.
   c. An alternate location for access opening is on side filler plate requiring a heavier plate.
   d. Access cover shall be 2 inches greater than access opening all around.
   e. Fiber sheet (⅛ inch thick) may be cemented in place to prevent cable chafing in lieu of melamine support.
   f. All bolts, nuts, washers, and plugs shall be of a corrosive resistant material.
   g. Gasket material shall be compatible with tank fuel in accordance with S9086-CM-STM-020/078.

FIGURE 4B53. Cableways through fuel oil tanks for cathodic protection system (surface ships).

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NOTES (continued):

2. The inner concentric pipe shall be galvanized. The outer concentric pipe shall be painted to conform to the tank paint system.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B53. Cableways through fuel oil tanks for cathodic protection system (surface ships) – Continued.

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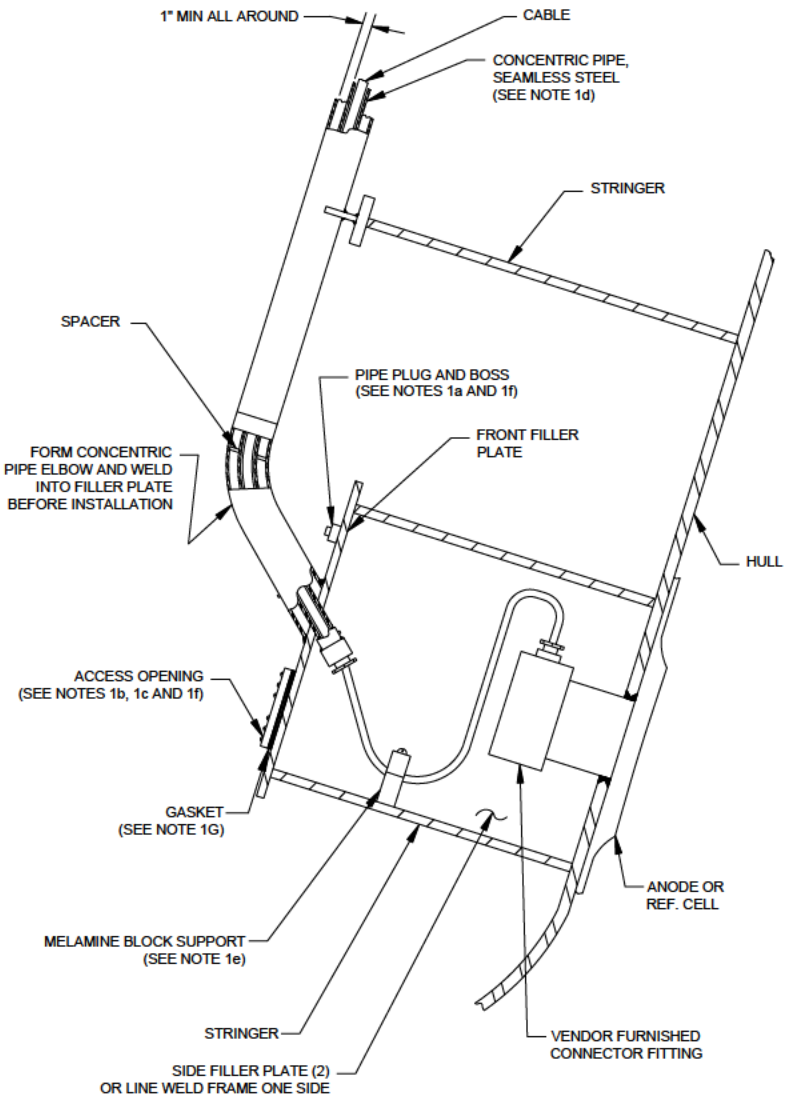
METHOD 4B-54-1
CABLE THROUGH CONDUIT N FUEL O L TANKS
WATERTIGHT NSTALLATION - SINGLE CABLE
ALTERNATE ENCLOSURE METHOD
(US NG STRINGERS OF LONGITUDINALS)



NOTES:

1. For cableways through fuel oil tanks for cathodic protection system:
   a. Install ¾-inch pipe plug and boss in enclosure for pressure test.
   b. An alternate location for access opening is on side filler plate requiring a heavier plate.
   c. Access cover shall be 2 inches greater than access opening all around.
   d. The inner concentric pipe shall be galvanized. The outer concentric pipe shall be painted to conform to the tank paint system.
   e. Fiber sheet (⅛ inch thick) may be cemented in place to prevent cable chafing in lieu of melamine support.
   f. All bolts, nuts, washers, and plugs shall be of a corrosive resistant material.
   g. Gasket material shall be compatible with tank fuel in accordance with S9086-CM-STM-020/078.

FIGURE 4B54. Cableways through fuel oil tanks for cathodic protection system (surface ships) – alternate method.

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NOTES (continued):

2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B54. Cableways through fuel oil tanks for cathodic protection system (surface ships) – alternate method – Continued.

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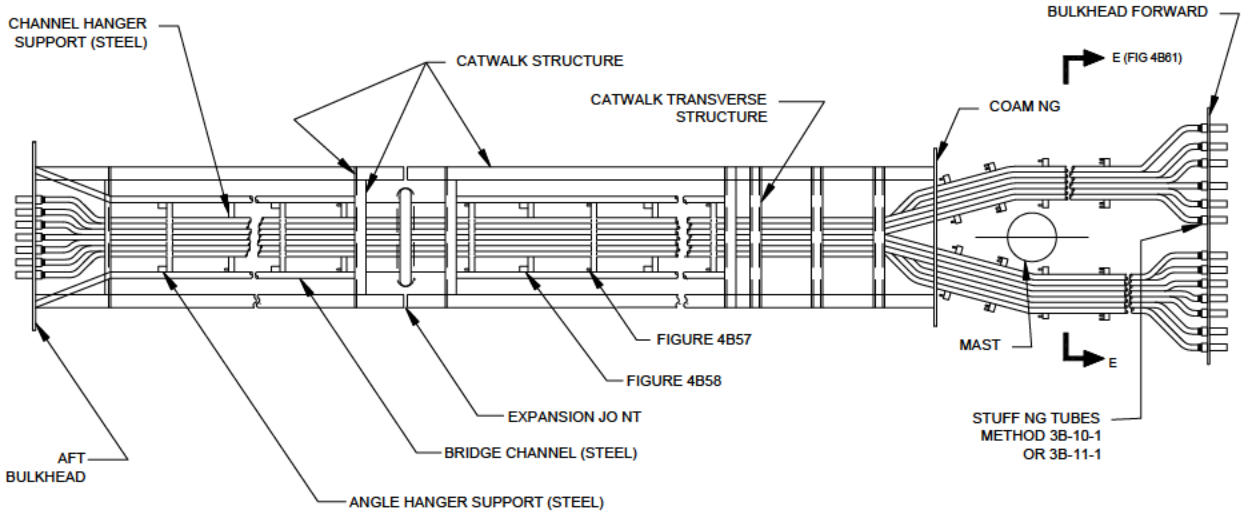
METHOD 4B-55-1
CABLES UNDER CATWALKS
FREE OF PIPING
SEE NOTES 1 THROUGH 4



PLAN VIEW
PROTECTIVE PLATES REMOVED

NOTES:

1. All mild steel material used for supporting and protecting cables under catwalk shall be zinc-coated after drilling and prior to installation. The complete installation shall be painted.
2. Bolts used to secure protective sheath shall be spaced approximately 6 inches on center. Sections of protective sheathing shall be five-pound plate and shall not exceed approximately 64 inches in length (side and bottom of wireway).
3. Sufficient slack in cables shall be provided for working of expansion joint. Allow 2 inches minimum clearance between cables and bottom framing.
4. The fire installation detail on figure 4B55 shall be installed in accordance with 803-5184182.
5. Methods 3B-10-1, “Single or Multiple Cables Through Protective Decks Overhead with Insulation and Sheathing”, and 3B-11-1, “Cables Through Permanent Sections of False Decks”, are from MIL-STD-2003-3.

FIGURE 4B55. Topside cableways on tankers.

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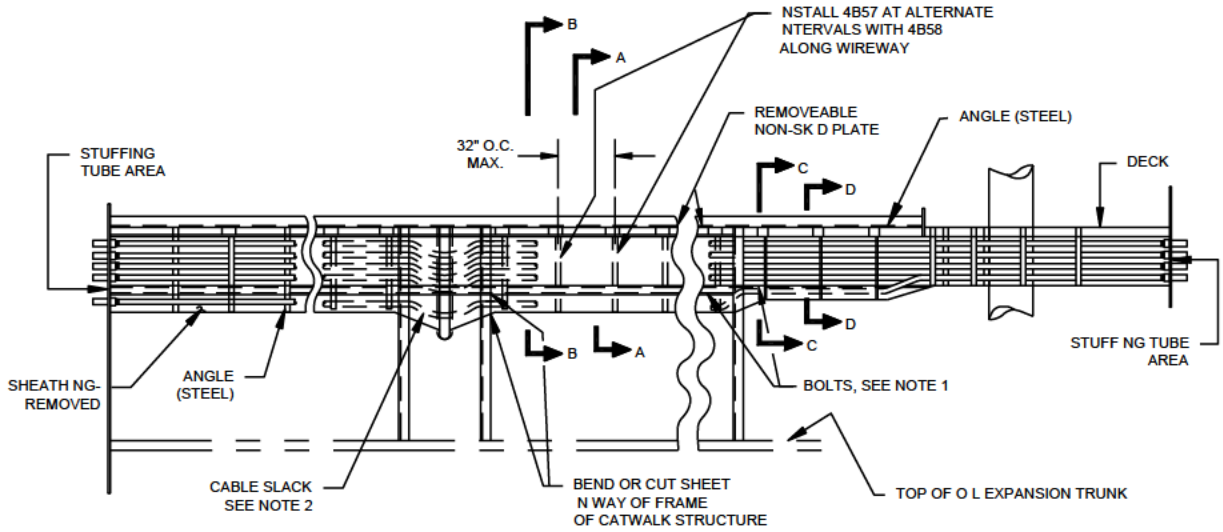
ELEVATION VIEW FOR METHOD 4B-56-1
CABLES UNDER CATWALKS
FREE OF PIPING
SEE FIGURE 4B55 FOR PLAN VIEW



ELEVATION
FOR SECTION AND DETA L V EWS
SEE FIGURES 4B57 THRU 4B60

NOTES:

1. Bolts used to secure protective sheath shall be spaced approximately 6 inches on center. Sections of protective sheathing shall be five-pound plate and shall not exceed approximately 64 inches in length (side and bottom of wireway).
2. Provide sufficient slack in cables for working of expansion joint. Allow 2 inches minimum clearance between cables and bottom framing.

FIGURE 4B56. Topside cableways on tankers – elevation view.

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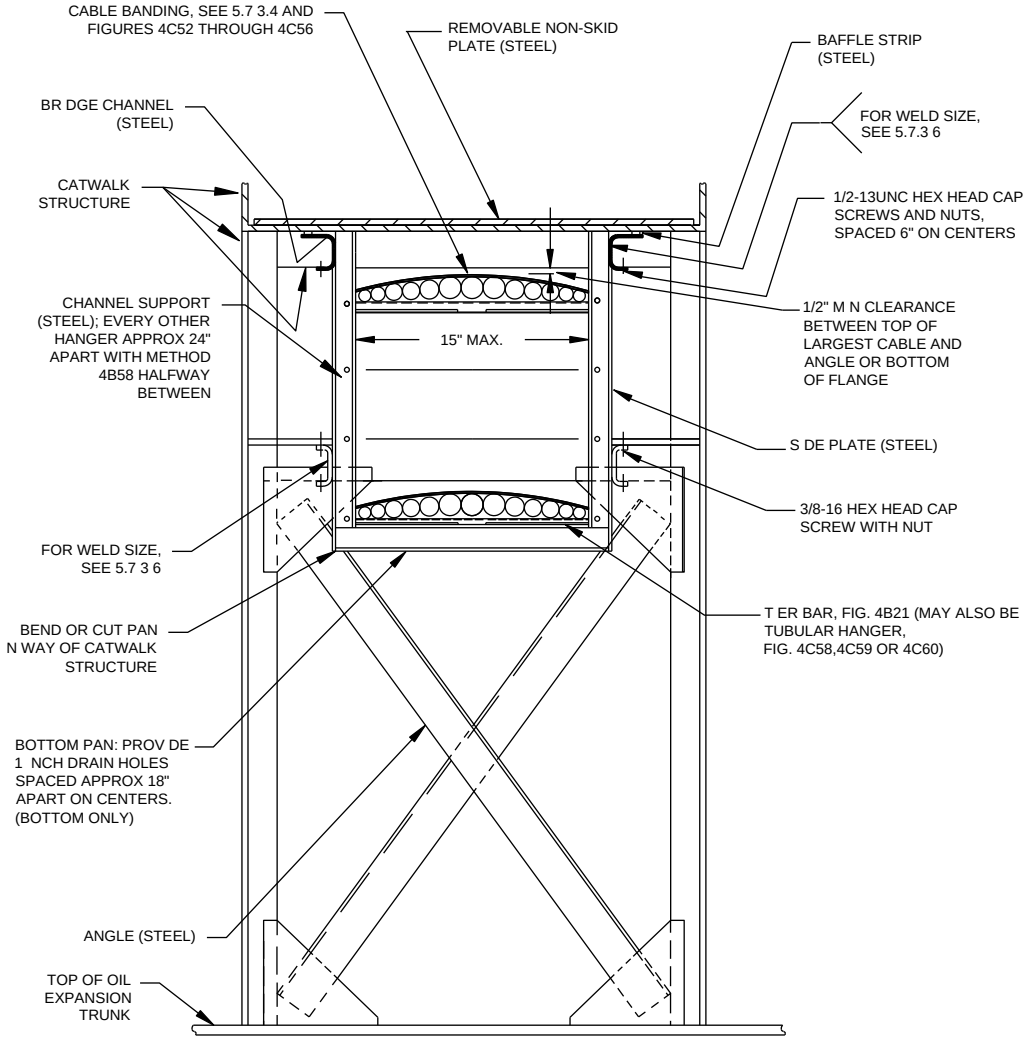
SECTION A-A FOR FIGURE 4B56
VIEW SHOW NG SUPPORT OF CABLES AND SHEATHING
USING SQUARE TUBE HANGERS
ATTACHED TO BRIDGE CHANNELS



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B57. Topside cableways on tankers – section “A-A”.

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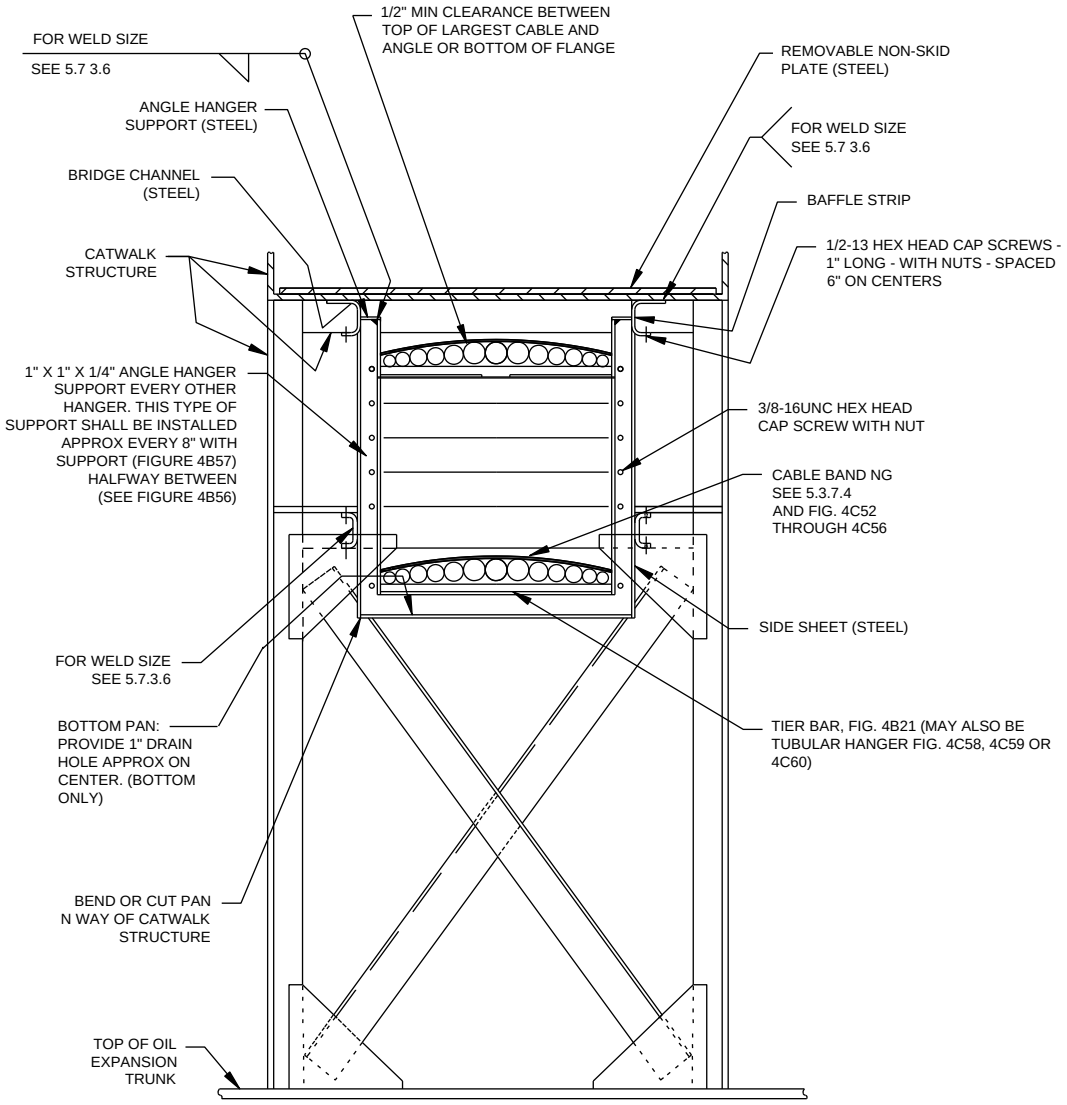
SECTION B-B FOR FIGURE 4B56
VIEW SHOWING SUPPORT OF CABLES
USING ANGLE HANGER SUPPORT
SHEATH NG NOT ATTACHED TO HANGER



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B58. Topside cableways on tankers – section "B-B".

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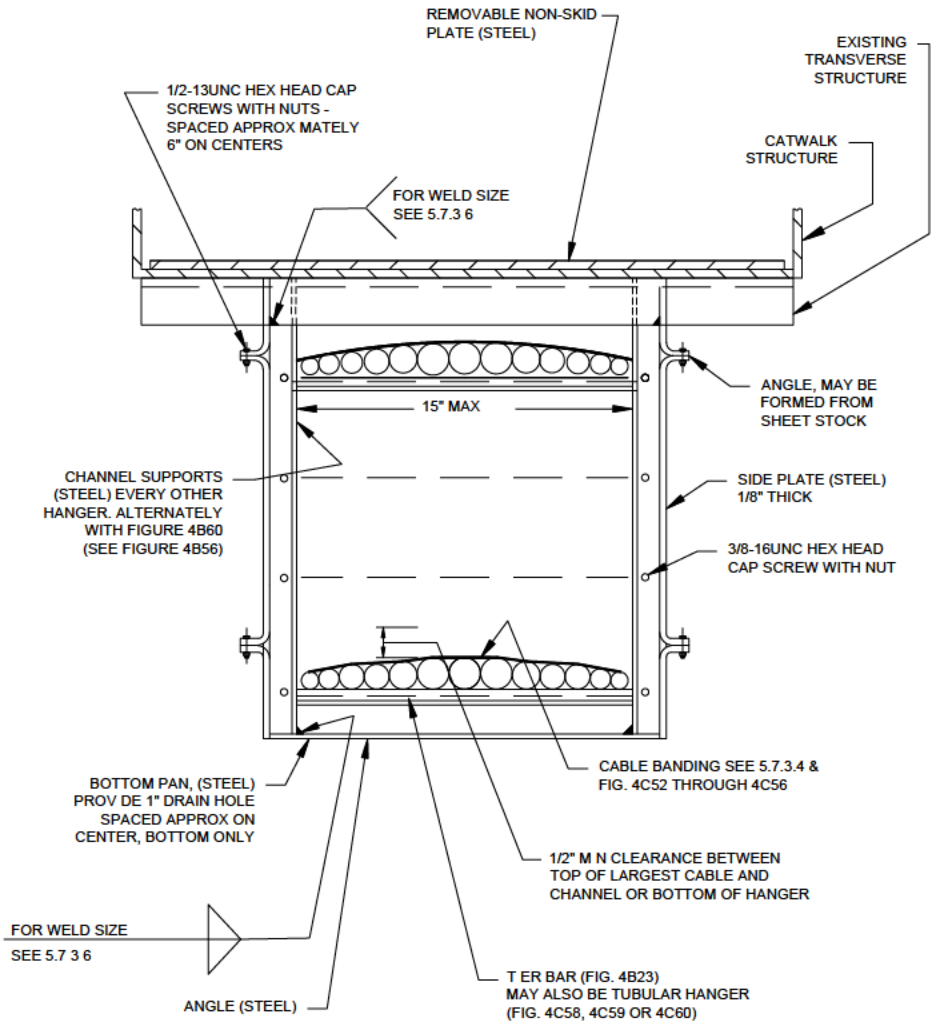
SECTION C-C FOR FIGURE 4B56
V EW SHOW NG CHANNEL HANGER SUPPORT
SUSPENDED FROM CATWALK TRANSVERSE STRUCTURE



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B59. Topside cableways on tankers – section "C-C".

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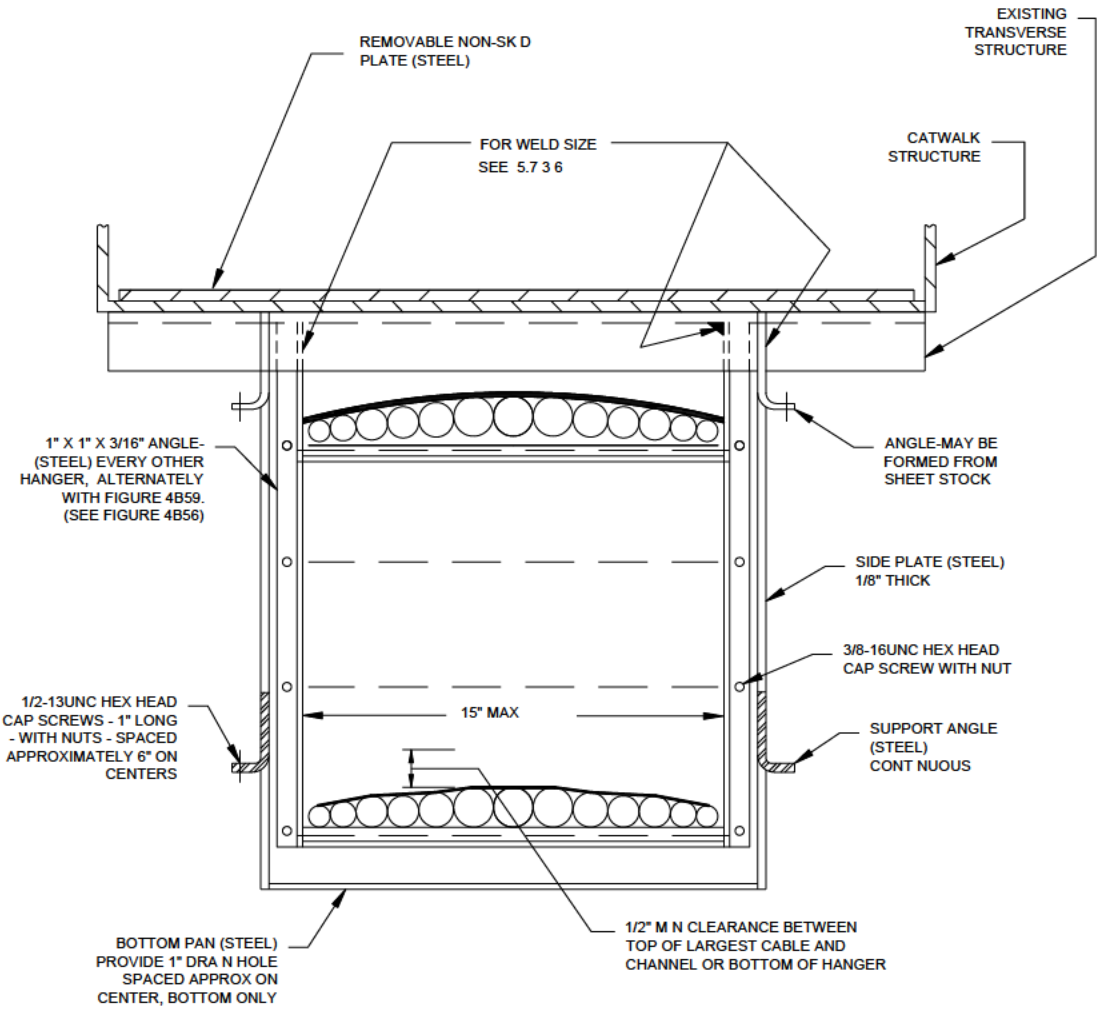
SECTION D-D FOR FIGURE 4B56
V EW SHOW NG CHANNEL HANGER SUPPORT
SUSPENDED FROM CATWALK TRANSVERSE STRUCTURE



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B60. Topside cableways on tankers – section "D-D".

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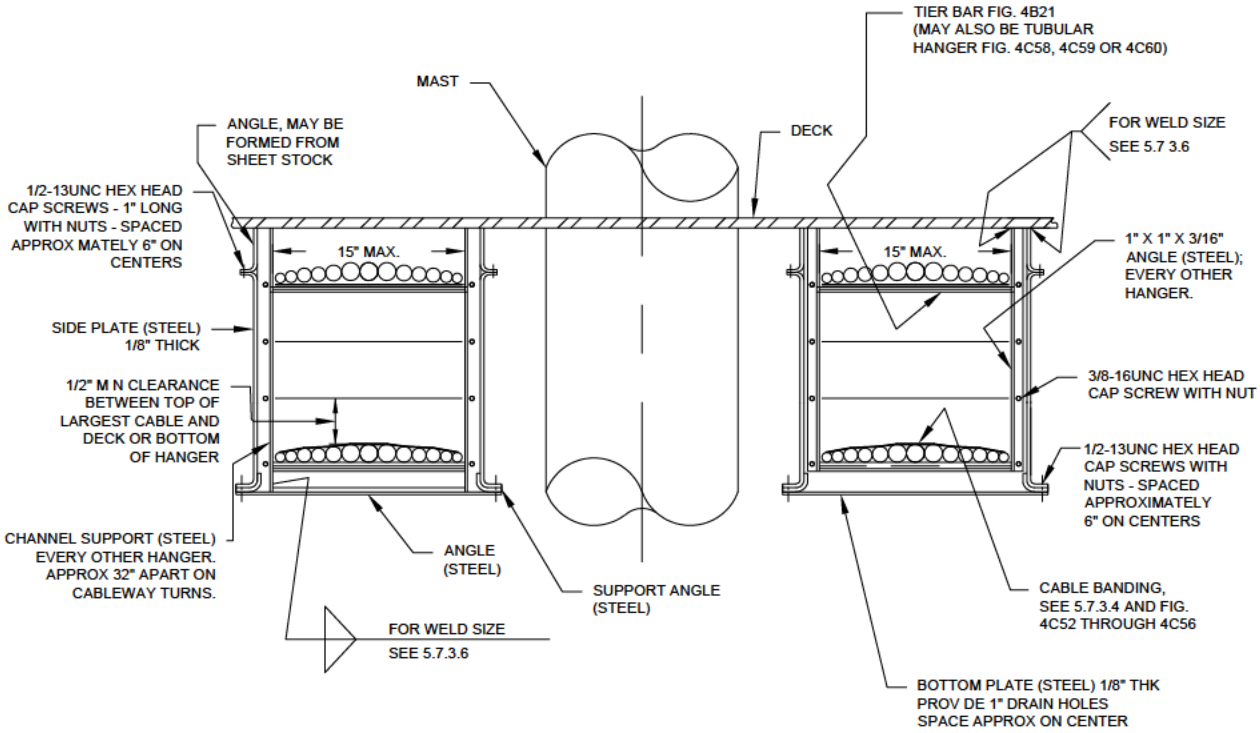
SECTION E-E FOR FIGURE 4B55
VIEW SHOWING CABLEWAY
DIVIDED TO PASS AN OBSTRUCTION



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B61. Topside cableways on tankers – divided to pass obstruction.

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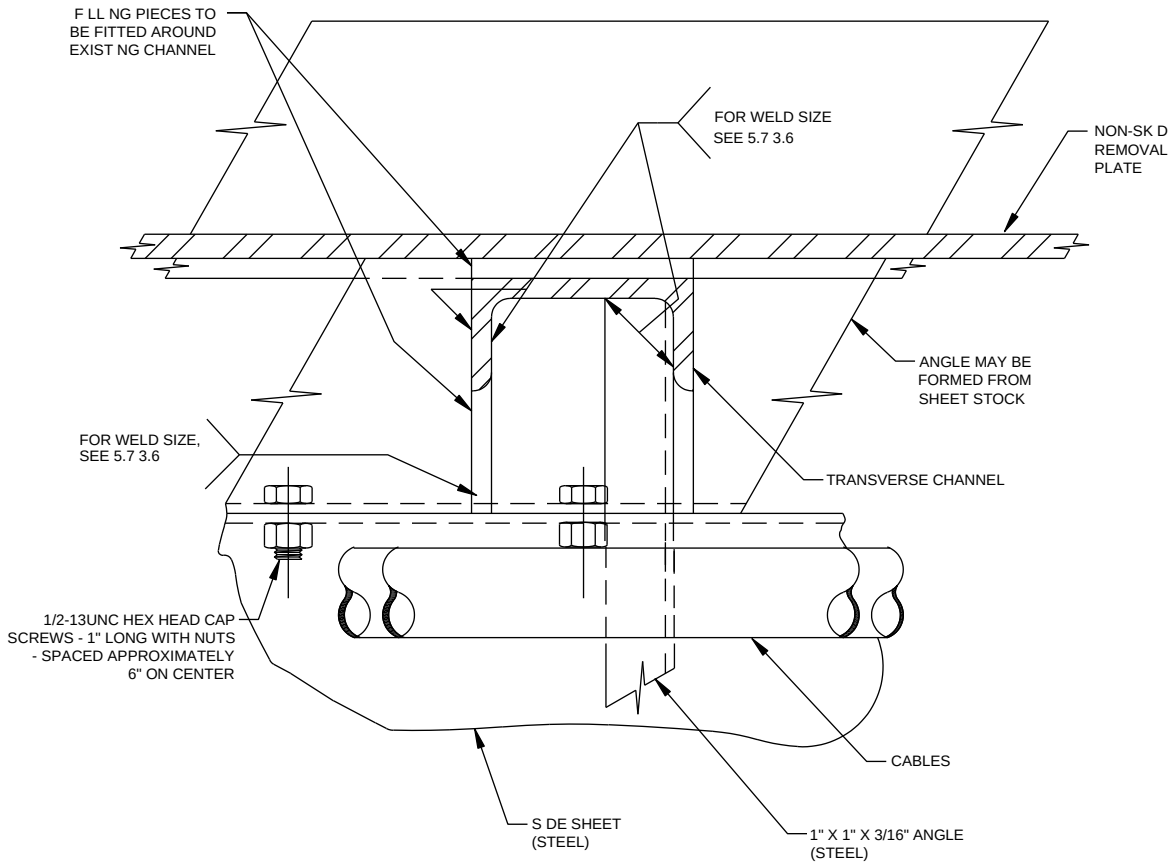
METHOD 4B-62-1
V EW SHOWING HANGER SUPPORT
ATTACHED TO TRANSVERSE MEMBER
SEE METHOD 4B-55-1



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B62. Topside cableways on tankers.

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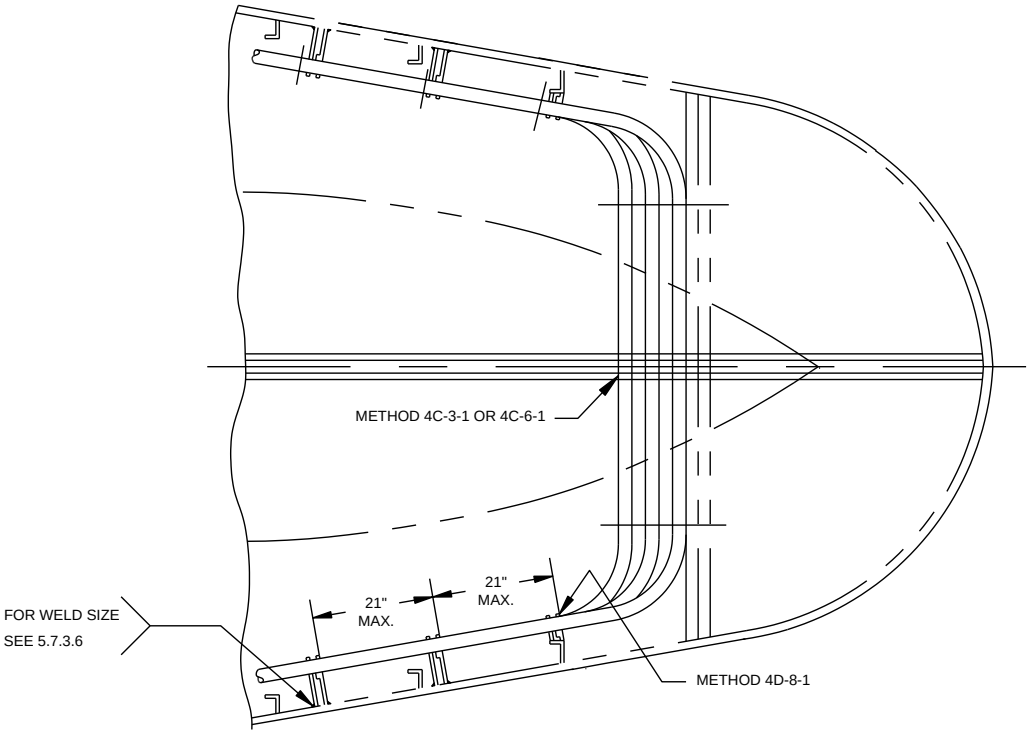
METHOD 4B-63-1
CABLES IN TURN OF BOW ATTACHMENT TO G RDER
METHOD MAY BE USED FOR GENERAL NSTALLATION
WHERE APPLICABLE (SEE NOTE 1)



PLAN VIEW
SEE FIGURES 4B64 AND 4B65 FOR ELEVATION V EWS

NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B63. Cable support for degaussing cables (surface ships) – plan view.

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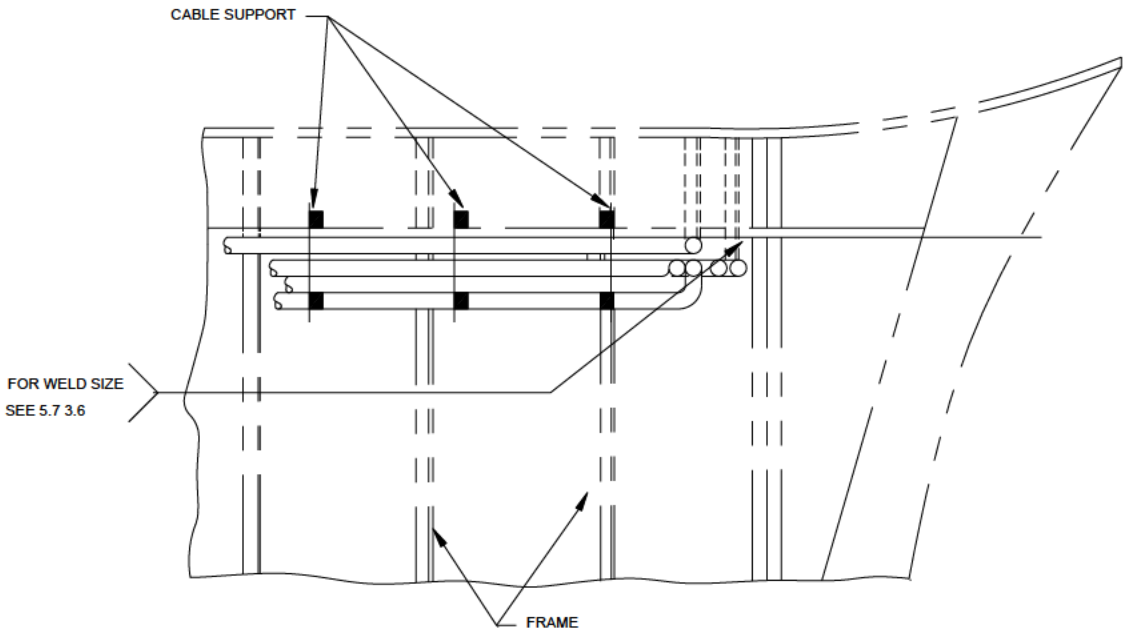
ELEVATION FOR METHOD 4B-63-1
CABLES IN TURN OF BOW ATTACHMENT TO G RDER
METHOD MAY BE USED FOR GENERAL INSTALLATION
WHERE APPLICABLE (SEE NOTE 1)



ELEVATION LOOK NG OUTBOARD
(SEE FIGURE 4B63 FOR PLAN V EW)

NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B64. Cable support for degaussing cables (surface ships) – elevation looking outboard.

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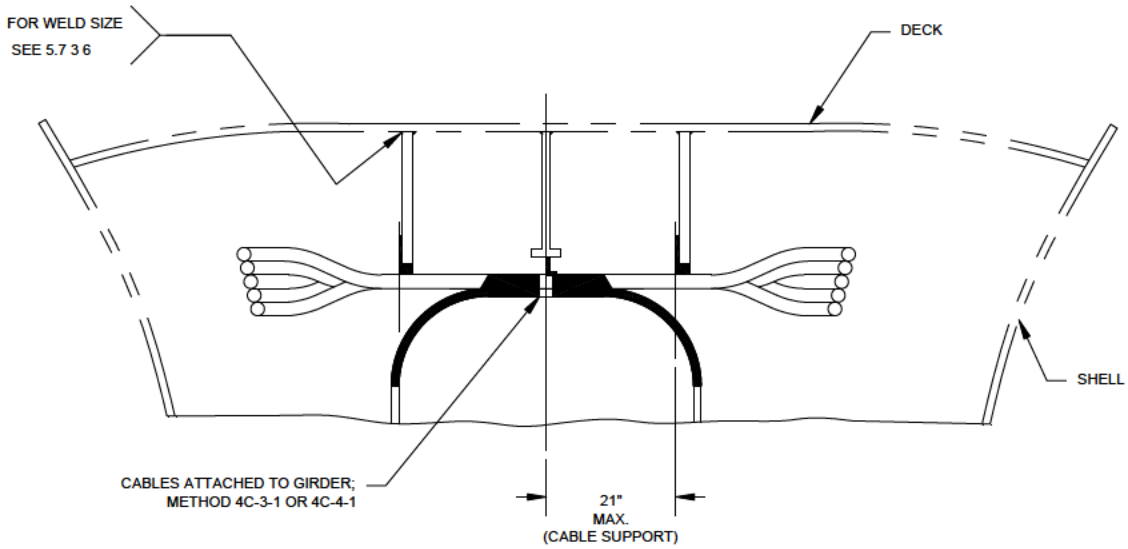
TYPICAL FRAME FOR METHOD 4B-63-1
CABLES IN TURN OF BOW
ATTACHMENT TO GIRDER
(SEE NOTE 1)



TYPICAL FRAME - LOOKING FORWARD
(SEE FIGURE 4B63 FOR PLAN VIEW)

NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B65. Cable support for degaussing cables (surface ships) – typical frame.

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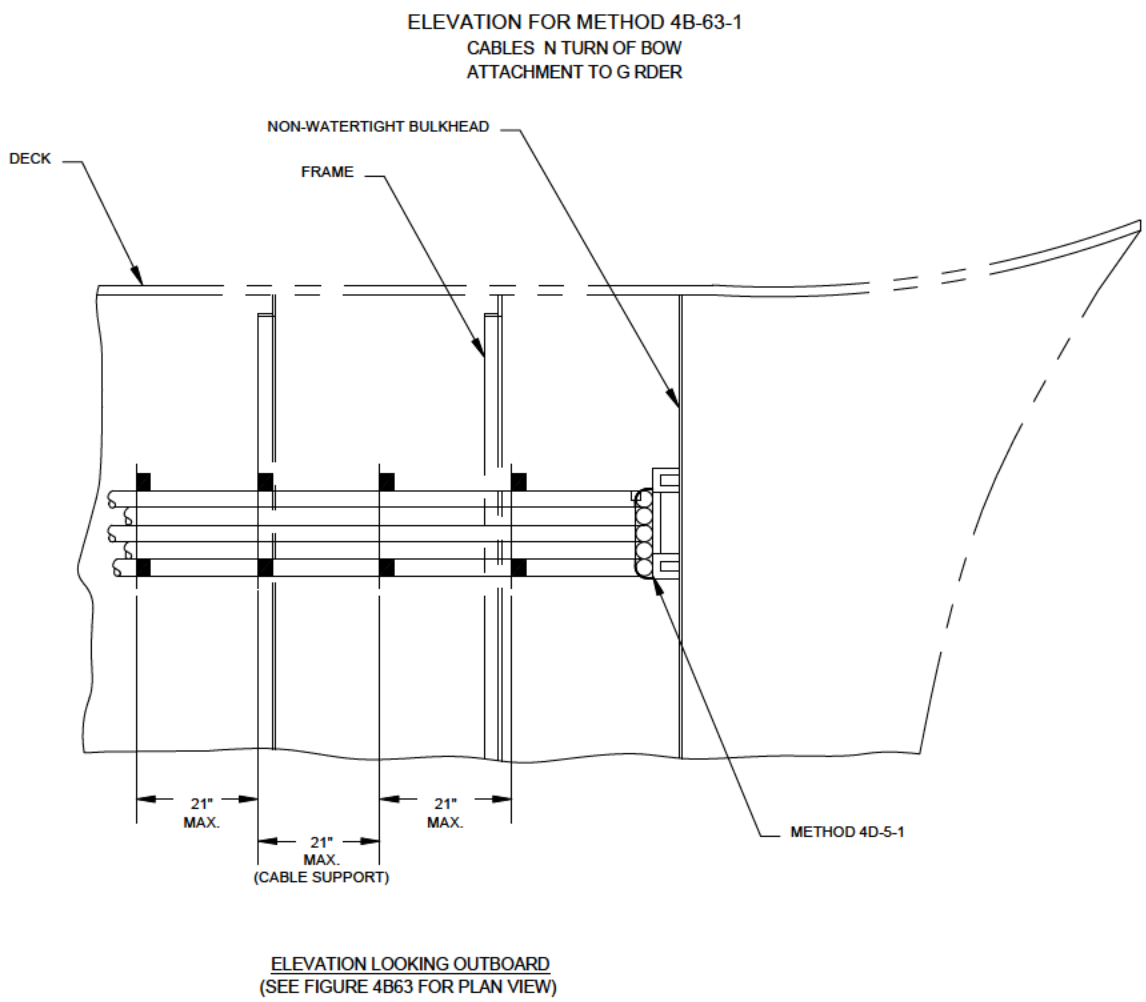

FIGURE 4B66. Cable support for degaussing cables (surface ships) – elevation looking outboard.

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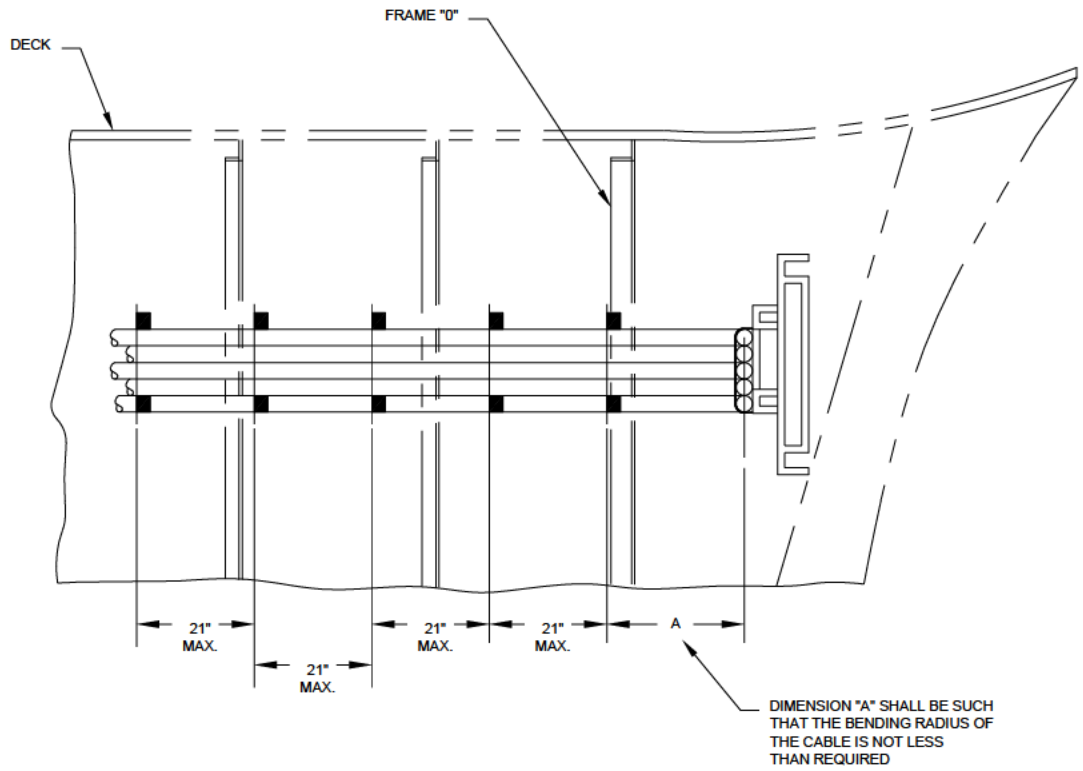
METHOD 4B-67-1
CABLES IN TURN OF BOW
EXTENDING FORWARD OF FRAME "0"
(SEE NOTE 1)



NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B67. Cable support for degaussing cables (surface ships) – elevation looking outboard.

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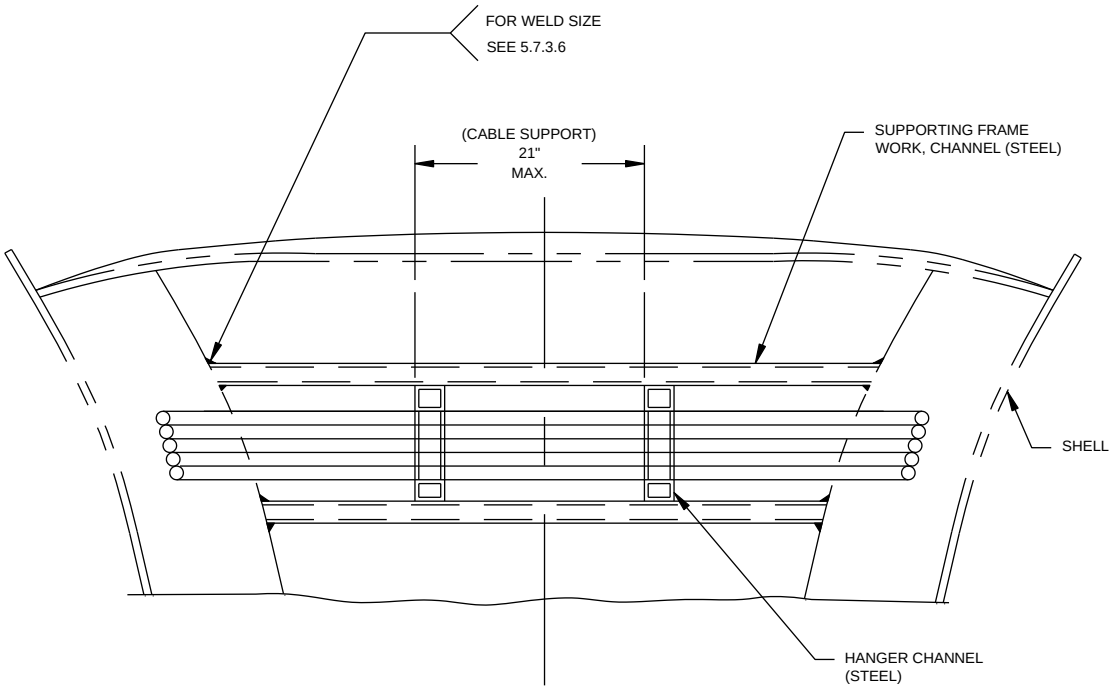
TYPICAL FRAME (LOOKING FORWARD) FOR METHOD 4B-67-1
CABLES IN TURN OF BOW
ATTACHMENT TO BULKHEAD



TYPICAL FRAME LOOKING FORWARD

FIGURE 4B68. Cable support for degaussing cables (surface ships) – typical frame.

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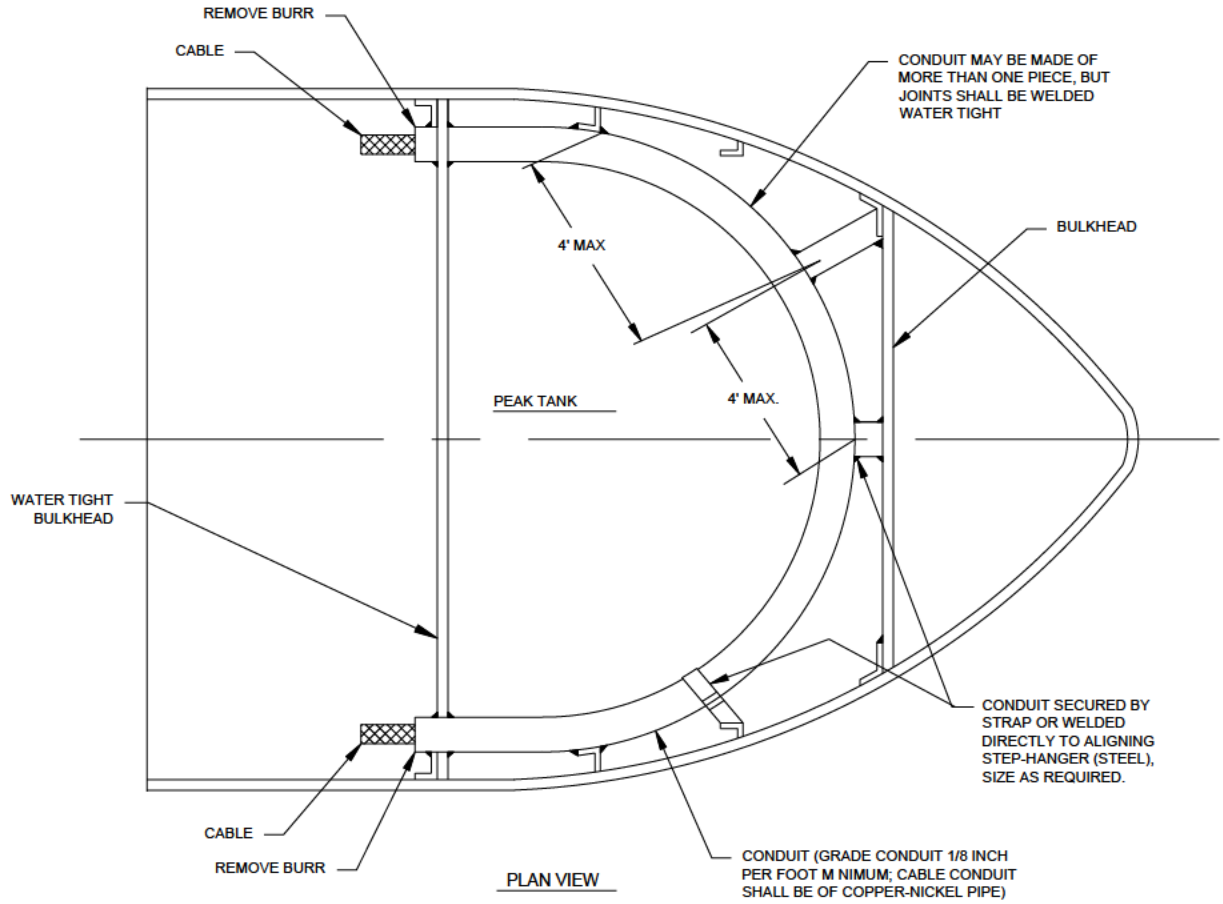
METHOD 4B-69-1
CABLES IN TURN OF BOW THROUGH CONDUIT
METHOD MAY BE USED FOR GENERAL INSTALLATION WHERE APPLICABLE
(SEE NOTE 1)



NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B69. Cable support for degaussing cables (surface ships).

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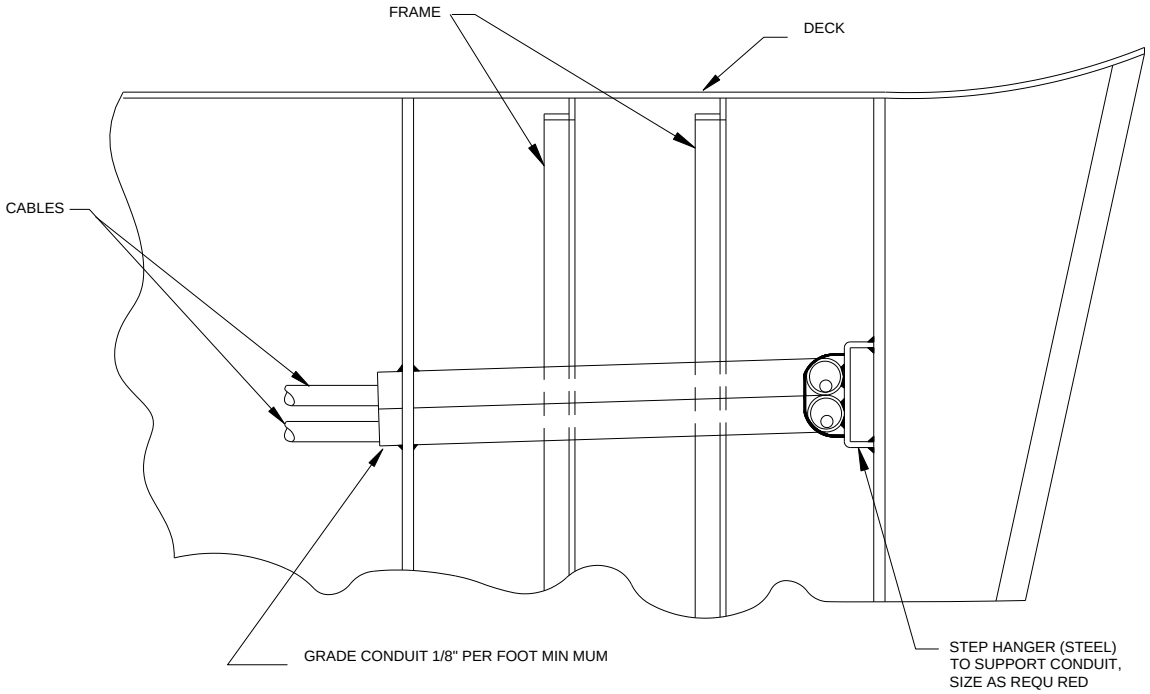
ELEVATION VIEW (LOOKING OUTBOARD) FOR METHOD 4B-69-1
CABLES IN TURN OF BOW THROUGH CONDUIT



ELEVATION LOOKING OUTBOARD
(SEE 4B69 FOR PLAN VIEW)

FIGURE 4B70. Cable support for degaussing cables (surface ships).

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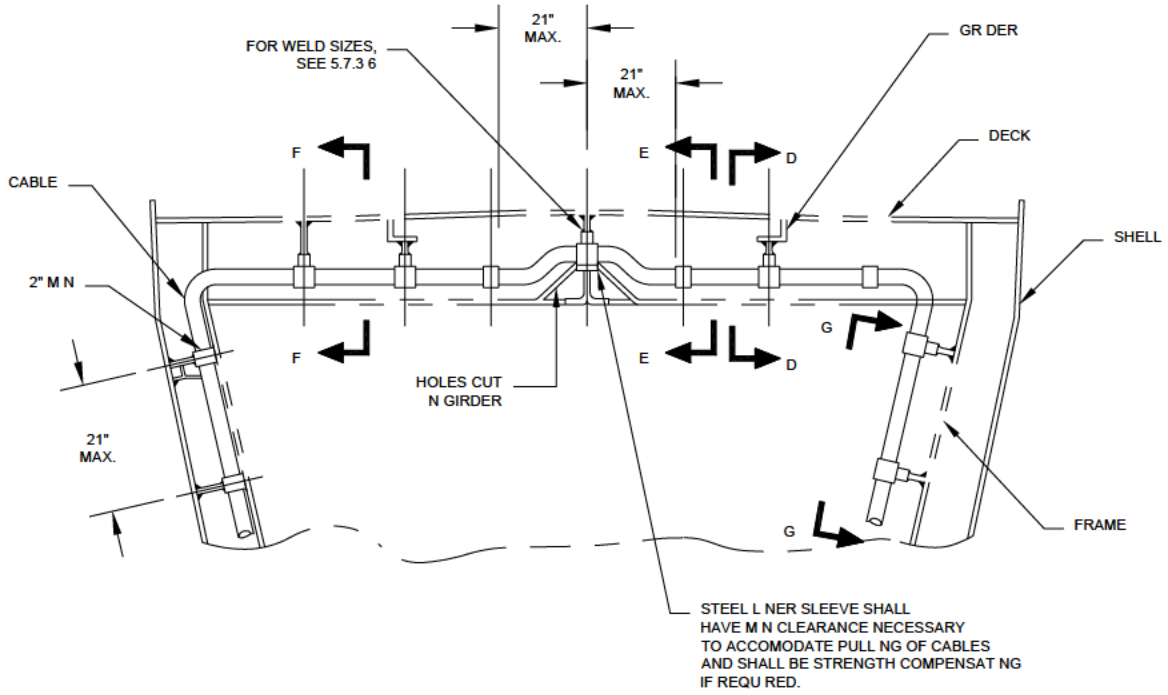
METHOD 4B-71-1
CABLE RUNS ATHWART SHIP - OVERHEAD
(SEE NOTE 1)



NOTES:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.
2. See figure 4B74 for section views referenced in this figure.

FIGURE 4B71. Cable support for degaussing cables (surface ships).

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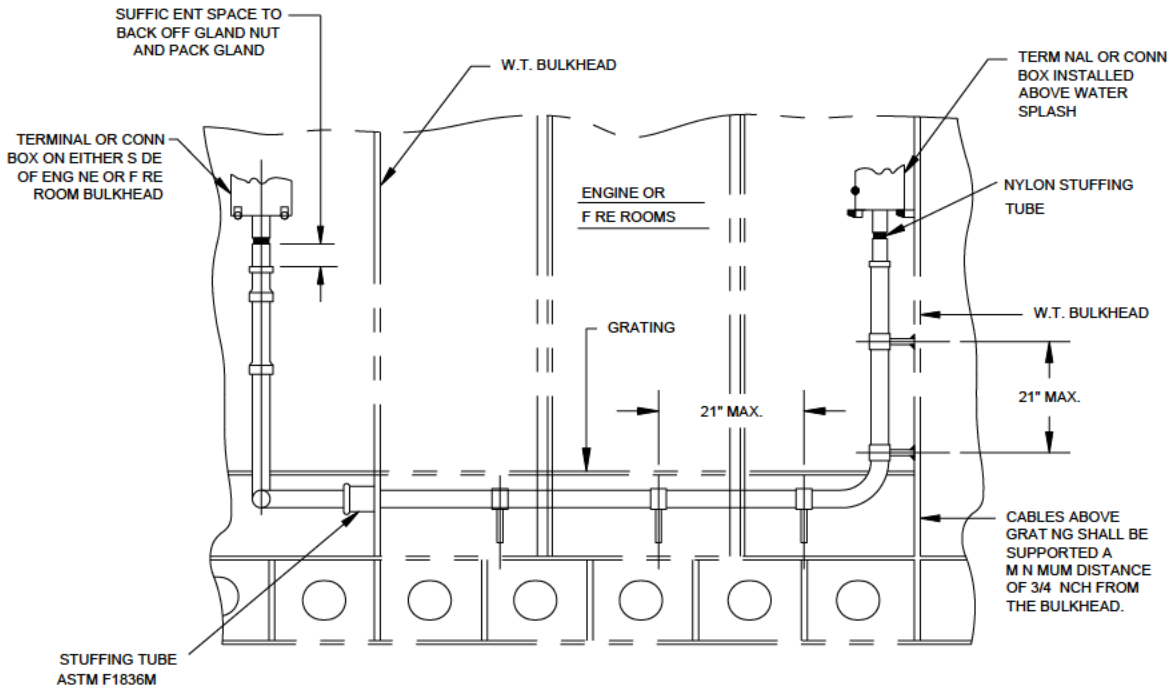
METHOD 4B-72-1
CABLE IN B LGES - LEAD SHEATHED
(SEE NOTE 1)



ELEVATION LOOKING OUTBOARD

NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B72. Cable support for degaussing cables (surface ships).

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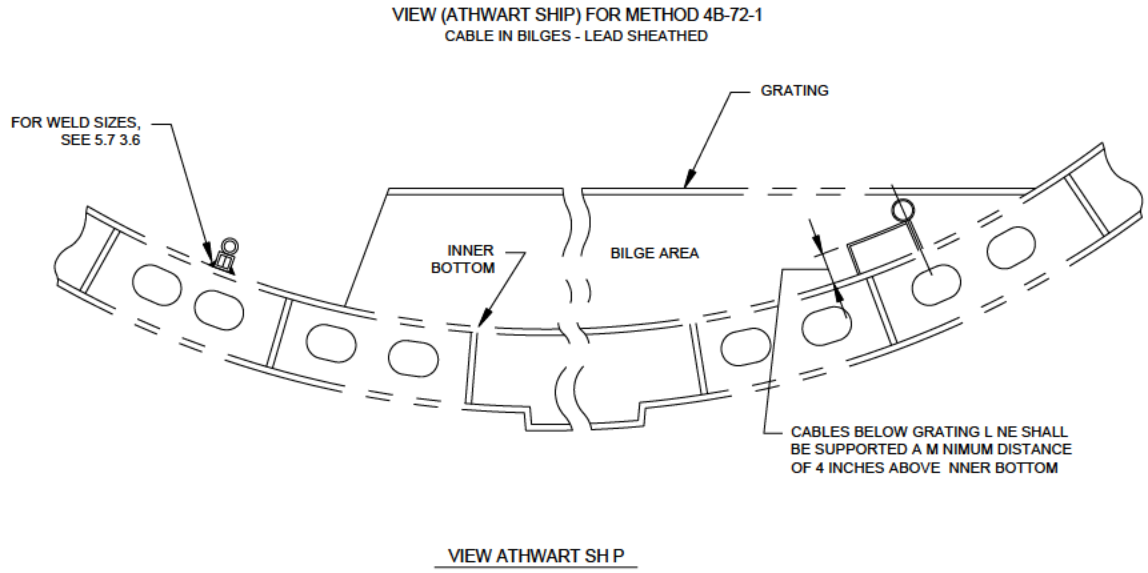

FIGURE 4B73. Cable support for degaussing cables (surface ships).

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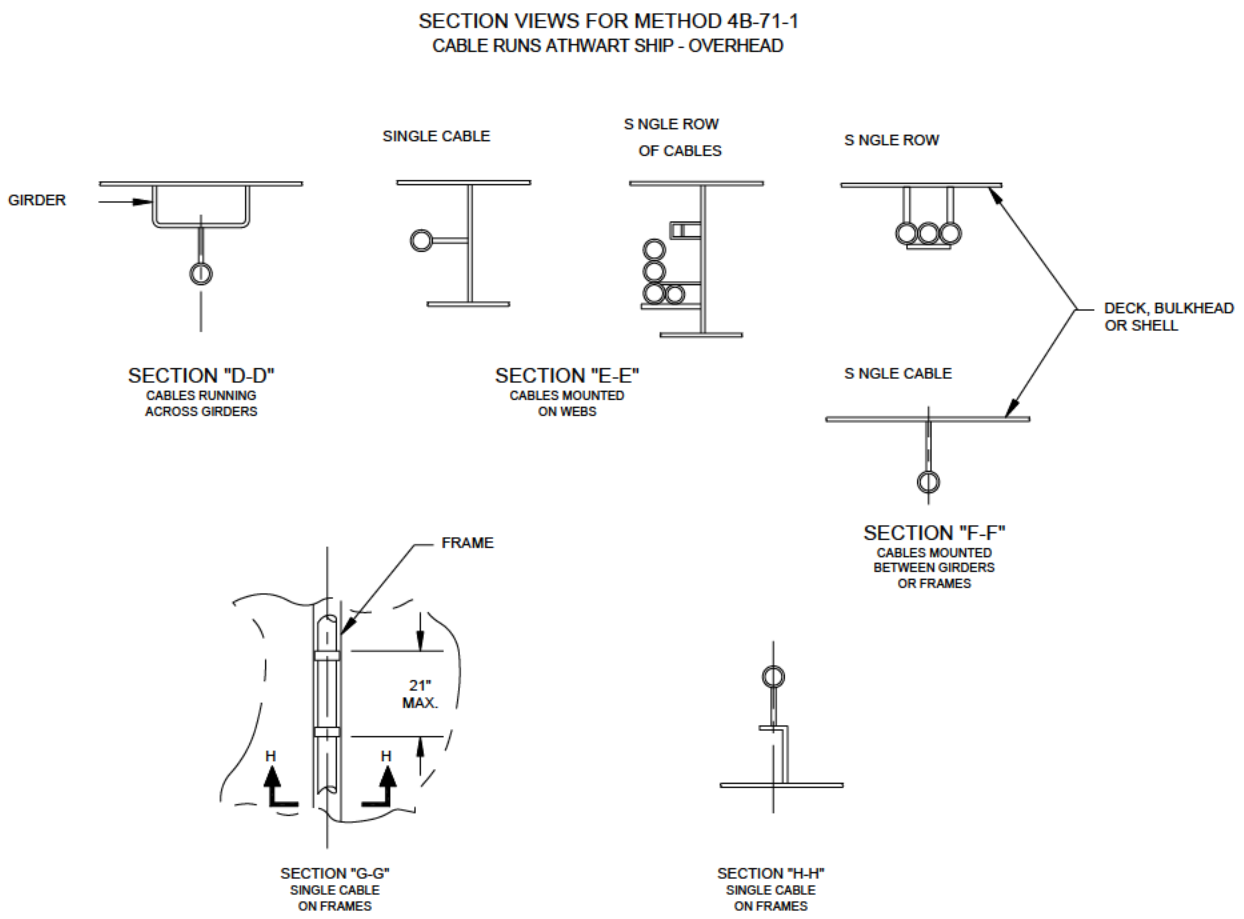

FIGURE 4B74. Cable support for degaussing cables (surface ships) – section views.

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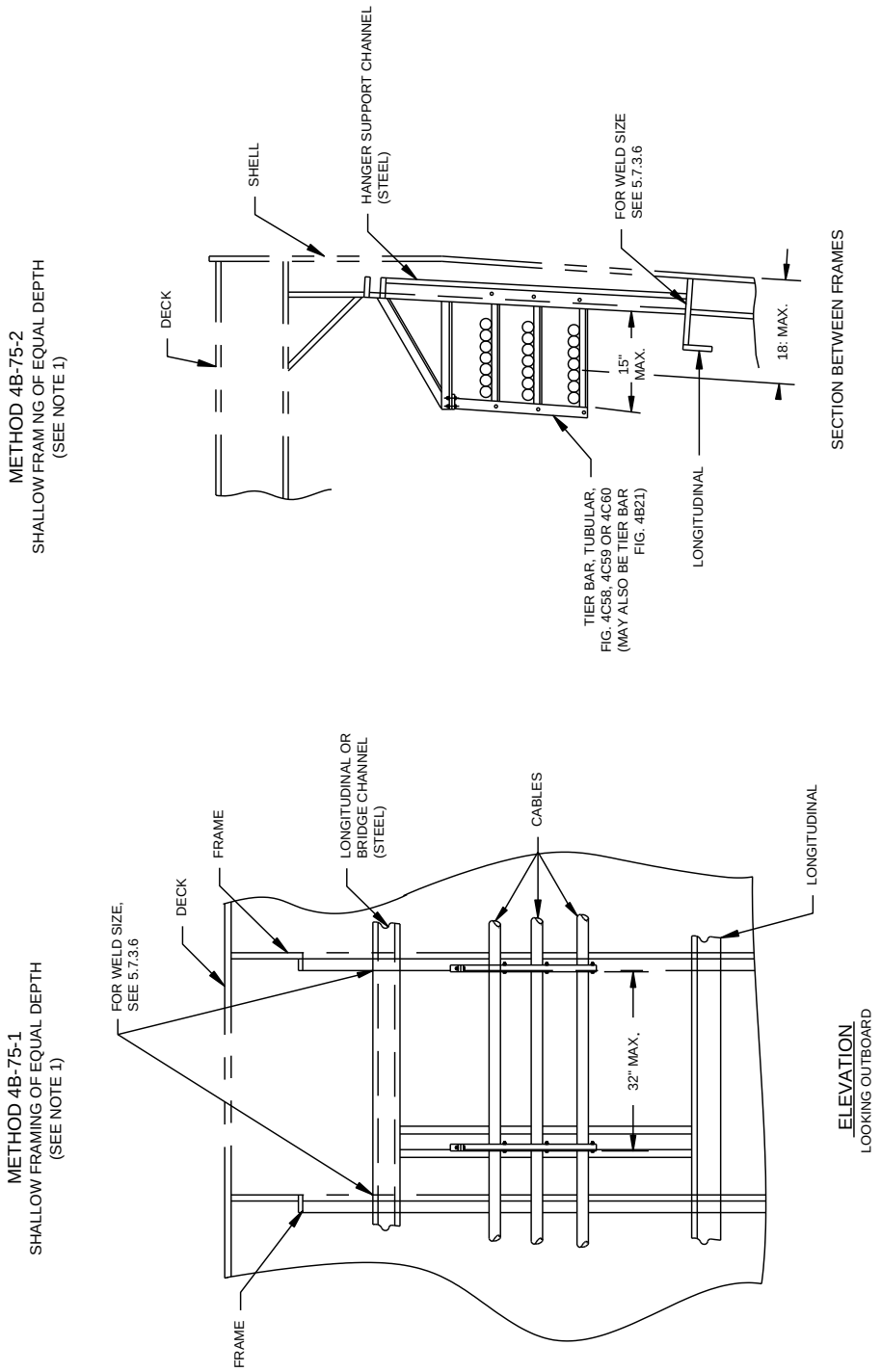

FIGURE 4B75. Cable support for degaussing cables (surface ships).

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NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B75. Cable support for degaussing cables (surface ships) – Continued.

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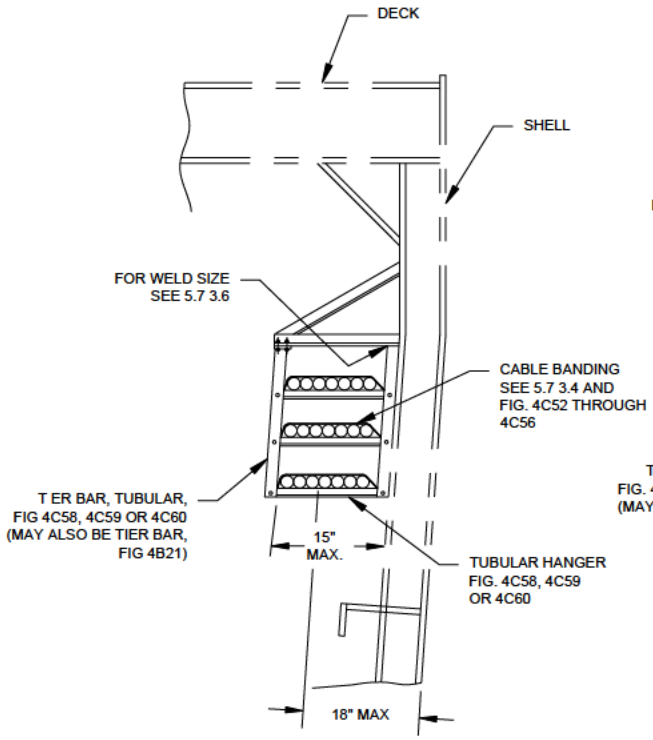
METHOD 4B-76-1
SHALLOW FRAM NG OF EQUAL DEPTH

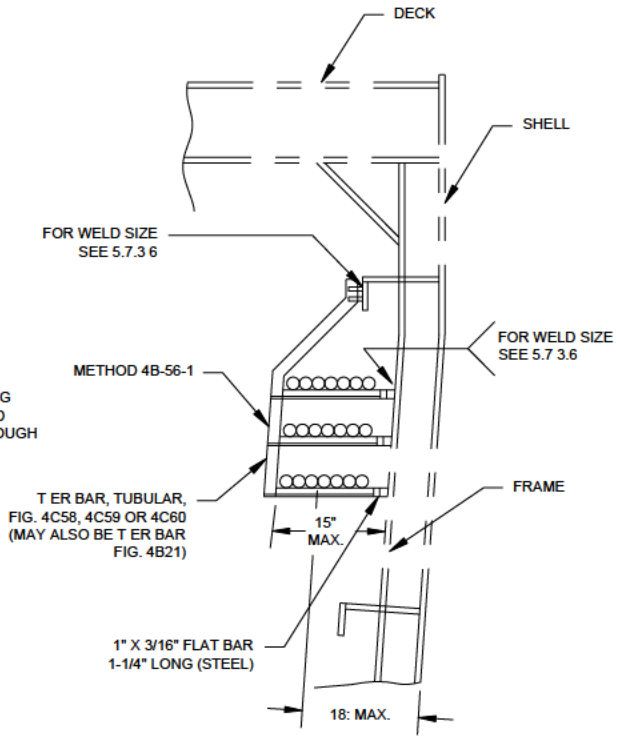
METHOD SHOWN ON THIS SHEET MAY BE USED FOR GENERAL NSTALLATIONS WHERE APPLICABLE



SECTION AT FRAMES
LARGE VESSEL

METHOD 4B-76-2
SHALLOW FRAMING OF EQUAL DEPTH
(SEE NOTE 1)

METHOD SHOWN ON THIS SHEET MAY BE USED FOR GENERAL INSTALLATIONS WHERE APPLICABLE



SECTION AT FRAMES
SMALL VESSELS

NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.
   f. Elevation view looking outboard for these methods is shown on figure 4B75.

FIGURE 4B76. Cable support for degaussing cables (surface ships).

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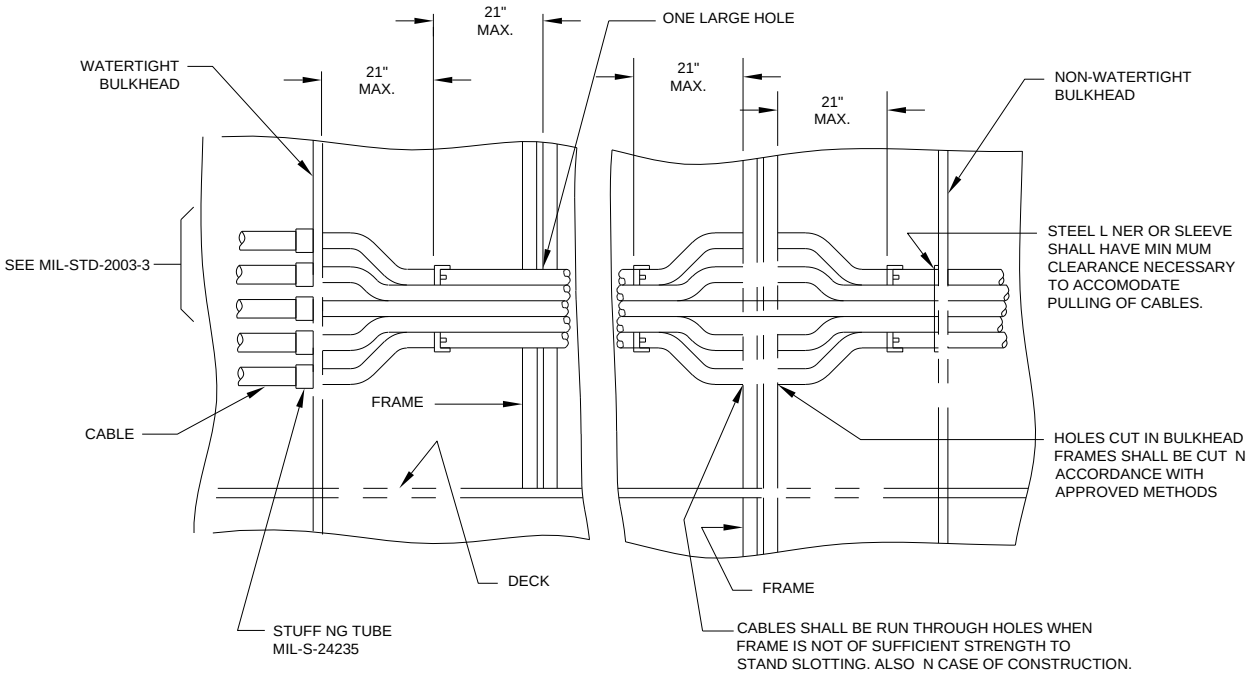
METHOD 4B-77-1
CABLES RUN LONGITUDINALLY
THROUGH WEB FRAMING
(SEE NOTE 1)



NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B77. Cable support for degaussing cables (surface ships).

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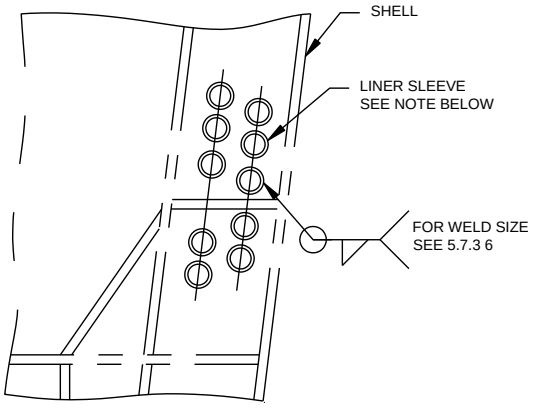
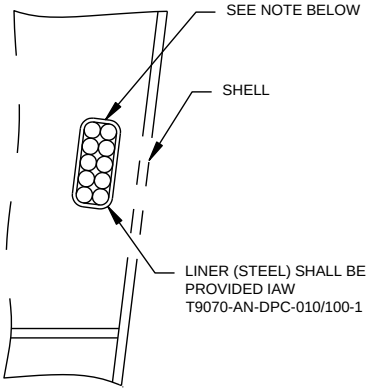
METHOD 4B-78-1
CABLES RUN LONGITUDINALLY THROUGH WEB FRAMING
TWO TIERS - US NG LINER SLEEVES



SECTION AT FRAME

METHOD 4B-78-2
CABLES RUN LONGITUD NALLY THROUGH WEB FRAMING
TWO TIERS - USING STEEL LINER



SECTION AT N.W.T.
BULKHEAD OR FRAME

NOTES:

1. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
2. Elevation view looking outboard for these methods is shown on figure 4B77.

FIGURE 4B78. Cable support for degaussing cables (surface ships).

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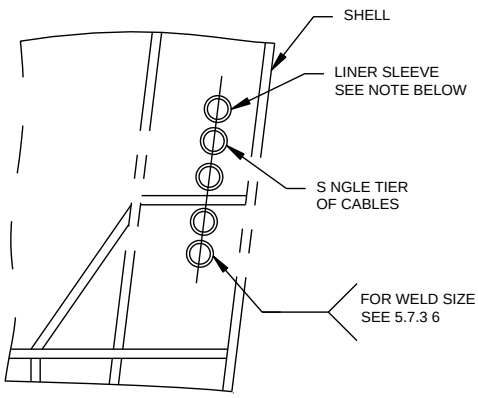
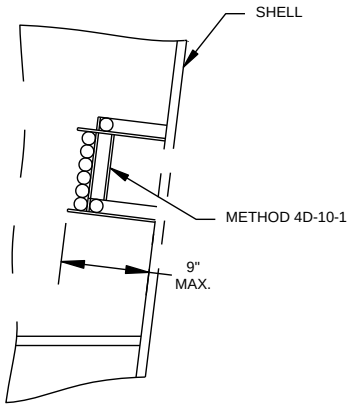
METHOD 4B-79-1
CABLES RUN LONGITUD NALLY THROUGH WEB FRAMING
S NGLE TIER - USING L NER SLEEVE



SECTION AT FRAME

METHOD 4B-79-2
CABLES RUN LONGITUD NALLY THROUGH WEB FRAMING
S NGLE TIER - USING CABLE HANGER



SECTION BETWEEN FRAMES
WHEN CABLE T ER IS 9 INCHES
OR UNDER FROM SHELL

NOTES:

1. Methods shown may be used for general installations where applicable.
2. For non-magnetic application, see 5.7.3.2.
3. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
4. Elevation view looking outboard for these methods is shown on figure 4B77.

FIGURE 4B79. Cable support for degaussing cables (surface ships).

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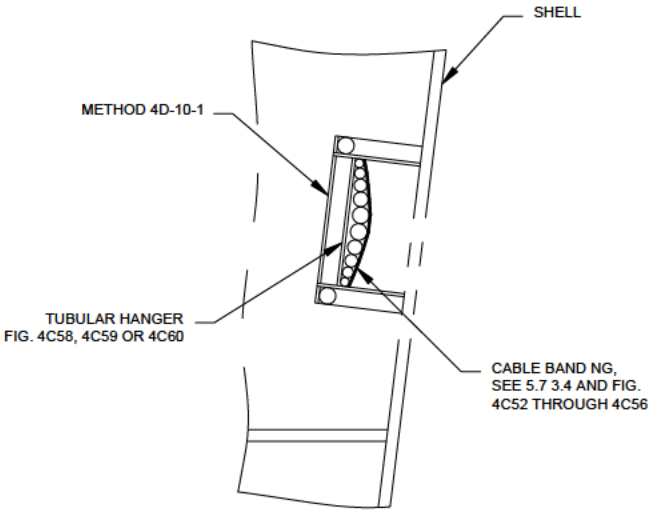
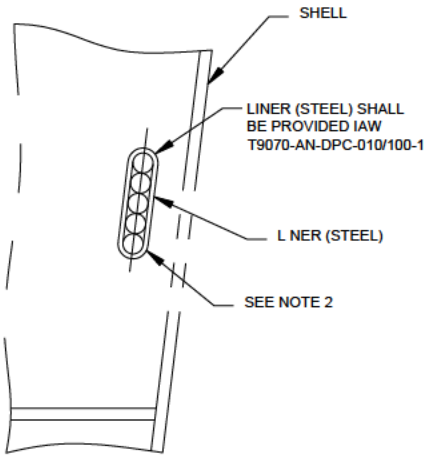
METHOD 4B-80-1
CABLES RUN LONGITUDINALLY THROUGH WEB FRAMING
S NGLE TIER - USING CABLE HANGER
(SEE NOTE 1)



SECTION BETWEEN FRAMES
WHEN CABLE TIER IS OVER
9 INCHES FROM SHELL
BALLISTIC AND NON-BALLISTIC

METHOD 4B-80-2
CABLES RUN LONGITUDINALLY THROUGH WEB FRAM NG
SINGLE TIER - US NG STEEL LINER
(SEE NOTE 1)



SECTION AT NON-WATERTIGHT
BULKHEAD OR FRAME

NOTES:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.
2. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer per MIL-I-3064, type HF.
3. Elevation view looking outboard for these methods is shown in figure 4B77.

FIGURE 4B80. Cable support for degaussing cables (surface ships).

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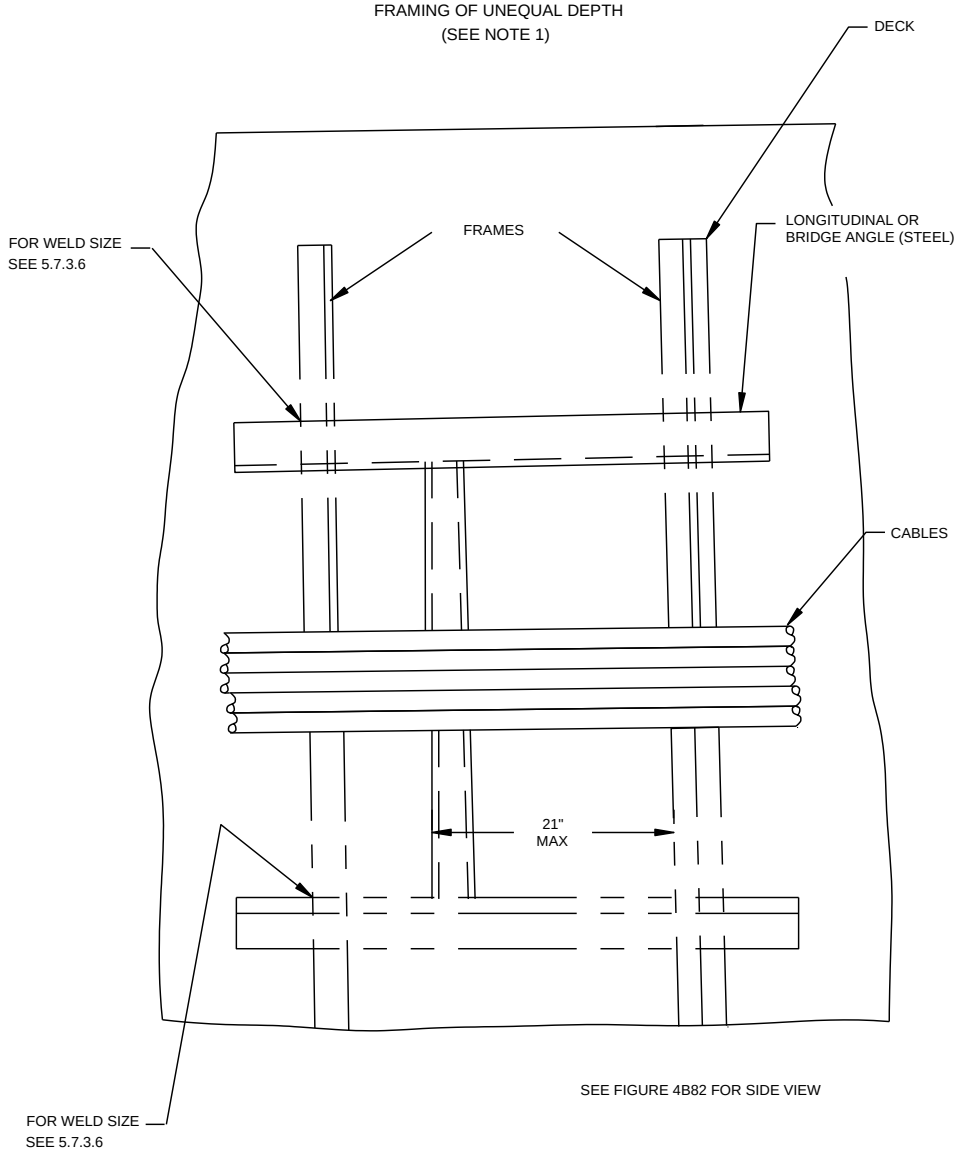
METHOD 4B-81-1
FRAMING OF UNEQUAL DEPTH
(SEE NOTE 1)



NOTE:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.

FIGURE 4B81. Cable support for degaussing cables (surface ships).

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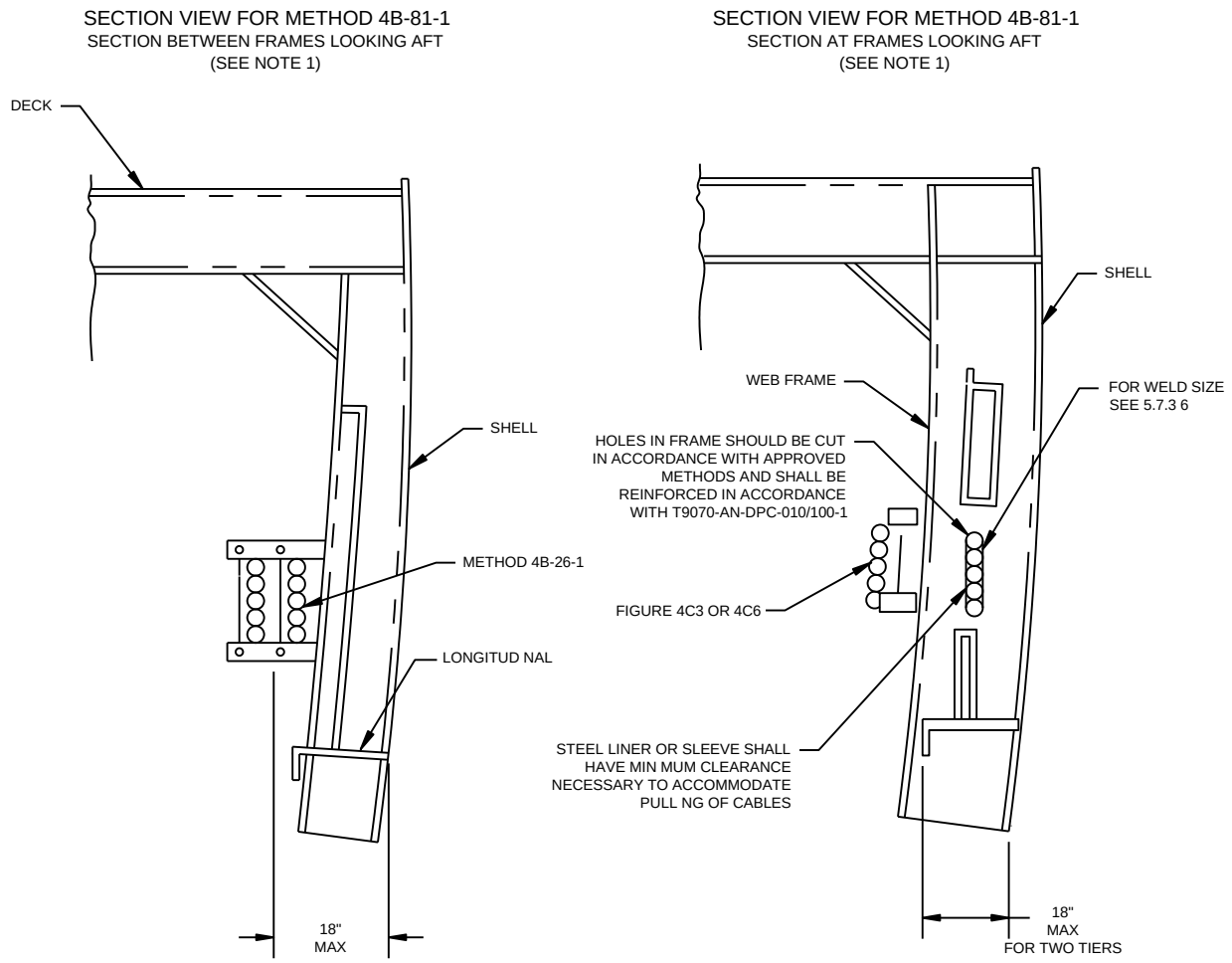

NOTES:

1. This figure provides cable support details for degaussing cables. Methods shown may be used for general installation where applicable.
   a. When insulation is used with degaussing cables, use corresponding insulation methods for cable hanger methods listed.
   b. Use appropriate ballistic methods for degaussing cable installation as required.
   c. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer in accordance with MIL-I-3064, type HF.
   d. Conduit shall be graded at ⅛ inch per foot minimum.
   e. Cable conduit shall be of copper-nickel pipe.
2. Where light-tightness is required, cables passing through non-watertight bulkheads shall be run through individual liner sleeves and then carefully packed with plastic sealer per MIL-I-3064, type HF.

FIGURE 4B82. Cable support for degaussing cables (surface ships).

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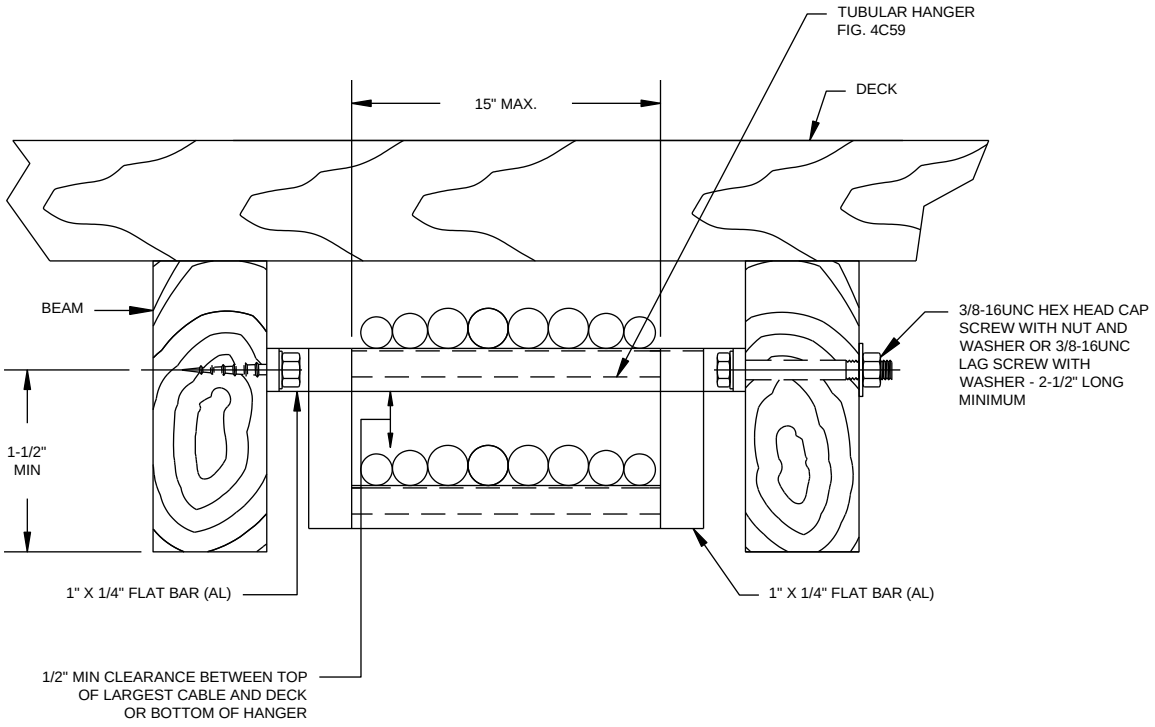
METHOD 4B-83-1
CABLE RUNS BETWEEN BEAMS
(CABLE BANDS NOT REQUIRED)
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. See 5.7.3.7 for fastener and fastener material requirements.
3. The lag screw configuration shown on this figure is allowed only when beam placement does not allow the use of a screw and nut mechanical joint.

FIGURE 4B83. Cableways on wooden ships (surface ships).
(*Guidance only*)

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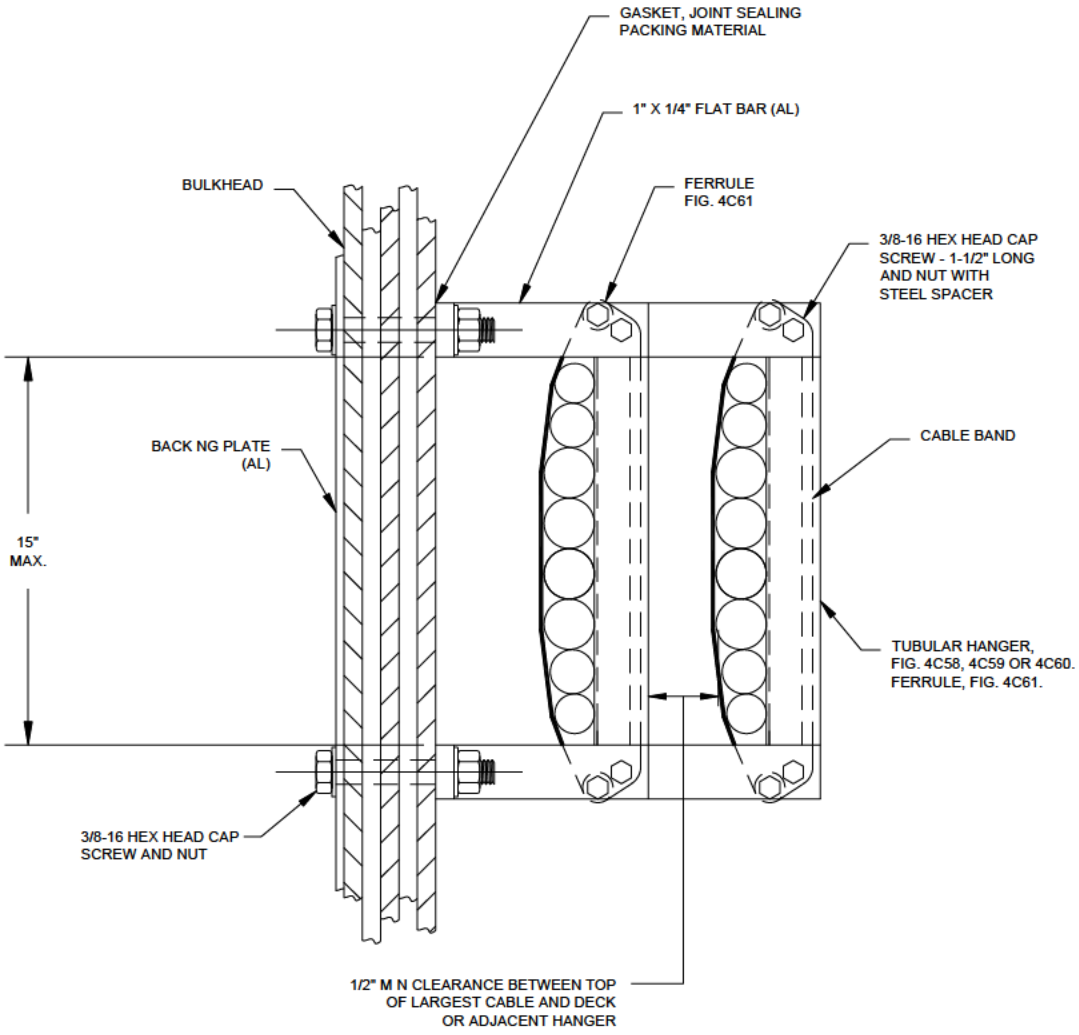
METHOD 4B-84-1
WATERTIGHT BULKHEADS
UNDER ONE INCH THICK
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B84. Cableways on wooden ships (surface ships).
(*Guidance only*)

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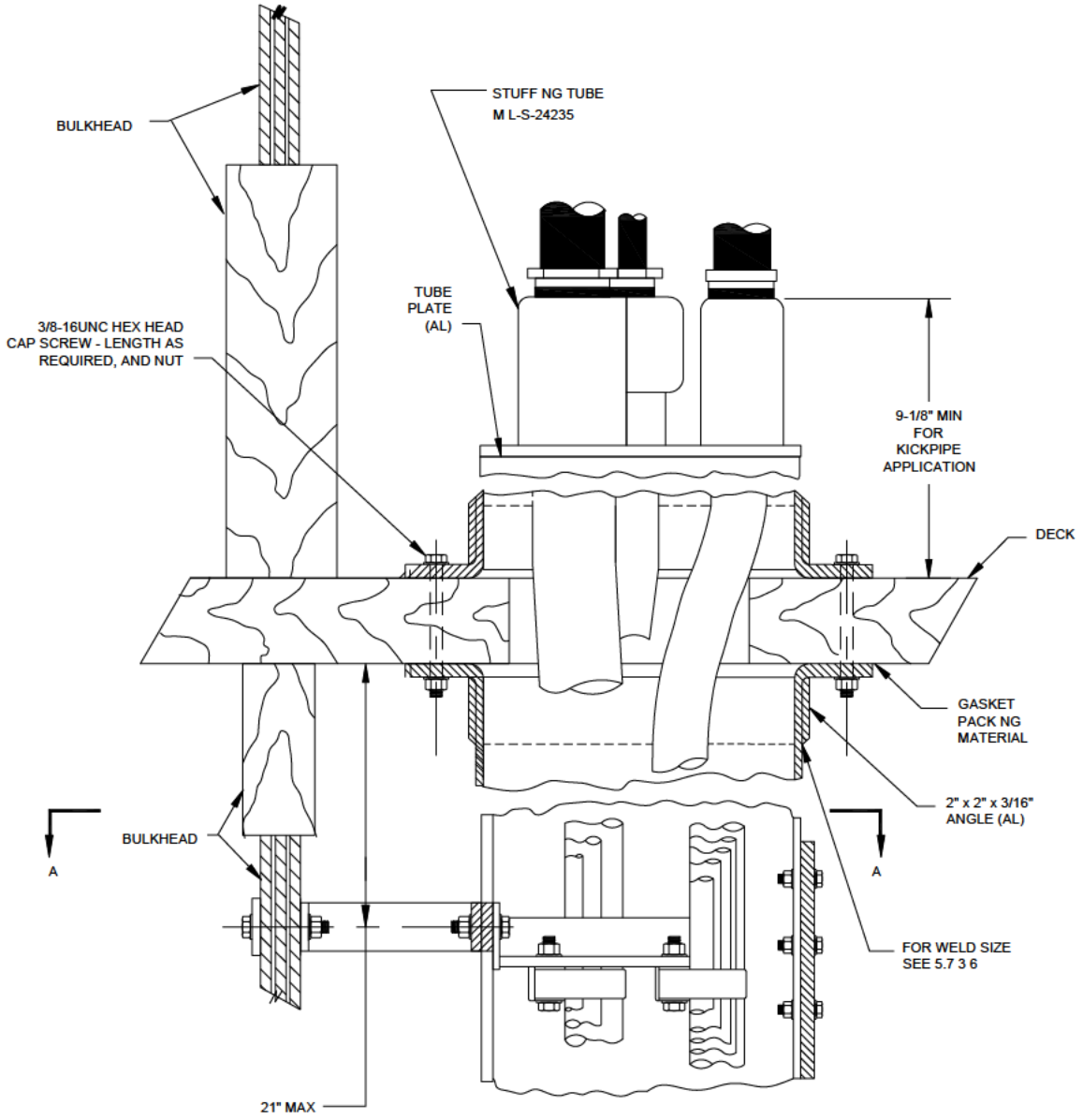
METHOD 4B-85-1
VERTICAL TIERS OF CABLES IN TRUNKS
FOR SECTION "A-A" V EW, SEE FIGURE 4B86
(SEE NOTES)



ELEVATION
PART IN SECTION

NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B85. Cableways on wooden ships (surface ships).
(*Guidance only*)

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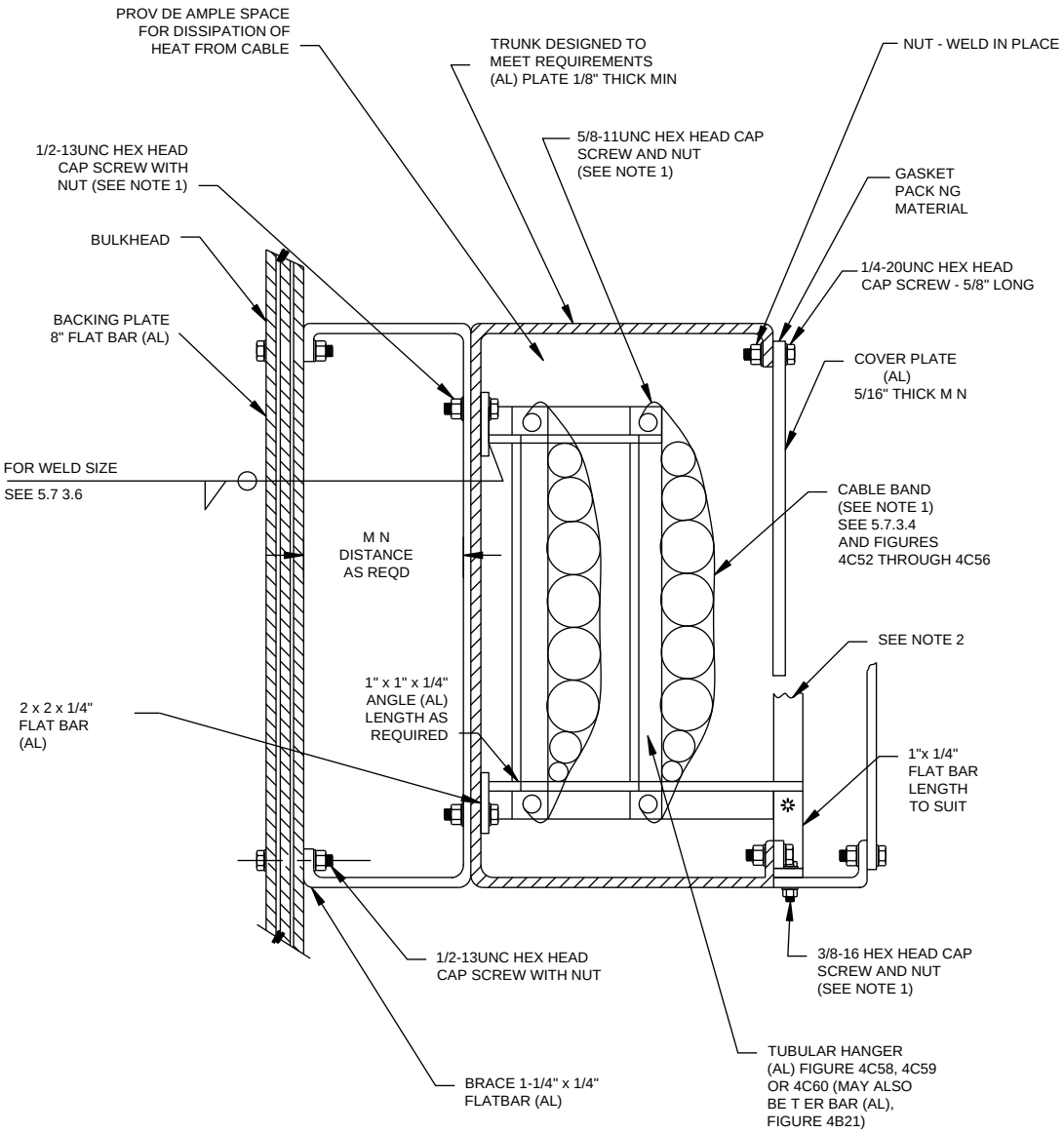
SECTION A-A VIEW FOR METHOD 4B-85-1
VERTICAL T ERS OF CABLES IN TRUNKS
(SEE NOTES)



PLAN VIEW
AT SECTION A-A

NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. Two rows of cables with a 9-inch length of cable span shall be considered normal. If a longer span or three rows of cables are required, secure the outer end of hanger support to the wall of the trunk.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B86. Cableways on wooden ships (surface ships). (*Guidance only*)

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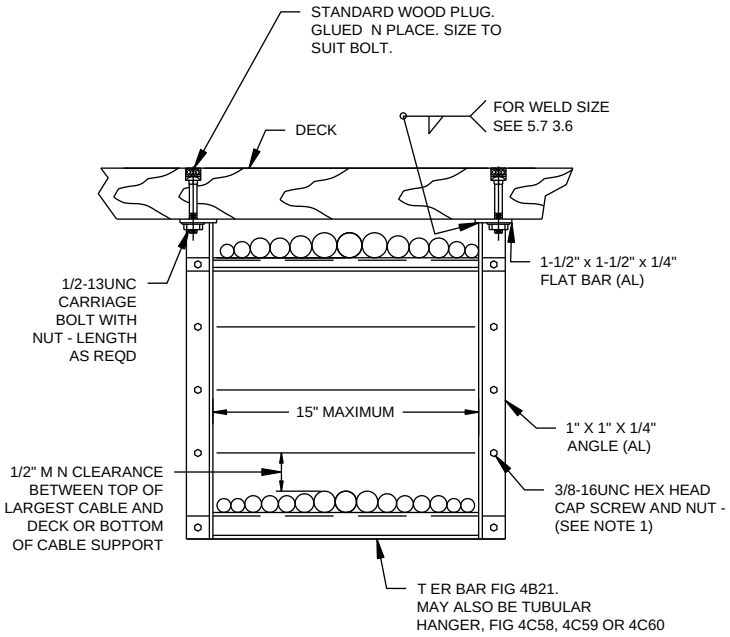
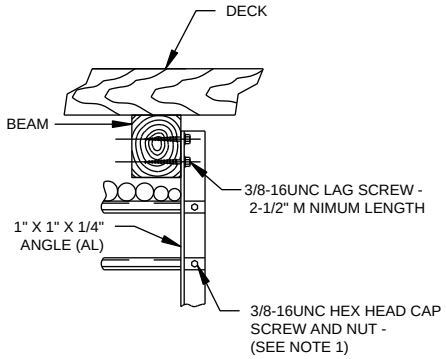
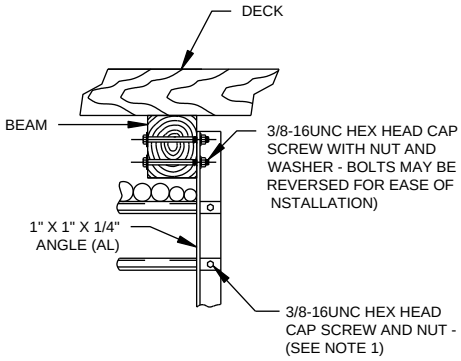
METHOD 4B-87-1
HANGER SUPPORTS SECURED TO WATERTIGHT DECKS
(SEE NOTES)



METHOD 4B-87-2
HANGER SUPPORTS SECURED TO BEAMS
(SEE NOTES)



METHOD 4B-87-3
HANGER SUPPORTS SECURED TO BEAMS
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. See 5.7.3.7 for fastener and fastener material requirements.
3. The lag screw configuration shown on this figure is allowed only when beam placement does not allow the use of a screw and nut mechanical joint.

FIGURE 4B87. Cableways on wooden ships (surface ships).
(*Guidance only*)

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Figure 4B88 has been deleted

FIGURE 4B88. Cableways on wooden ships (surface ships). (*Guidance only*)

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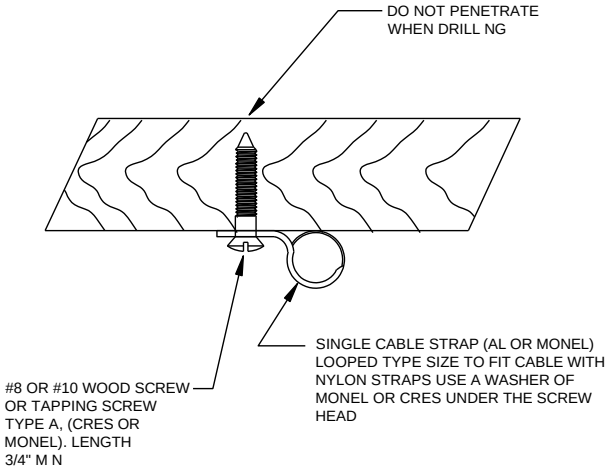
METHOD 4B-89-1
DECKS OR BULKHEADS OVER ONE NCH THICK
ALSO FOR BEAMS
CABLES WITH A MAX MUM DIAMETER OF 5/8"
SINGLE SUPPORT - ALUM NUM CABLE STRAPS
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. The methods shown are for use with cables up to 2 inches in diameter. For cables greater than 2 inches in diameter, use methods shown on figures 4B91 through 4B94.

FIGURE 4B89. Cableways on wooden ships (surface ships).
(*Guidance only*)

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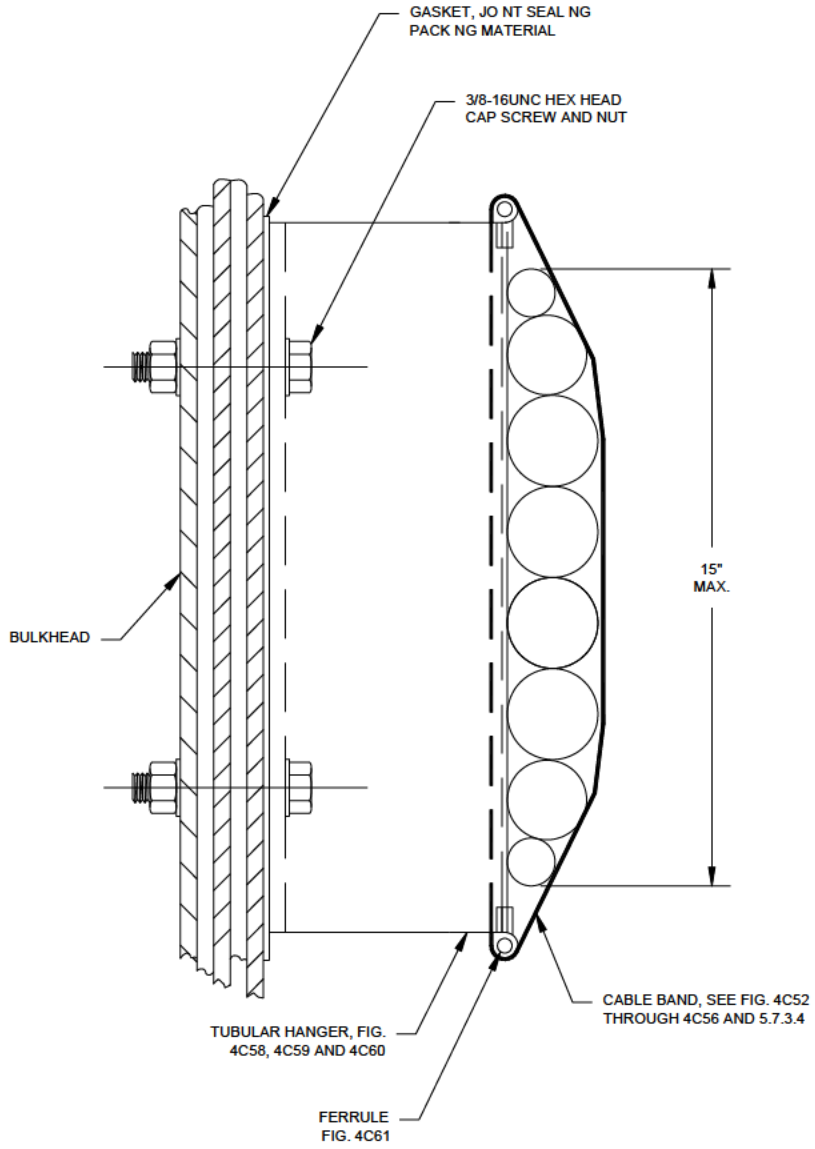
METHOD 4B-90-1
SINGLE TIER OF CABLES
SUPPORTED FROM WATERTIGHT BULKHEADS
UNDER ONE INCH THICKNESS
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. The method shown here may be used in lieu of those shown on figures 4B91 through 4B94.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B90. Cableways on wooden ships (surface ships).
(*Guidance only*)

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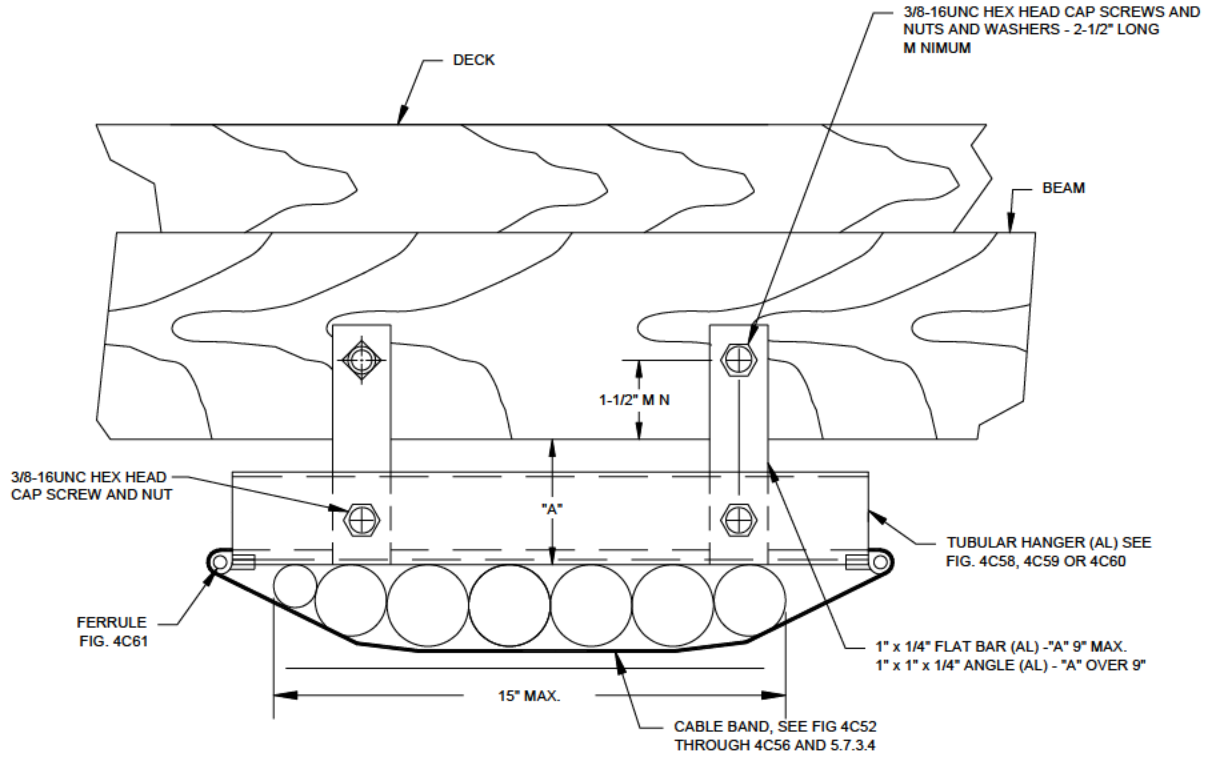
METHOD 4B-91-1
S NGLE TIER OF CABLES
SUPPORTED FROM BEAMS
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. For cables greater than 2 inches in diameter, use methods shown on figures 4B91 through 4B94.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B91. Cableways on wooden ships (surface ships).
(*Guidance only*)

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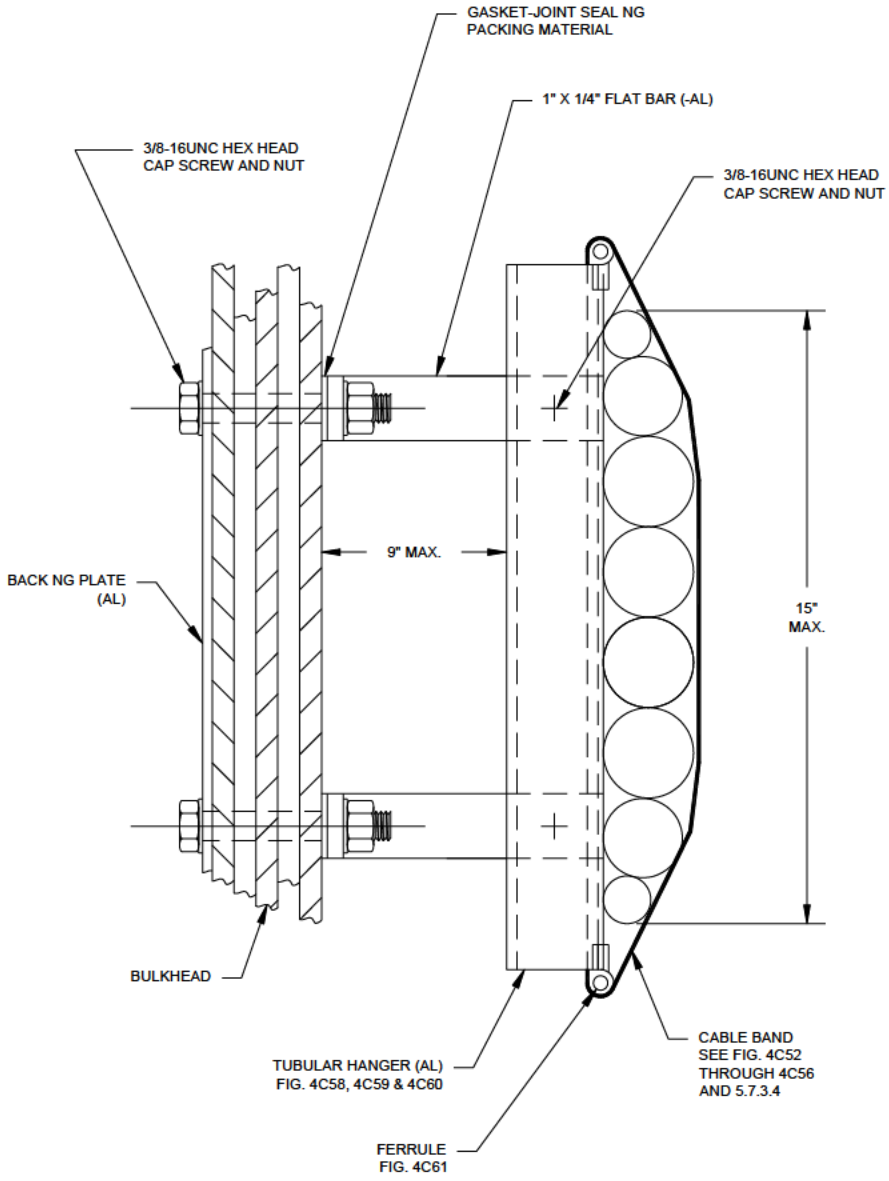
METHOD 4B-92-1
S NGLE TIER OF CABLES
SUPPORTED FROM WATERTIGHT BULKHEADS
UNDER ONE INCH THICKNESS
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. For cables greater than 2 inches in diameter, use methods shown on figures 4B91 through 4B94.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B92. Cableways on wooden ships (surface ships).
(*Guidance only*)

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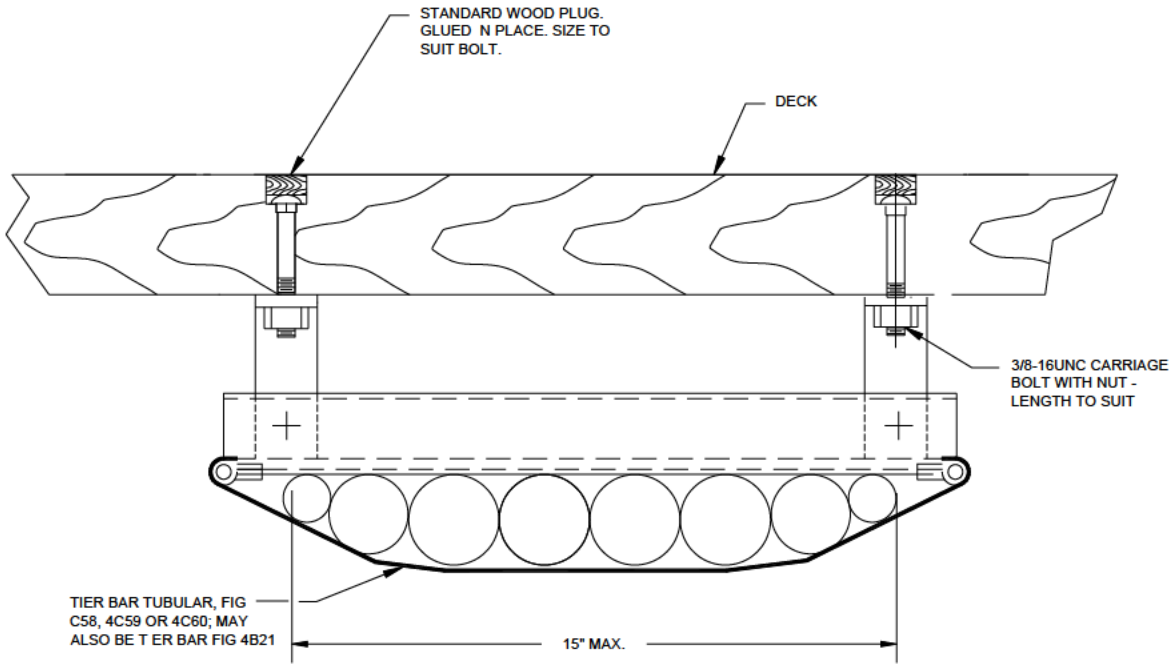
METHOD 4B-93-1
SINGLE TIER OF CABLES
SUPPORTED FROM WATERTIGHT DECKS
TWO NCH MINIMUM THICKNESS
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. For cables greater than 2 inches in diameter, use methods shown on figures 4B91 through 4B94.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B93. Cableways on wooden ships (surface ships).
(*Guidance only*)

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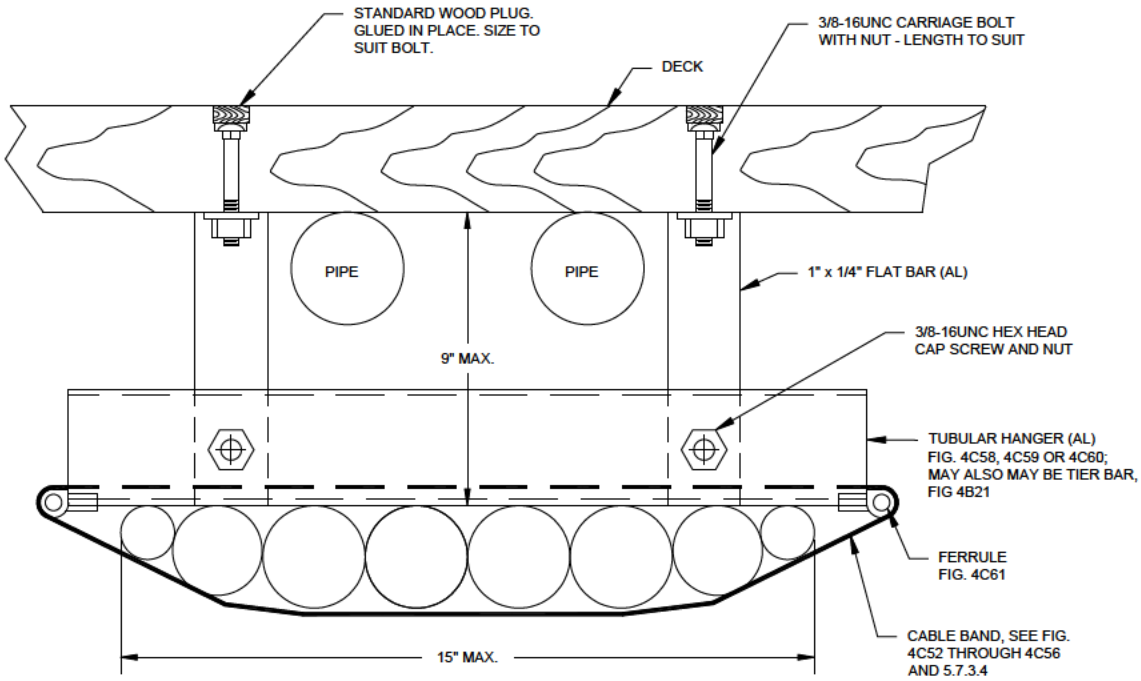
METHOD 4B-94-1
SINGLE T ER OF CABLES
SUPPORTED AWAY FROM WOOD DECKS
(SEE NOTES)



NOTES:

1. For non-magnetic application, see 5.7.3.2.
2. For cables greater than 2 inches in diameter, use methods shown on figures 4B91 through 4B94.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B94. Supporting a single row of cables to avoid an obstruction or preserve alignment of cable runs on wooden decks.
(*Guidance only*)

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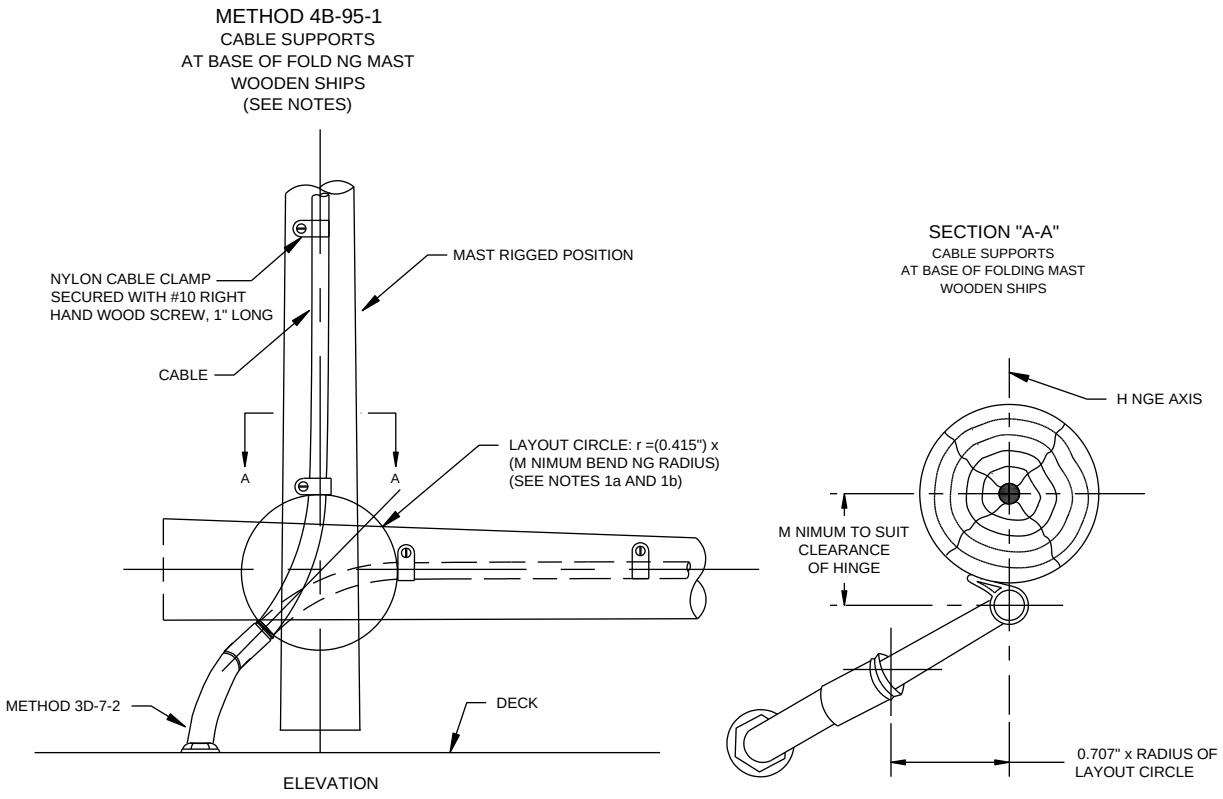

NOTES:

1. For folding masts on wooden ships:
   a. The dimension used for “r” shall not be less than 4 inches.
   b. Where more than one cable is involved, “r” shall be determined by using the bending radius of the largest cable.
   c. Cable shall be firmly fastened with mast in 45° position to ensure proper length for flexing.
2. See 5.7.3.7 for fastener and fastener material requirements.
3. Method 3D-7-2, “For Passing Single Cables Through W.T. Wood Decks”, is from MIL-STD-2003-3.

FIGURE 4B95. Cableways on folding masts (surface ships).

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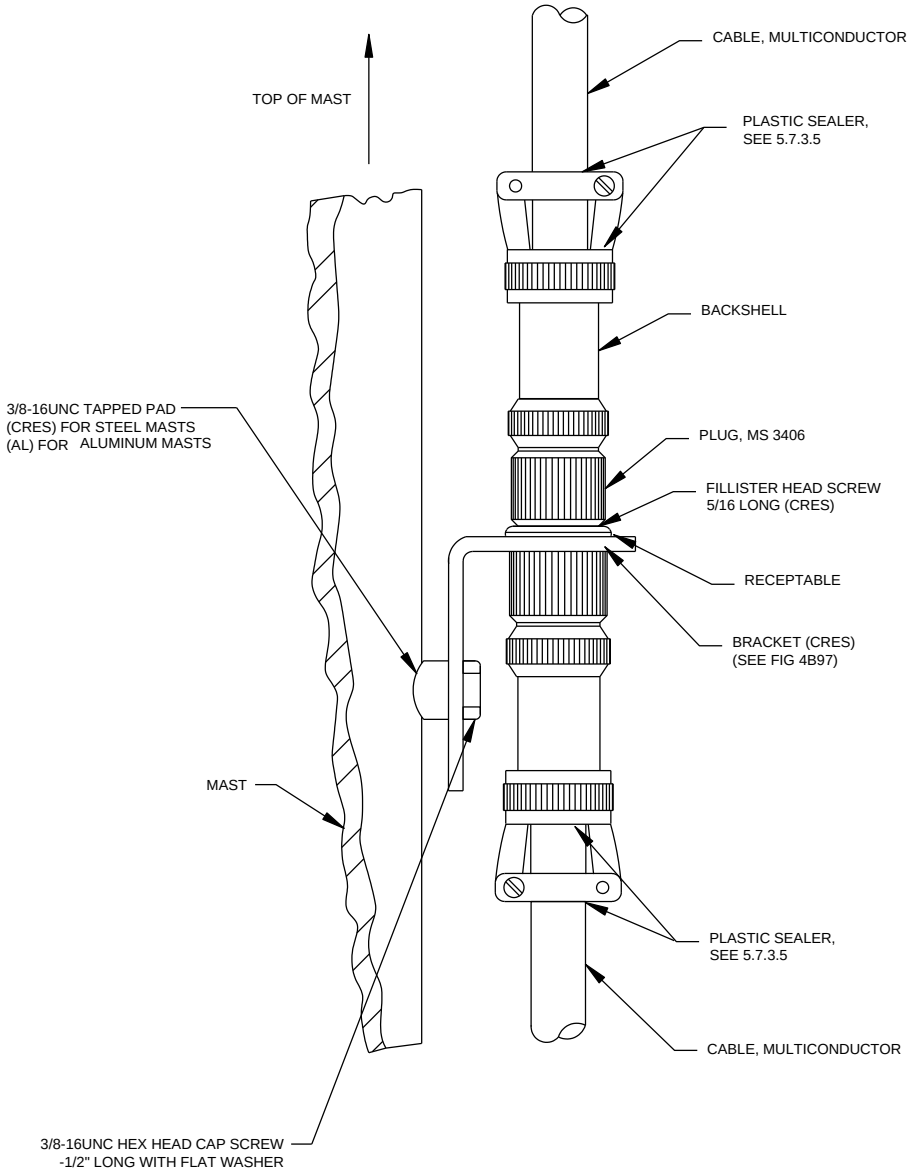
METHOD 4B-96-1
COUPLING OF MULTIPLE CABLES
(CONNECTORS PER MIL-STD-2003-5)



NOTES:

1. Water intrusion into connectors that are installed topside poses a significant problem. Installers shall take additional precautions to protect these connectors. Various options are available. MIL-STD-2003-1 includes methods for weatherproofing of topside electrical connectors. Local approved methods may also be used. If a local method or a method from MIL-STD-2003-1 is not selected, the following is recommended: The connector shall be wrapped with a suitable electrical tape using a one half lap wrap followed with an application of heat shrink tubing in accordance with SAE-AS23053/5 or SAE-AS23053/15. This procedure shall be accomplished on each portion of the connector above and below the bracket. The tape shall extend 3 inches beyond the cable clamps and the heat shrink tubing shall extend 4 inches beyond the cable clamps.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B96. Cableways on masts with connectors (surface ships).

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DETAILS FOR METHOD 4B-96-1
COUPLING OF MULTIPLE CABLES
(CONNECTORS PER MIL-STD-2003-5)

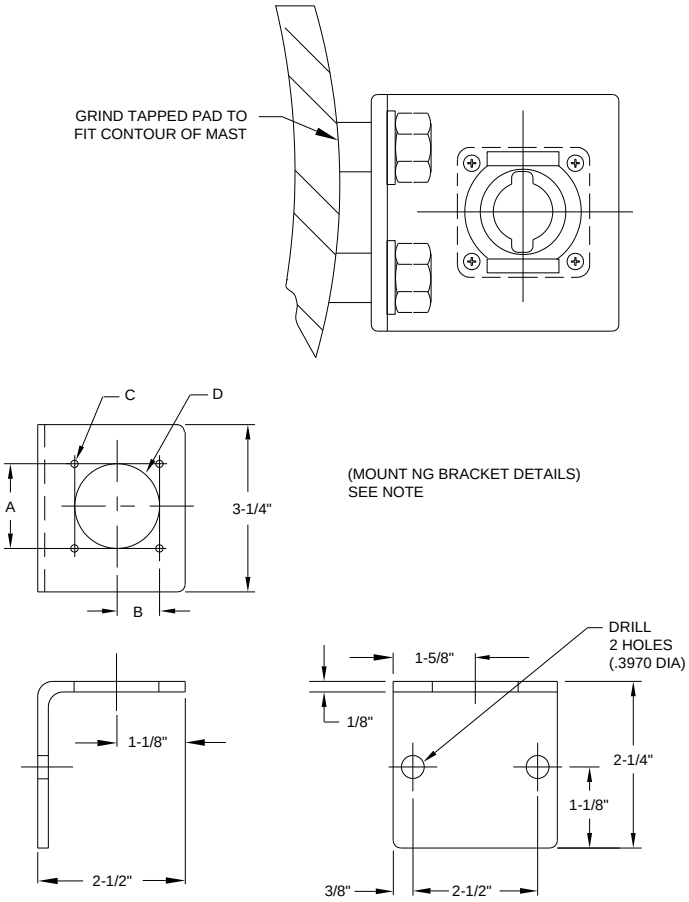

FIGURE 4B97. Cableways on masts with connectors (surface ships).

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NOTE:

1. Dimensions for the mounting bracket are as shown in table 4B97-I:

TABLE 4B97-I. Mounting bracket dimensions.

Shell size	Dimensions (inches)			
	A ±0.010	B ±0.010	C (dia) ±0.031	D (dia) +0.010 -0.005
18	1.062	0.531	0.120	1.125
20	1.156	0.578	0.120	1.125
22	1.250	0.625	0.120	1.375
24	1.375	0.688	0.147	1.500
28	1.562	0.781	0.147	1.813
32	1.750	0.875	0.173	2.063
36	1.938	0.967	0.173	2.313

FIGURE 4B97. Cableways on masts with connectors (surface ships) – Continued.

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METHOD 4B-98-1
CABLES THROUGH ENGINE AND BOILER ROOMS
SUPPORTED BETWEEN SHIPS LONGITUDINALS

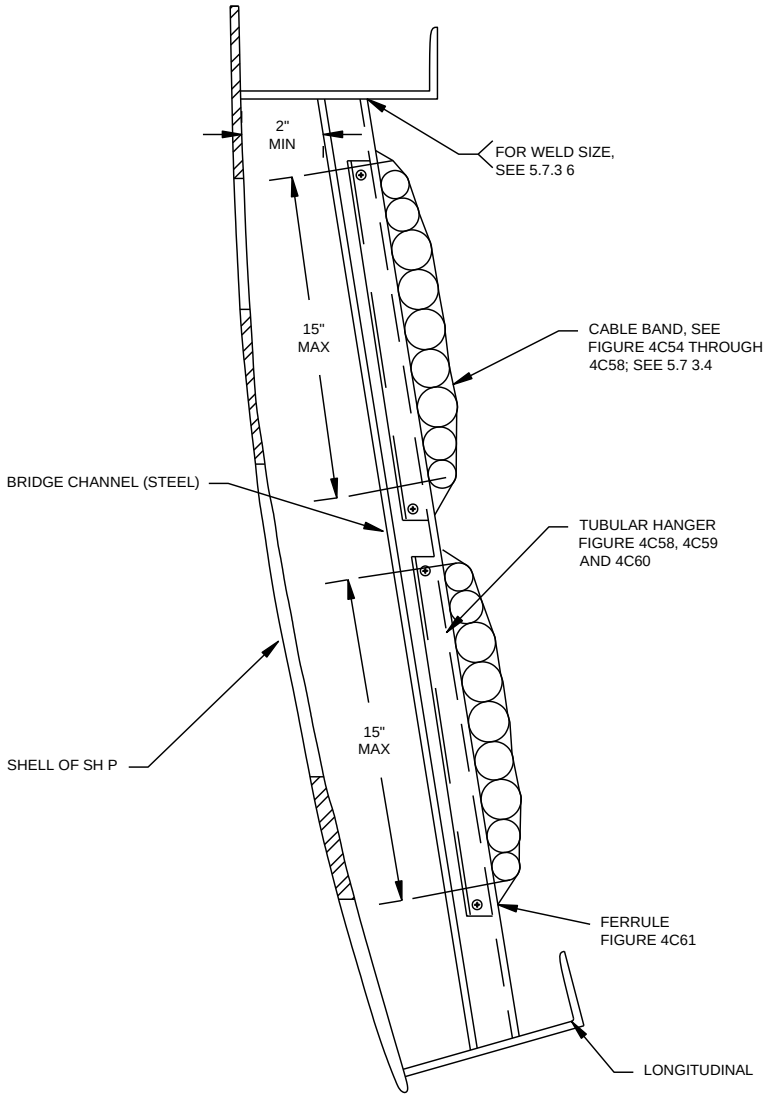

FIGURE 4B98. Cableways of main cable runs on small vessels (surface ships).

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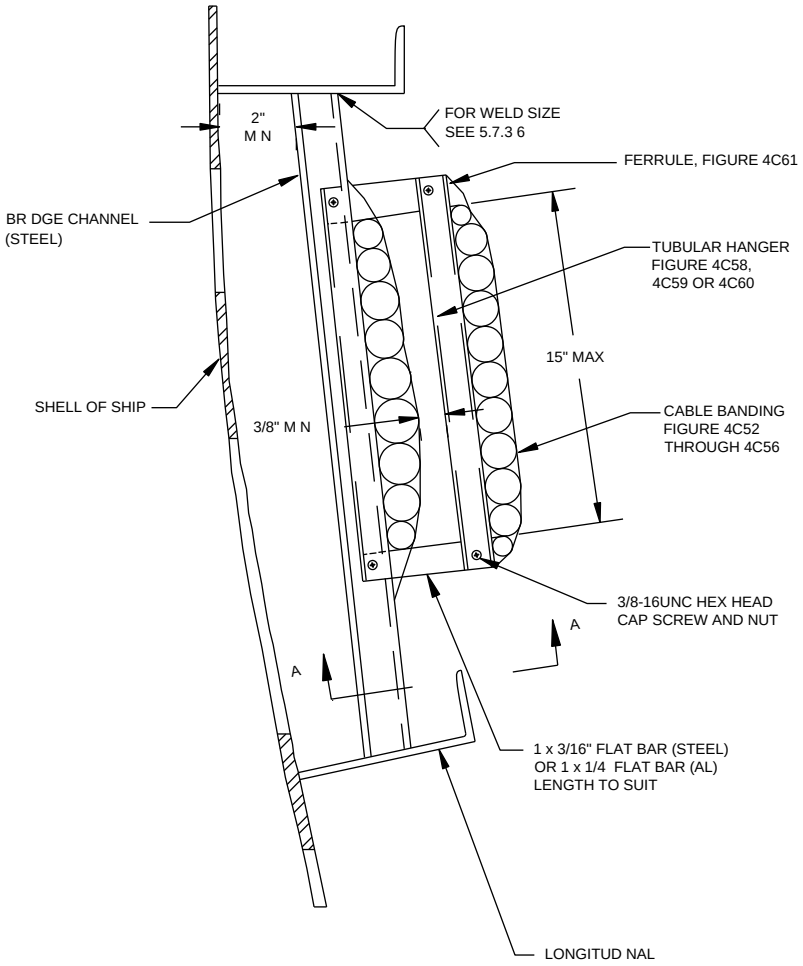
METHOD 4B-99-1
CABLES THROUGH ENGINE AND BOILER ROOMS
SUPPORTED BETWEEN SHIPS LONGITUDINALS
(FOR SECTION "A-A", SEE FIGURE 4B100)



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B99. Cableways of main cable runs on small vessels (surface ships).

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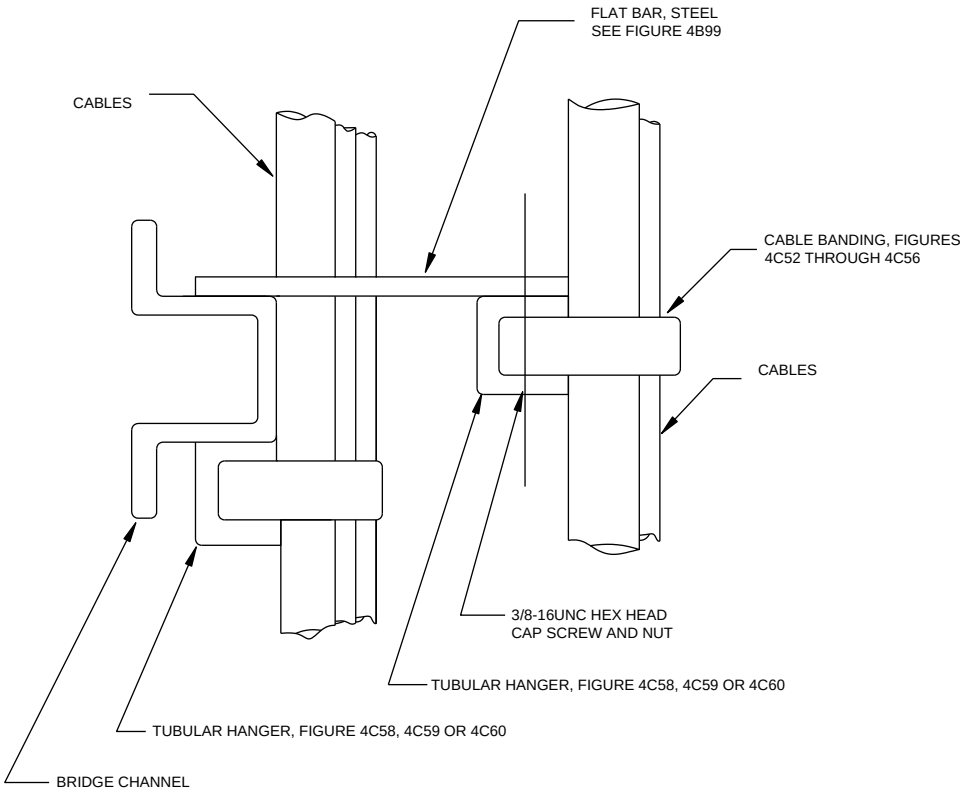
SECTION "A-A" FOR METHOD 4B-99-1
CABLES THROUGH ENGINE AND BO LER ROOMS
SUPPORTED BETWEEN SHIPS LONGITUDINALS



SECTION "A - A"

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4B100. Cableways of main cable runs on small vessels (surface ships) – section A-A.

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Method 4B-101-1
Y-Hangers for Cableway Support and Routing (3-Way/3 Tier) (Surface Ships)

NOTES:

1. Adhere to the figure below.
2. Y-hangers shall be used only for horizontal cable runs.
3. Y-hangers shall only be used in surface ships and shall not be used in aircraft carrier spaces under the cognizance of NAVSEA 08.
4. Y-hangers shall be used only at intersections of cable runs. Cable hangers in straight runs shall be in accordance with the other methods in this standard.
5. The maximum number of tiers that may be used with the Y-hangers is three.
6. Flatbar separators shall be installed between the tiers.
7. Edges shall be rounded to avoid chafing.
8. Material may be steel or aluminum.
9. Welding shall be in accordance with 5.7.3.6.

FIGURE 4B101. Y-hangers for cableway support and routing (3-way/3 tier) (surface ships).

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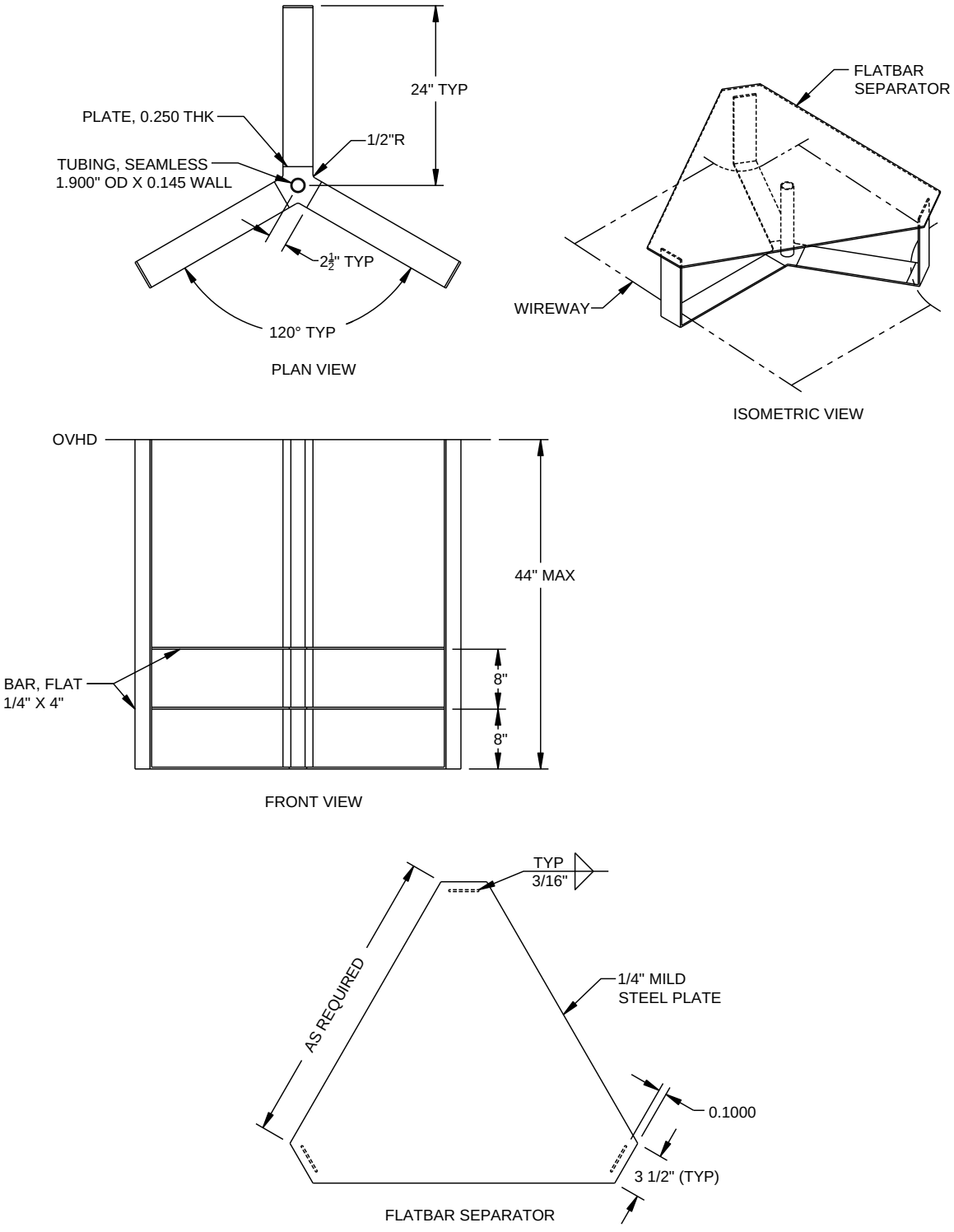

FIGURE 4B101. Y-hangers for cableway support and routing (3-way/3 tier) (surface ships) – Continued.

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Method 4B-102-1
Y-Hangers for Cableway Support and Routing (4-Way/3 Tier) (Surface Ships)

NOTES:

1. Adhere to the figure below.
2. Y-hangers shall be used only for horizontal cable runs.
3. Y-hangers shall only be used in surface ships and shall not be used in aircraft carrier spaces under the cognizance of NAVSEA 08.
4. Y-hangers shall be used only at intersections of cable runs. Cable hangers in straight runs shall be in accordance with the other methods in this standard.
5. The maximum number of tiers that may be used with the Y-hangers is three.
6. Flatbar separators shall be installed between the tiers.
7. Edges shall be rounded to avoid chafing.
8. Material may be steel or aluminum.
9. Welding shall be in accordance with 5.7.3.6.

FIGURE 4B102. Y-hangers for cableway support and routing (4-way/3 tier) (surface ships).

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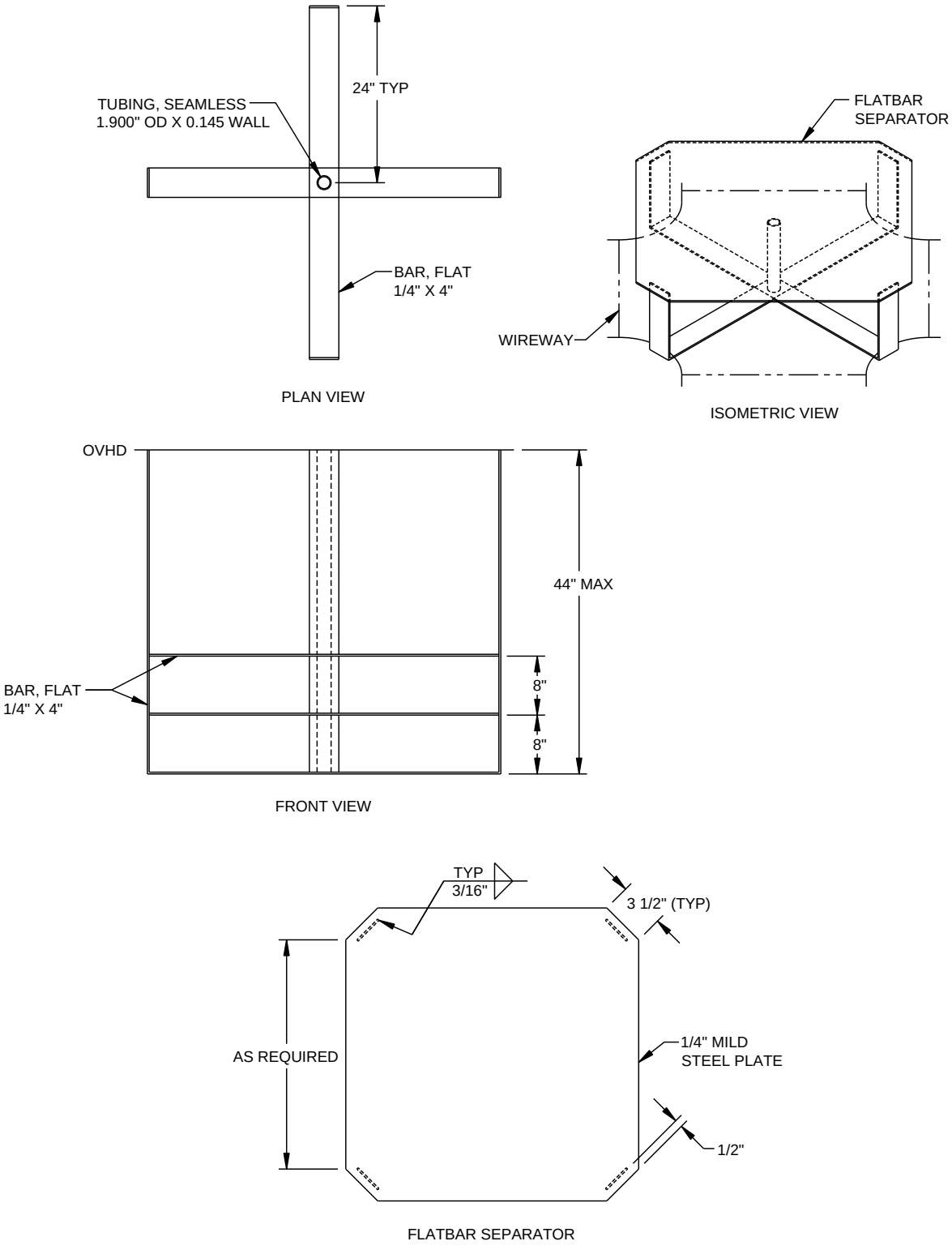

FIGURE 4B102. Y-hangers for cableway support and routing (4-way/3 tier) (surface ships) – Continued.

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Method 4B-103-1
Trapeze Type Cableways, Stud Weld Attachment - Steel

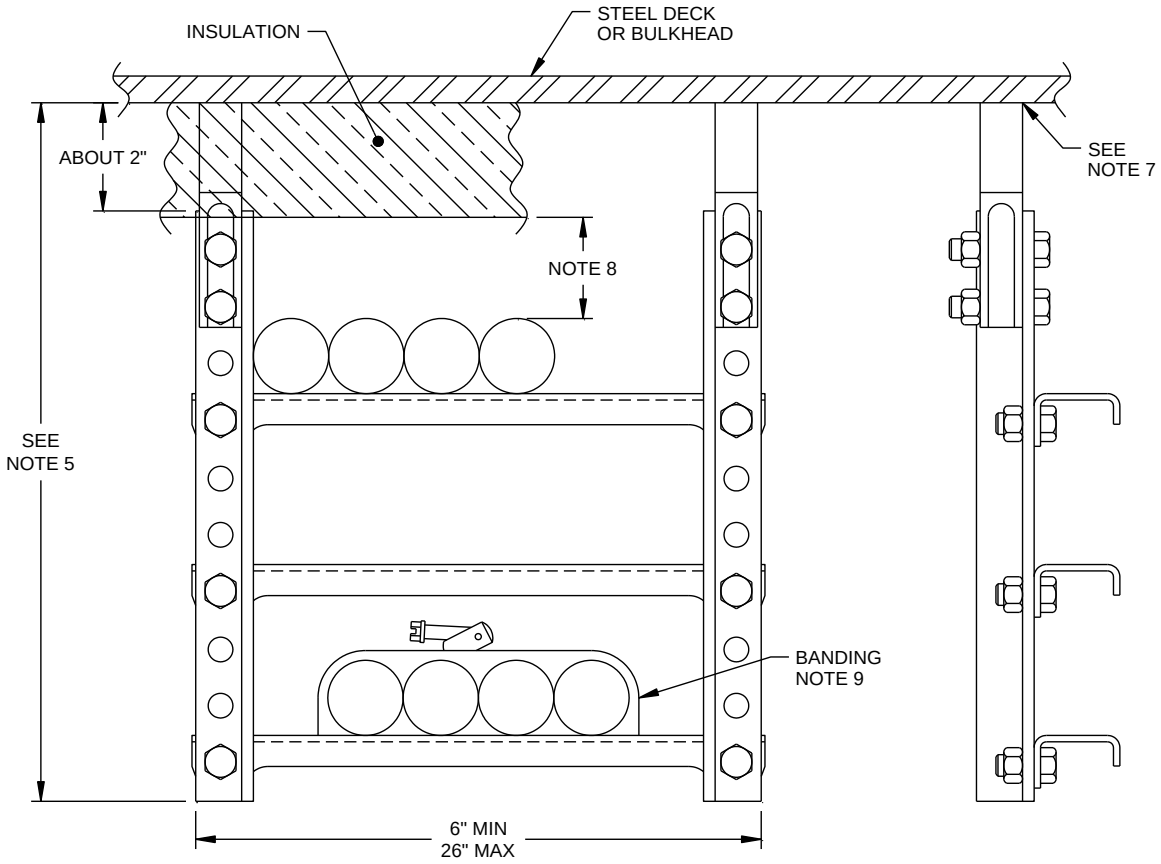

Illustration 1 – Typical Hanger Assembly

NOTES:

1. This method is applicable to mounting single or multiple cable tiers from structural steel decks and bulkheads.
2. Downcomers may be angle steel or channel steel. For demonstration purposes, only angle bar downcomer is shown in these illustrations. See figures 4B21 and 4B24 for typical dimensions and details of downcomers.
3. Cross tiers may be tier bars as shown on figures 4B21, 4B22, 4B24, or 4B25 or tubular hangers as shown on figures 4C58, 4C59, or 4C60. For demonstration purposes, only tier bars are shown here.
4. The maximum cable weight shall not exceed 96 pounds per tier. For a five tier assembly, the maximum weight shall not exceed 480 pounds. The number of tiers shall not exceed the following:
   a. Maximum of five tiers from deck, for hanger spans between 6 inches and 17 inches.
   b. Maximum of three tiers from deck, for hanger spans between 17 inches and 26 inches.
   c. Maximum of two tiers from bulkhead, for hanger spans between 6 inches and 17 inches.
   d. Maximum of one tier from bulkhead, for hanger spans between 17 inches and 26 inches.
   e. Maximum of three to five tiers from bulkhead with flat bar supports (see illustration 2).

FIGURE 4B103. Multiple cableways on steel decks and bulkheads (surface ships).

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NOTES (continued):

5. The maximum lengths of the cable hangers shall not exceed the following:
   a. Steel angle downcomer from deck: 38 inches.
   b. Steel channel downcomer from deck: 65 inches.
   c. Steel angle downcomer from bulkhead: 20 inches.
   d. Steel channel downcomer from bulkhead: 36 inches.
6. The maximum center-to-center hanger spacing shall not exceed the limits in 5.7.3.1.
7. The attachment method shall be in accordance with illustrations 2 and 3. See weld note 3 after illustration 3 for attaching to plating less than ¼ inch thick.
8. A minimum clearance of ½ inch shall be maintained from the largest cable to adjacent structure, tier, or insulation.
9. Cable banding shall be in accordance with Appendix 4C.
10. Weld studs shall be steel. See 5.7.3.8.
11. See 5.7.3.7 for fastener and fastener material requirements. The orientation of the fastener connection between the weld stud and downcomer should be as shown in illustration 1 to maximize the shear strength of the connection.

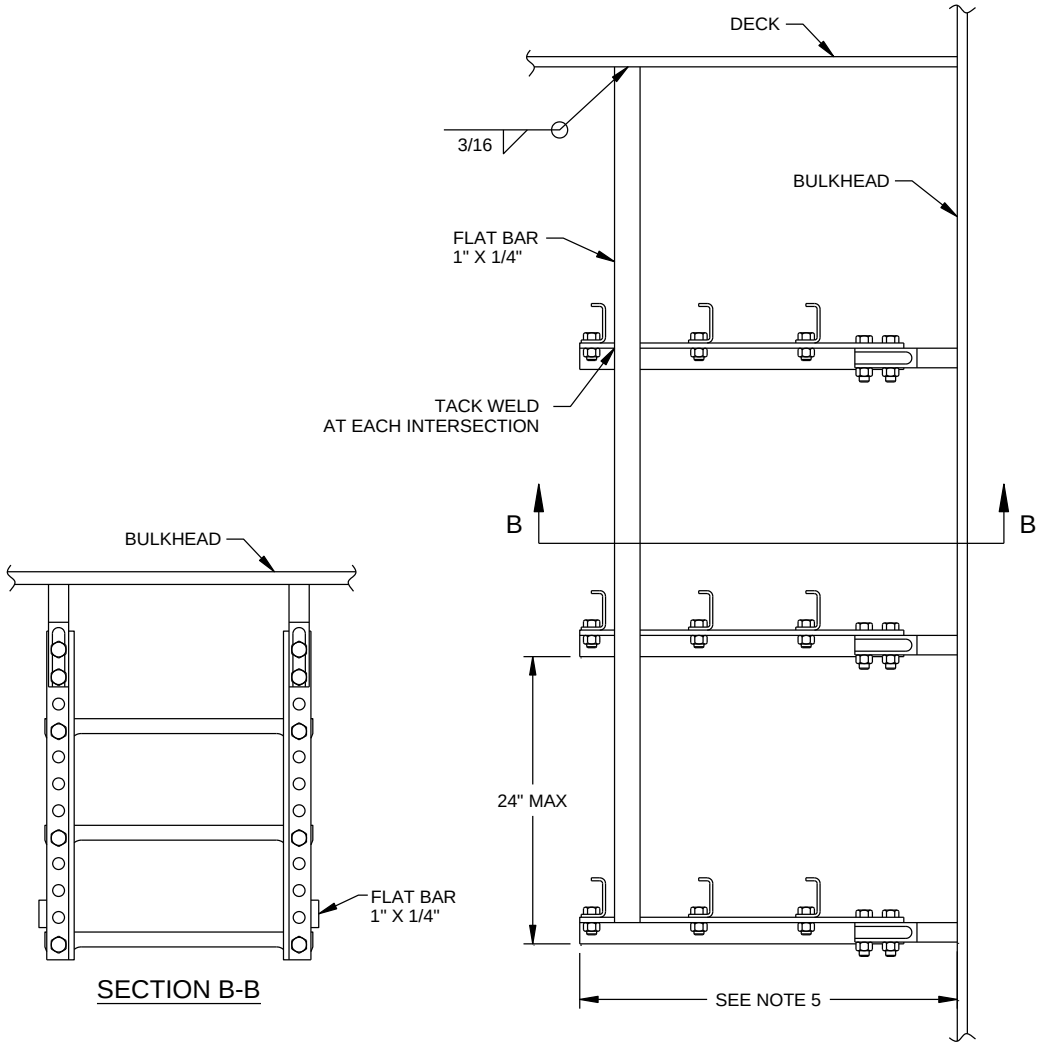

Illustration 2 – Additional Support for Bulkhead Attached Cableway

FIGURE 4B103. Multiple cableways on steel decks and bulkheads (surface ships) – Continued.

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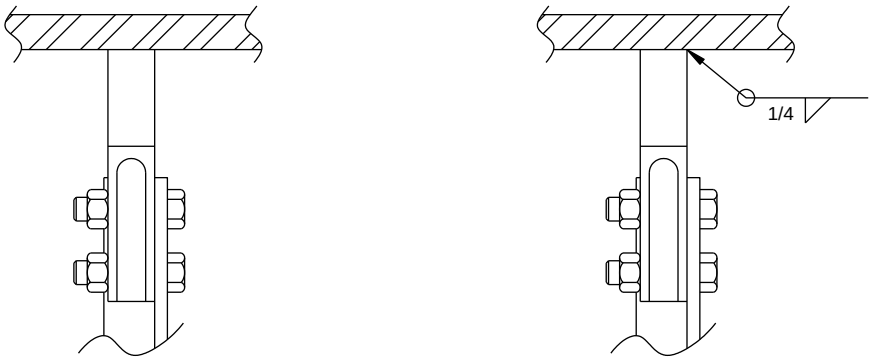

Illustration 3 – Rounded Corner Welded Stud Attachment

WELD NOTES:

1. All welding shall be in accordance with 5.7.3.6.
2. Type 1 is the preferred attachment method using ¾ inch round/square studs.
3. Use type 2 (SMAW) weld attachment method for plating less than ¼ inch thick. Type 2 attachments may also be used when stud welding is not practical. When SMAW welding, the flux ball at the base of the stud shall be completely removed.

FIGURE 4B103. Multiple cableways on steel decks and bulkheads (surface ships) – Continued.

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Method 4B-103-2
Inverted “T” Type Cableway hangers, Stud Weld Attachment - Steel

NOTES:

1. This method is for installation of stud welded inverted “T” hangers for main cableways.
2. A maximum of three tiers may be used for this cable hanger.
3. Maximum hanger spacing shall not exceed the limits in 5.7.3.1.
4. The orientation for this hanger is restricted to parallel to the ship fore and aft axis.
5. See 5.7.3.6 for welding requirements.
6. See 5.7.3.4 for cable retention requirements.
7. Cable orientation restricted to the ship fore/aft axis.
8. See 5.7.3.7 for fastener and fastener material requirements.
9. See 5.7.3.8 for collar and welding stud requirements.

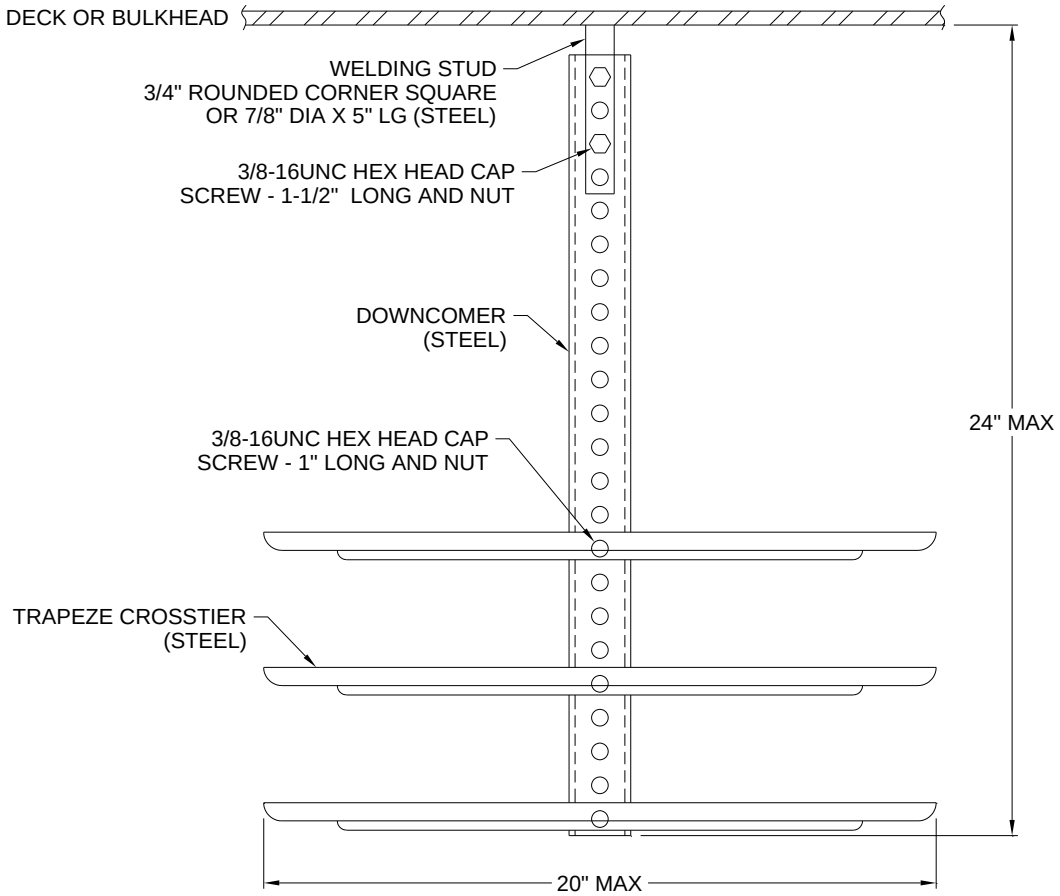

FIGURE 4B103. Multiple cableways on steel decks and bulkheads (surface ships) – Continued.

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Method 4B-103-3
Trapeze Type Cable Hangers, Stud Weld Attachment, Square Tube Cross-Tiers – Steel

NOTES:

1. The number of tiers shall not exceed three.
2. Cable orientation shall be perpendicular to the ship fore/aft axis.
3. Hanger spacing shall not exceed the limits in 5.7.3.1.
4. See 5.7.3.7 for fastener and fastener material requirements.
5. See 5.7.3.8 for collar and welding stud requirements.

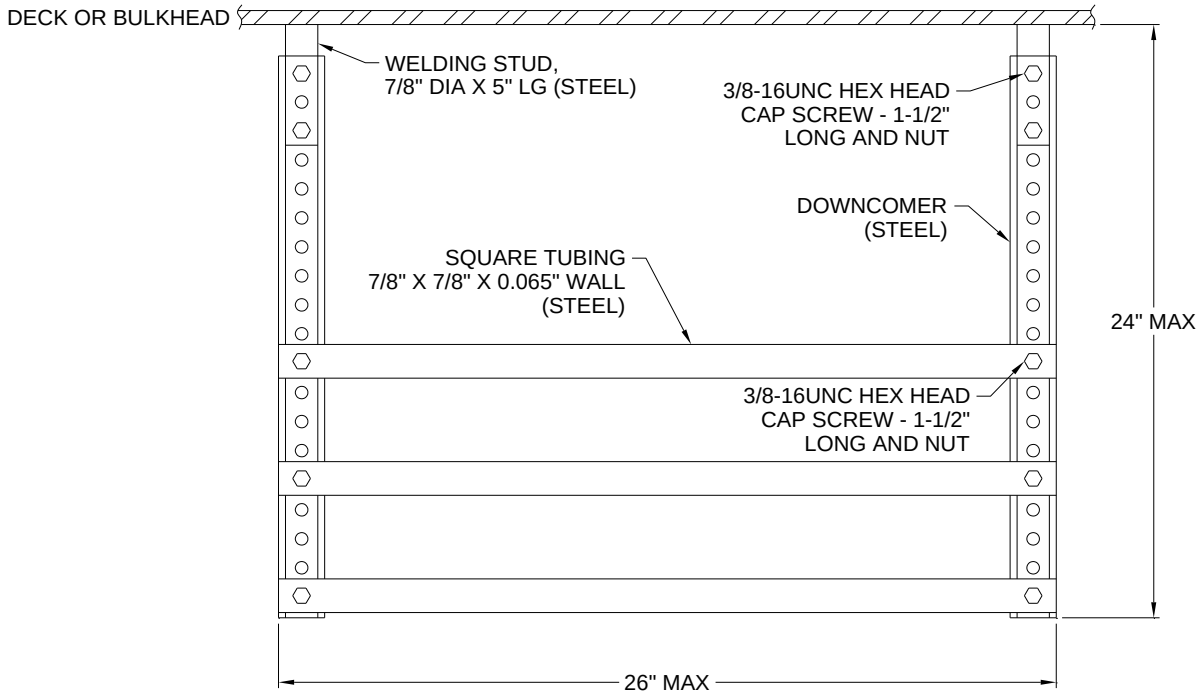

FIGURE 4B103. Multiple cableways on steel decks and bulkheads (surface ships) – Continued.

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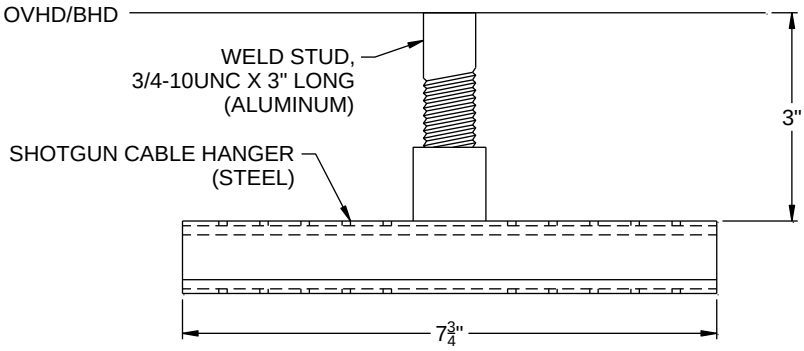
Method 4B-104-1
Shotgun Hanger Mounted with Aluminum Stud

NOTES:

1. Purpose: The purpose of this method is to provide requirements for installation of shotgun hangers mounted with an aluminum welding stud.
2. Maximum loading on hanger: 40 pounds.
3. Orientation restriction: none.
4. Hanger spacing: Shall not exceed the limits in 5.7.3.1.
5. Cross tier length: 7¾ inches.
6. Downcomer: ¾ inch x 3 inches aluminum stud.
7. Downcomer attachment method: stud weld (see 5.7.3.6).
8. Cable banding: see 5.7.3.4.
9. Cable diameter: limited to 1.5 inches maximum.
10. See 5.7.3.8 for collar and welding stud requirements.
11. See 5.7.3.7 for fastener and fastener material requirements.



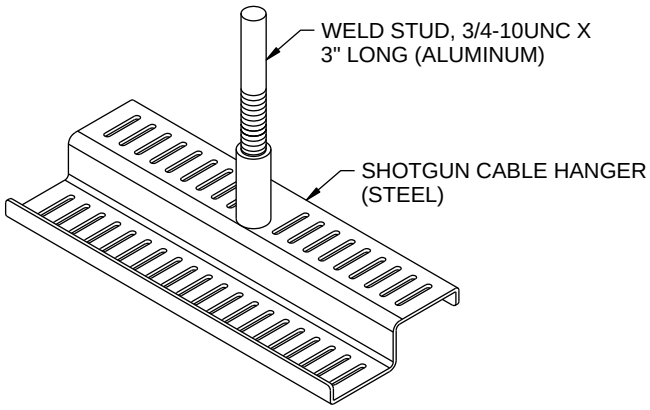


FIGURE 4B104. Shotgun hangers.

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Method 4B-104-2
Shotgun Hanger Mounted with Steel Stud

NOTES:

1. Purpose: The purpose of this method is to provide requirements for installation of shotgun hangers mounted with a steel welding stud.
2. Maximum loading on hanger: 20 pounds.
3. Orientation restriction: none.
4. Hanger spacing: Shall not exceed the limits in 5.7.3.1.
5. Cross tier length: 7¾ inches.
6. Downcomer: ⅜ inch x 6 inches steel stud.
7. Downcomer attachment method: stud weld (see 5.7.3.6).
8. Cable banding: see 5.7.3.4.
9. Cable diameter: limited to 1.5 inches maximum.
10. See 5.7.3.8 for collar and welding stud requirements.
11. See 5.7.3.7 for fastener and fastener material requirements.

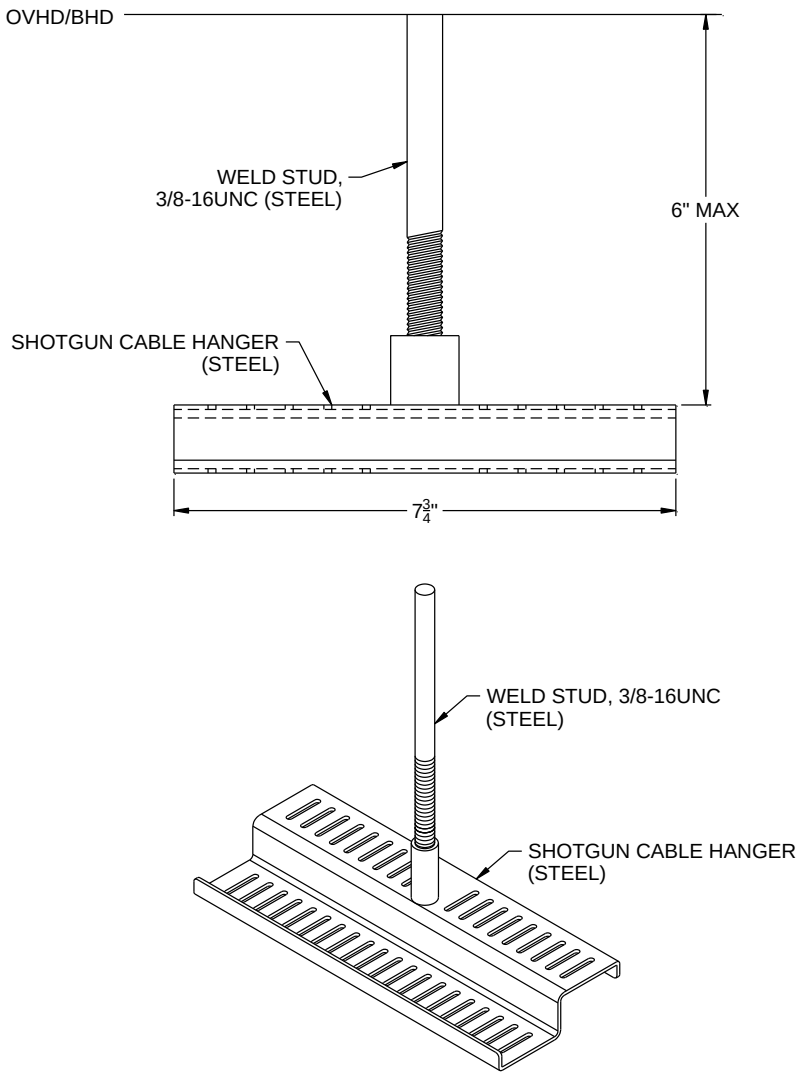

FIGURE 4B104. Shotgun hangers – Continued.

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General Notes:

1. Purpose: The purpose of these methods is to provide installation instructions for trapeze hangers to be installed beneath false decks.
2. A maximum of three tiers may be used for these cable hangers.

Method 4B-105-1
False Deck Trapeze Hanger Using Weld Studs – Steel

NOTES:

1. See general notes at the beginning of this figure.
2. Orientation: Cable orientation is restricted to parallel to the ship fore and aft axis.
3. Typical spacing above the top tier should be at least 2 inches. 1-inch spacing is acceptable.
4. Typical spacing between tiers is 4 inches. Non-standard spacing may be used.
5. Hanger spacing shall not exceed the limits in 5.7.3.1.
6. See 5.7.3.7 for fastener and fastener material requirements.
7. See 5.7.3.8 for collar and welding stud requirements.

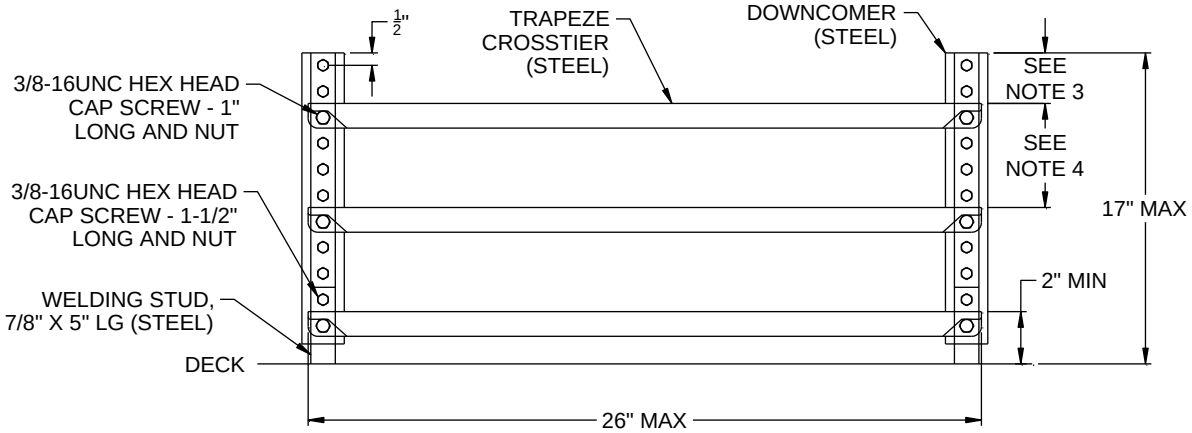

Illustration – Steel below deck trapeze hanger using weld studs.

FIGURE 4B105. Installation of false deck trapeze hangers.

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Method 4B-105-2
False Deck Trapeze Hanger, Direct Weld to Deck – Steel

NOTES:

1. See general notes at the beginning of this figure.
2. Maximum load per cross tier: 144 pounds.
3. Maximum load per hanger: 432 pounds.
4. Typical spacing above the top tier should be at least 2 inches. 1-inch spacing is acceptable.
5. Typical spacing between tiers is 4 inches. Non-standard spacing may be used.
6. Unrestricted hanger orientation.
7. See 5.7.3.6 for welding requirements. Weld directly to plating.
8. Hanger spacing shall not exceed the limits in 5.7.3.1.
9. See 5.7.3.7 for fastener and fastener material requirements.

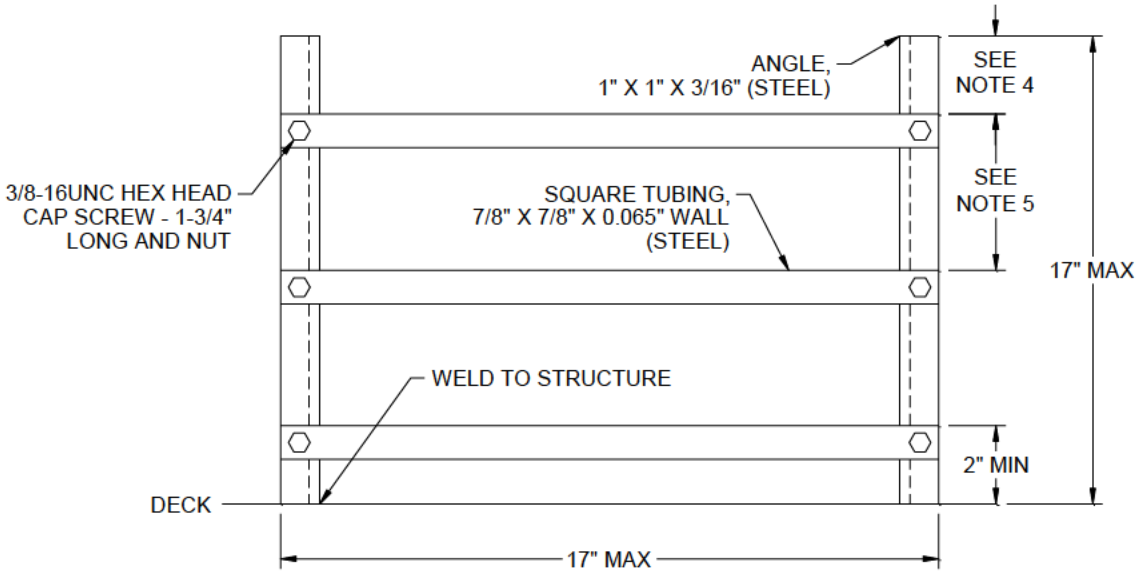

Illustration – False deck trapeze hanger, direct weld to deck – steel

FIGURE 4B105. Installation of false deck trapeze hangers – Continued.

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Method 4B-105-3
False Deck Trapeze Hanger, Direct Weld to Deck – Aluminum

NOTES:

1. See general notes at the beginning of this figure.
2. Maximum load per cross tier: 111 pounds.
3. Maximum load per hanger: 333 pounds.
4. Typical spacing above the top tier should be at least 2 inches. 1-inch spacing is acceptable.
5. Typical spacing between tiers is 4 inches. Non-standard spacing may be used.
6. Unrestricted hanger orientation.
7. See 5.7.3.6 for welding requirements. Weld directly to plating.
8. Hanger spacing shall not exceed the limits in 5.7.3.1.
9. See 5.7.3.7 for fastener and fastener material requirements.

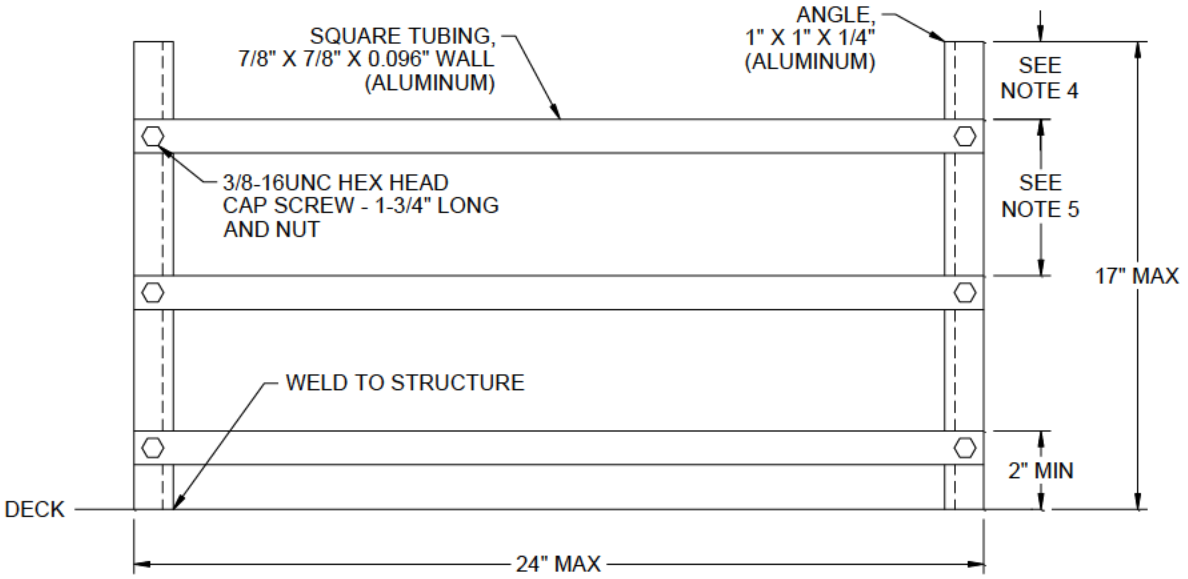

Illustration – False deck trapeze hanger, direct weld to deck – aluminum

FIGURE 4B105. Installation of false deck trapeze hangers – Continued.

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Method 4B-105-4
False Deck Trapeze Hanger, Direct Weld to Deck – Aluminum

NOTES:

1. See general notes at the beginning of this figure.
2. Maximum load per cross tier: 111 pounds.
3. Maximum load per hanger: 333 pounds.
4. Typical spacing above the top tier should be at least 2 inches. 1-inch spacing is acceptable.
5. Typical spacing between tiers is 4 inches. Non-standard spacing may be used.
6. Unrestricted hanger orientation.
7. See 5.7.3.6 for welding requirements. Weld directly to plating.
8. Hanger spacing shall not exceed the limits of 5.7.3.1.
9. See 5.7.3.7 for fastener and fastener material requirements.

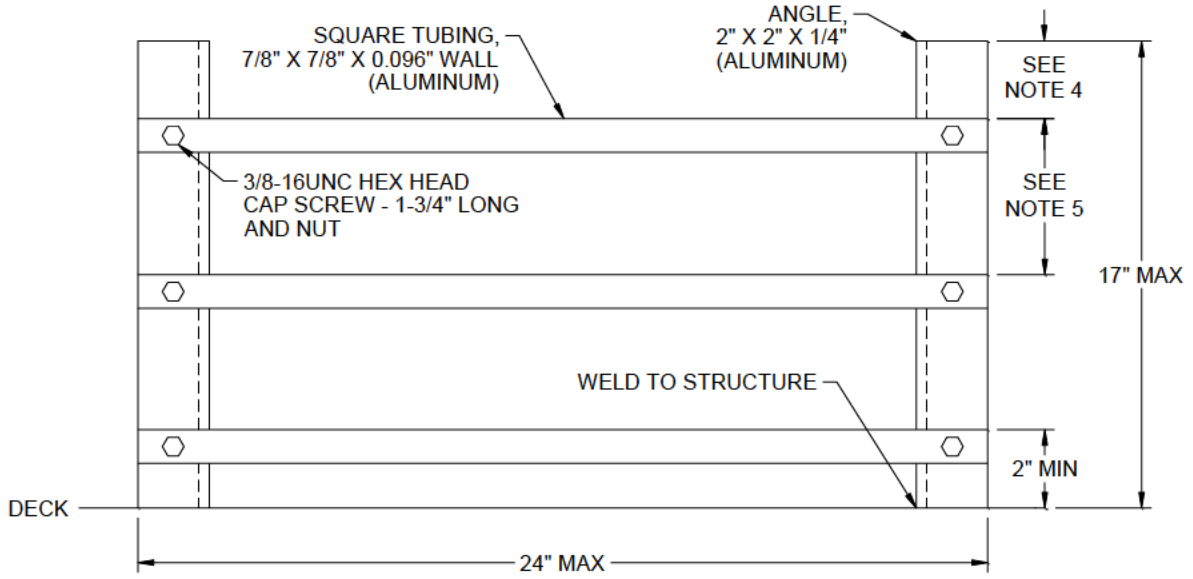

Illustration – False deck trapeze hanger, direct weld to deck – aluminum

FIGURE 4B105. Installation of false deck trapeze hangers – Continued.

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General Notes:

1. The purpose of this figure is to provide methods for installation of bulkhead and overhead “L” hangers.
2. A maximum of one cable tier is allowed for these cable hangers.
3. Orientation: Unrestricted.
4. Cable retention and banding: See 5.7.3.4.
5. Welding shall be in accordance with 5.7.3.6.

Method 4B-106-1
Aluminum Bulkhead “L” Hangers

NOTES:

1. Spacing: Shall not exceed the limits of 5.7.3.1.
2. See 5.7.3.6 for welding requirements.

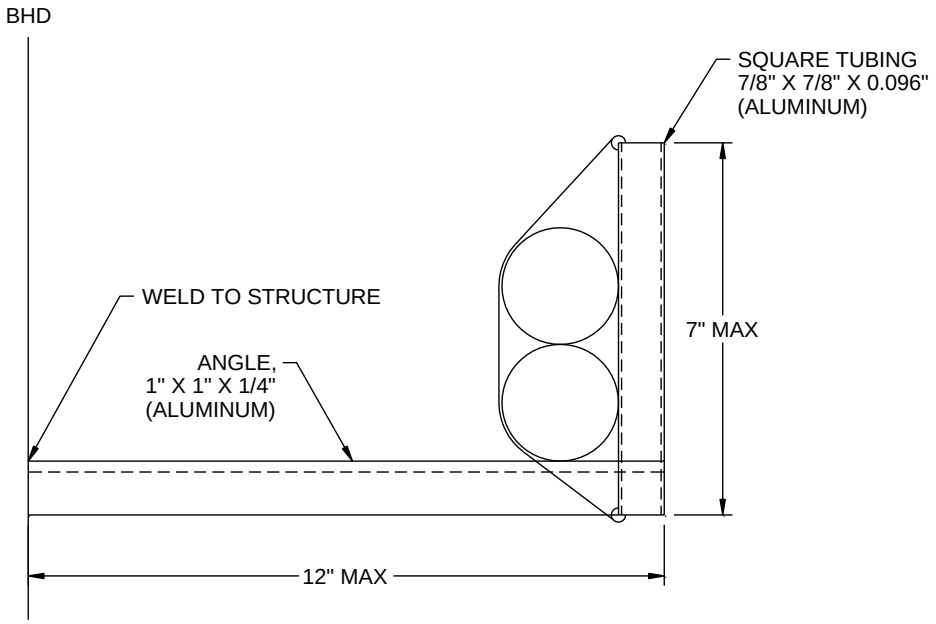

FIGURE 4B106. Bulkhead and overhead “L” hangers.

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Method 4B-106-2
Steel Bulkhead “L” Hangers Attached to Aluminum Bulkheads

NOTES:

1. This method is for attaching a steel hanger to an aluminum bulkhead.
2. Adhere to 5.7.3.1 requirements for interspersing steel hangers with aluminum hangers for cableways attached to aluminum bulkheads or decks.
3. Spacing, as required by 5.7.3.1.
4. See 5.7.3.6 for welding requirements.
5. See 5.7.3.7 for fastener and fastener material requirements.

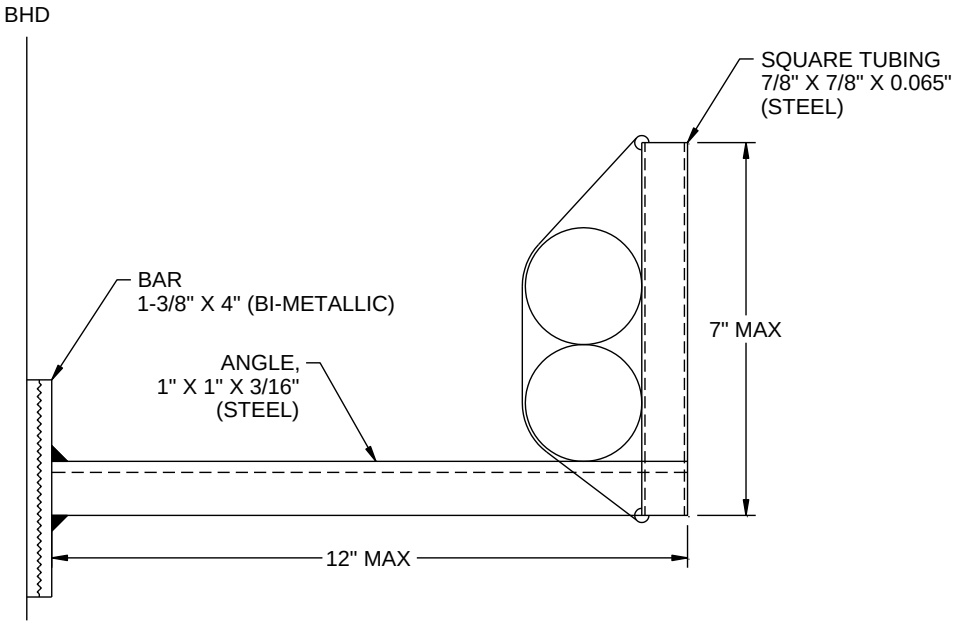

FIGURE 4B106. Bulkhead and overhead “L” hangers – Continued.

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Method 4B-106-3
Steel Bulkhead “L” Hangers

NOTES:

1. Weld directly to bulkhead.
2. Maximum spacing shall not exceed the limits of 5.7.3.1.

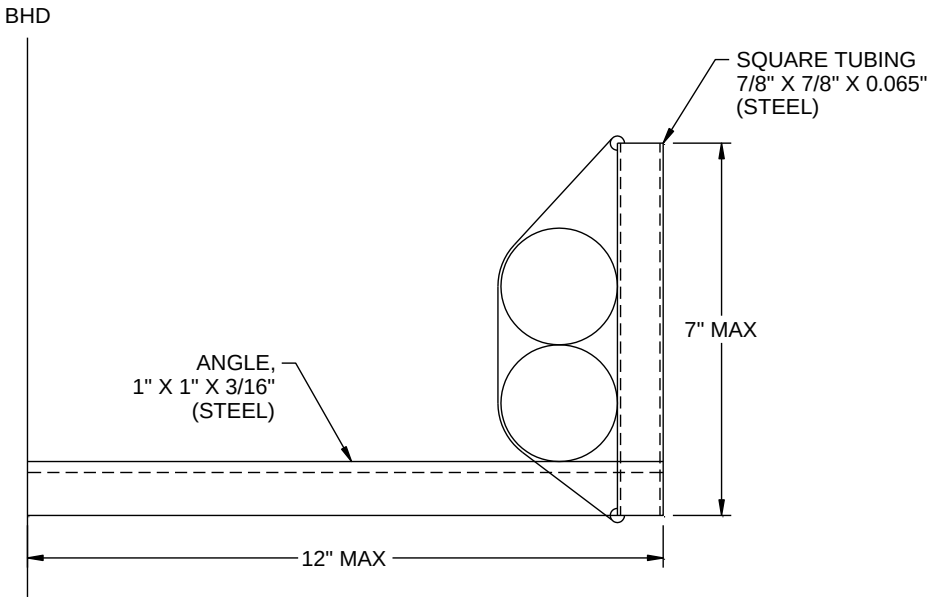

FIGURE 4B106. Bulkhead and overhead “L” hangers – Continued.

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Method 4B-106-4
Aluminum Overhead “L” Hangers

NOTE:

1. Maximum spacing shall not exceed the limits of 5.7.3.1.

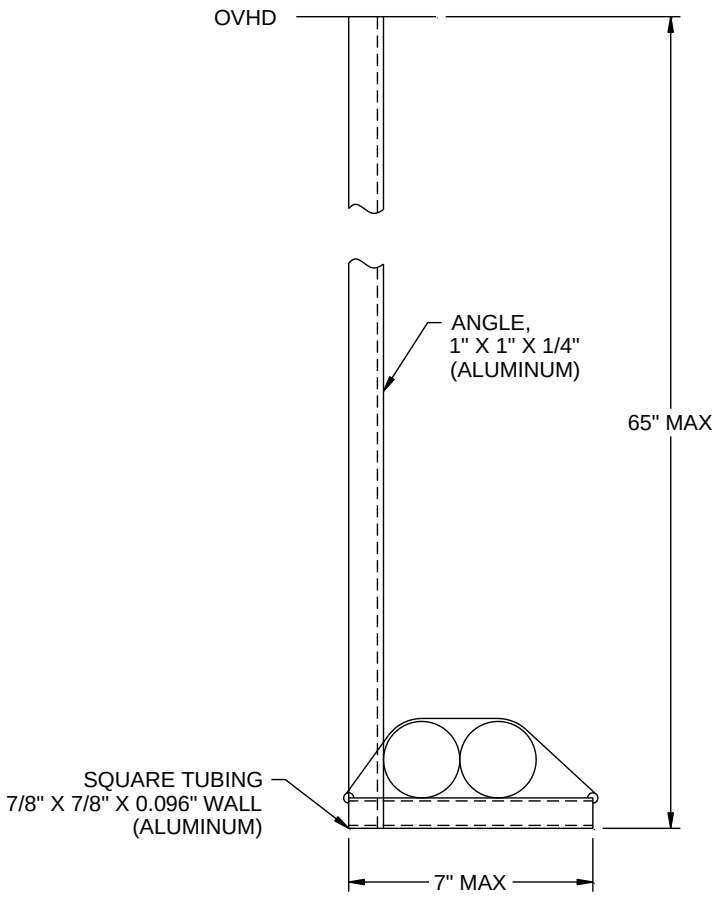

FIGURE 4B106. Bulkhead and overhead “L” hangers – Continued.

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Method 4B-106-5
Steel Overhead “L” Hangers Attached to Aluminum Overheads

NOTES:

1. This method is for attaching a steel hanger to an aluminum overhead.
2. Adhere to 5.7.3.1 requirements for interspersing steel hangers with aluminum hangers for cableways attached to aluminum bulkheads or decks.
3. Spacing, as required by 5.7.3.1.
4. See 5.7.3.7 for fastener and fastener material requirements.

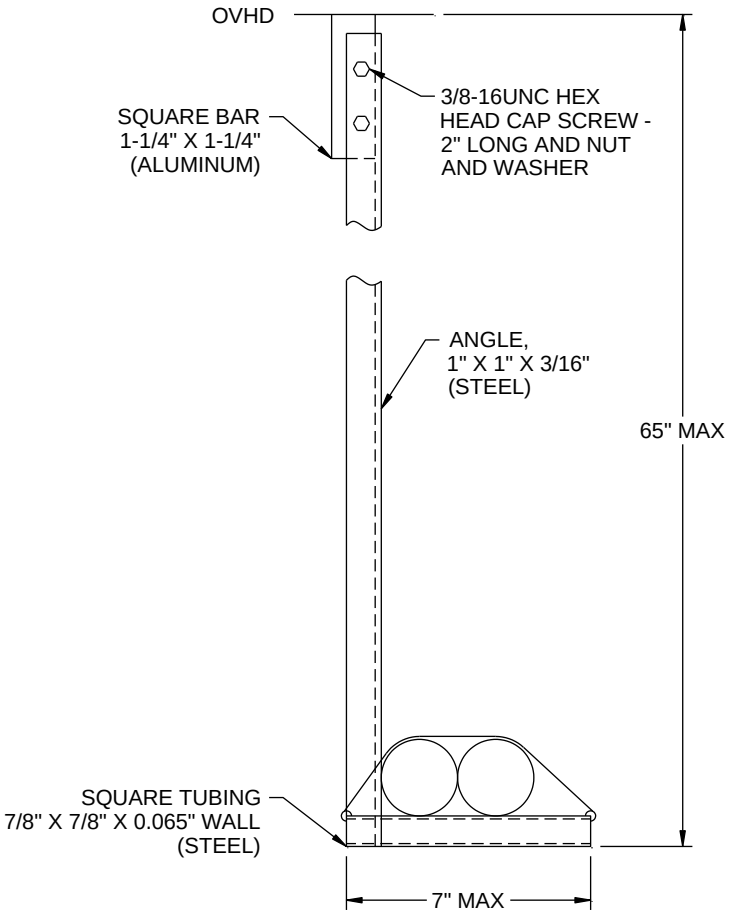

FIGURE 4B106. Bulkhead and overhead “L” hangers – Continued.

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Method 4B-106-6
Steel Overhead “L” Hangers

NOTE:

1. Maximum spacing shall not exceed the limits of 5.7.3.1.

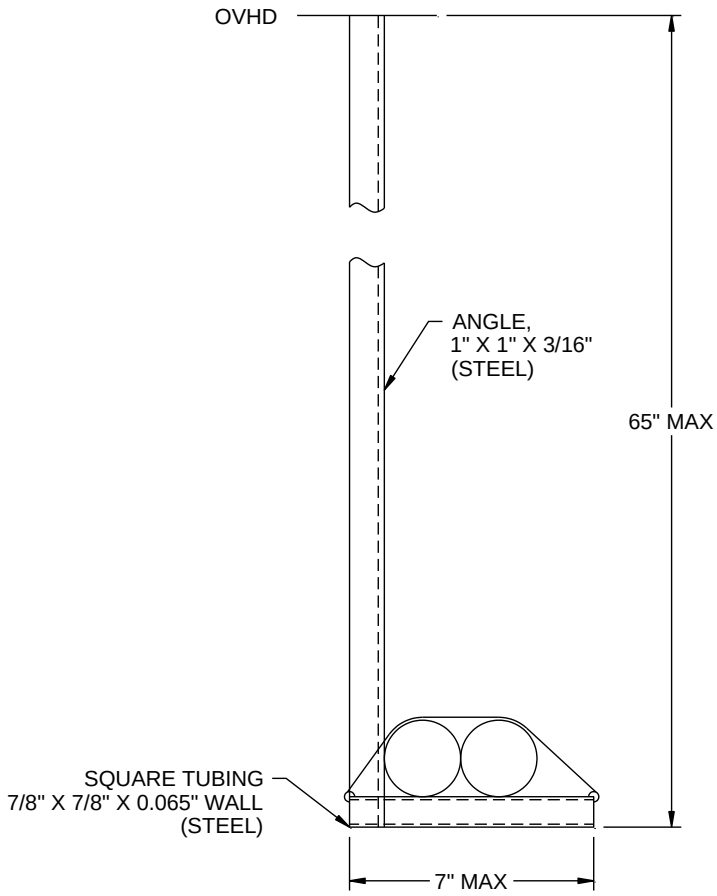

FIGURE 4B106. Bulkhead and overhead “L” hangers – Continued.

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NOTES:

1. One tier of cables maximum.
2. Unrestricted orientation.
3. Weld directly to overhead (see 5.7.3.6).

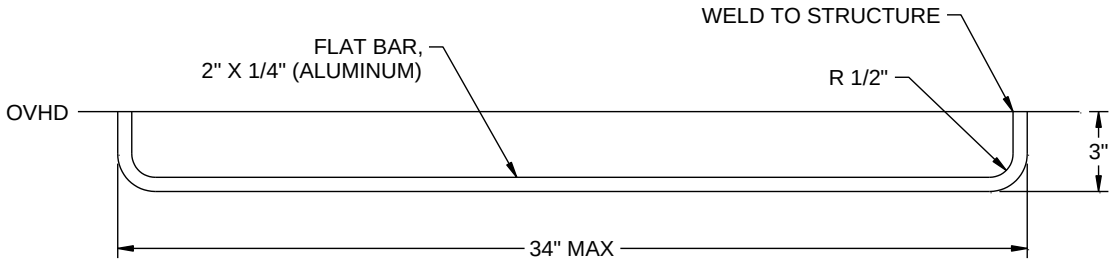

FIGURE 4B107. U-Bar hangers attached to overhead.

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APPENDIX 4C – CABLEWAYS (GENERAL)

C.1 SCOPE

C.1.1 Scope. This appendix describes general procedures for the installation of cableways on surface ships and submarines. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

C.2. APPLICABLE DOCUMENTS

C.2.1 General. The documents listed in this section are specified in this appendix. 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 this appendix, whether or not they are listed.

C.2.2 Government documents.

C.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-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-I-3064	-	Insulation, Electrical, Plastic-Sealer
MIL-PRF-6855	-	Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes, General Specification for
MIL-S-24149	-	Studs, Welding, and Arc Shields (Ferrules), General Specification for
MIL-S-24149/1	-	Stud, Welding, and Arc Shields (Ferrules); Type I, Class 1, 2, 3, and Type II, Class 1, 4, 5, 5A, 6, Carbon Steel, for Direct Energy Arc Welding
MIL-S-24149/2	-	Studs, Welding, and Arc Shields (Ferrules); Type III, Class 1, 2, 3, and Type IV, Class 1, 2, 3, 4, 5, 6, Aluminum Alloy, for Direct Energy Arc Welding
MIL-S-24149/3	-	Studs, Welding, and Arc Shields (Ferrules); Type V, Class 1, 4, 5, 5A, Corrosion-Resistant Steel, for Direct Energy Arc Welding

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)
MIL-STD-2003-3	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Penetrations)
MIL-STD-2042-4	-	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Cableways)

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

C.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.

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ASTM INTERNATIONAL

ASTM A240/A240M	-	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276/A276M	-	Standard Specification for Stainless Steel Bars and Shapes
ASTM A568/A568M	-	Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A666	-	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A693	-	Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A713	-	Standard Specification for Steel Wire, High-Carbon Spring, for Heat-Treated Components
ASTM B209	-	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B241/B241M	-	Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B633	-	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM D3953	-	Standard Specification for Strapping, Flat Steel and Seals
ASTM F1836M	-	Standard Specification for Stuffing Tubes, Nylon, and Packing Assemblies (Metric)

(Copies of these documents are available online at www.astm.org.)

C.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.

C.3 REQUIRED EQUIPMENT AND MATERIALS

C.3.1 Required equipment and materials. The equipment and materials in the tables and referenced in the text of this appendix shall be used for the installation of cableways on surface ships and submarines. For fiber optic cable, refer to MIL-STD-2042-4. Refer to 5.7.3.7 for requirements regarding the use of mounting fasteners.

C.4 NOTES AND PROCEDURES

C.4.1 Dimensions. For figures and tables in this appendix, all dimensions are in inches unless otherwise noted.

C.4.2 Figures. Table 4CI provides information for the figures in this appendix. Figures 4C2 through 4C12 and 4C35 are for local runs only.

TABLE 4CI. Figures for the installation of cableways on surface ships and submarines.

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TABLE 4CI. Figures for the installation of cableways on surface ships and submarines – Continued.

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TABLE 4CI. Figures for the installation of cableways on surface ships and submarines – Continued.

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C.4.3 Material list. Tables 4CII through 4CVII provide material information for the welded studs and cable loop hangers used in figures in this appendix. These tables are for user information to provide stock numbers for individual parts. The technical requirements in the figures in this appendix shall be met.

TABLE 4CII. ⅜-16UNC angled threaded collar studs.

Length	MIL-S-24149/1 steel type II, class 6	MIL-S-24149/3 CRES type V	MIL-S-24149/2 aluminum type IV, class 4
0.625	5307-01-148-8237	5307-01-293-9583	--
0.750	5307-01-293-1815	5307-01-293-9584	--
0.875	5307-01-148-3720	5307-01-293-9585	--
1.000	5307-01-293-6161	5307-01-293-9586	5307-01-293-9596
1.125	5307-01-293-6162	5307-01-293-9587	5307-01-293-9597
1.250	5307-01-293-1816	5307-01-293-9588	5307-01-294-4372
1.350	--	--	5307-01-294-1750
1.500	5307-01-293-1074	5307-01-293-9589	5307-01-294-1751
1.625	--	--	5307-01-294-0267
1.750	5307-01-293-6163	5307-01-293-9590	5307-01-294-3147
1.875	--	--	5307-01-294-0268
2.000	5307-01-293-1075	5307-01-293-9591	5307-01-294-1752
2.250	--	--	5307-01-295-1097
2.500	5307-01-293-1817	5307-01-293-9592	--
3.000	5307-01-293-6164	5307-01-293-9593	--
3.500	5307-01-293-1076	5307-01-293-9594	--
4.000	5307-01-293-9598	5307-01-293-9595	--

TABLE 4CIII. 5/16-18UNC internal thread welding studs - steel.

Length	MIL-S-24149/1 steel type II, class 5A	MIL-S-24149/3 CRES 316 type V, class 5A
0.875	5307-01-295-7614	5307-01-293-5411
1.000	5307-01-294-3146	5307-01-293-5412
1.125	5307-01-294-2273	5307-01-295-0179
1.250	5307-01-293-2911	5307-01-293-9578
1.375	5307-01-293-2912	5307-01-293-9579
1.500	5307-01-293-1073	5307-01-293-9580
1.625	5307-01-293-2913	5307-01-294-1747
1.750	5307-01-293-2914	5307-01-293-5413
1.875	5307-01-293-1814	5307-01-293-9581
2.000	5307-01-294-1748	5307-01-293-9582
2.250	5307-01-293-6710	5307-01-294-4367
2.500	5307-01-293-6711	5307-01-293-5414
2.750	5307-01-294-4368	5307-01-293-5415
3.000	5307-01-294-4369	5307-01-293-5416

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TABLE 4CIV. 5/16-18UNC internal thread welding studs - aluminum.

Length	MIL-S-24149/2 aluminum type IV, class 5	Length	MIL-S-24149/2 aluminum type IV, class 5
1.000	5307-01-293-5417	1.875	5307-01-293-5424
1.125	5307-01-293-5418	2.000	5307-01-293-5425
1.250	5307-01-293-5419	2.250	5307-01-293-6712
1.375	5307-01-293-5420	2.500	5307-01-294-6829
1.500	5307-01-293-5421	2.750	5307-00-306-4912
1.625	5307-01-293-5422	3.000	5307-01-294-1749
1.750	5307-01-293-5423		

TABLE 4CV. 3/8-16UNC external thread welding studs.

Length	MIL-S-24149/1 steel type II, class 1	MIL-S-24149/3 CRES 316 type V, class 4 (Military P/N or NSN)	MIL-S-24149/2 aluminum type IV, class 1
0.750	5307-01-293-7981	M24149/3-35	5307-01-298-5394
0.875	5307-01-294-3148	M24149/3-36	5307-01-293-5428
1.000	5307-01-293-1818	5307-01-530-8842	5307-01-293-5427
1.250	5307-01-294-3149	M24149/3-39	5307-01-293-5426
1.500	5307-01-244-6967	5307-01-325-5380	5307-01-293-5429
1.750	5307-01-280-9436	M24149/3-43	5307-01-293-5430
2.000	5307-01-293-1819	5307-01-439-5175	5307-01-294-4370
2.500	5307-01-292-9609	5307-01-235-3230	5307-01-293-5431
3.000	5307-01-292-9610	M24149/3-49	5307-01-293-5432
3.500	5307-01-294-3150	M24149/3-51	5307-01-294-4371
4.000	5307-01-295-1098	--	5307-01-293-7980

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TABLE 4CVI. National stock numbers (NSNs) for 5/16-18UNC external thread collar studs.

Length	MIL-S-24149/1 steel type II, class 4	MIL-S-24149/3 CRES type V, class 4	MIL-S-24149/2 aluminum type IV, class 3
1.000	5307-01-294-3145	5307-01-294-1746	--
1.125	5307-01-293-5408	5307-01-294-4364	--
1.250	5307-01-293-1806	5307-01-294-3144	--
1.350	5307-01-293-1807	--	--
1.375	--	5307-01-294-4365	5307-01-293-6708
1.500	5307-01-293-1808	5307-01-295-0178	5307-01-294-4366
1.625	5307-01-293-1809	5307-01-295-2586	5307-01-293-6709
1.750	5307-01-293-6158	5307-01-294-8129	5307-01-293-5410
1.875	5307-01-293-6159	5307-01-293-6703	--
2.000	5307-01-293-6160	5307-01-293-6704	--
2.250	5307-01-292-9602	5307-01-294-4357	--
2.500	5307-01-293-1810	5307-01-293-7979	--
2.750	5307-01-293-1811	--	--
3.000	5307-01-293-5409	5307-01-293-6705	--
3.250	5307-01-293-1812	--	--
3.500	5307-01-292-9603	5307-01-293-6706	--
3.750	5307-01-292-9604	--	--
4.000	5307-01-292-9605	5307-01-293-6707	--
4.250	5307-01-292-9606	--	--
4.500	5307-01-292-9607	--	--
4.750	5307-01-293-1813	--	--
5.000	5307-01-292-9608	--	--
5.250	5307-01-293-1072	--	--
5.500	5307-01-293-9577	--	--

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TABLE 4CVII. Cable loop hangers.

Type	Size	Material	National stock number
Single loop	0.531	CRES 316	5975-01-294-2133
	0.358	CRES 316	5975-01-294-2134
	0.680	CRES 316	5975-01-294-2135
	0.900	CRES 316	5975-01-294-2136
	0.750	CRES 316	5975-01-294-2137
	1.224	CRES 316	5975-01-294-2138
	0.531	Steel	5975-01-030-9018
	0.680	Steel	5975-01-020-9171
	1.224	Steel	5975-01-114-8071
	0.750	Steel	5975-01-294-9092
	0.358	Steel	5975-01-294-9093
Double loop	0.531	CRES 316	5975-01-020-9174
	0.358	CRES 316	5975-01-294-6558
	0.680	CRES 316	5975-01-294-2132
	0.900	CRES 316	5975-01-239-2353
	0.531	Steel	5975-01-020-9174
	0.680	Steel	5975-01-020-9176
	0.900	Steel	5975-01-020-9177
	0.358	Steel	--
	1.000	CRES 316	5975-01-294-9090
	1.000	Steel	5975-01-082-0894
Triple loop	0.531	CRES 316	5975-01-294-9091
	0.531	Steel	5975-01-020-9183

C.4.4 Cable banding general requirements See figures 4C52 through 4C56.

a. Cables shall be arranged so that the larger cables are in the center of the hanger, if possible.

b. The length of banding hanger shall not be less than the overall width of cables for a single cable or a row of cables.

c. The minimum radius of bend shall be as specified in 5.2.

d. For the application of banding material on figures 4C52 through 4C56, band requirements are as follows:

(1) Single cables 1-inch diameter and under: 0.015 inch thick, one turn

(2) Single cables over 1-inch diameter: 0.015 inch thick, two turns

(3) Multiple cables 2-inch diameter and under: 0.015 inch thick, two turns

(4) Multiple cables over 2-inch diameter: 0.015 inch thick, three turns or 0.020 inch thick, two turns

e. For fully loaded hangers (where hanger width does not exceed the width of a single cable or a single row of cables by more than ½ inch), use method 4C-55-2.

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f. The banding method shall be used to support coaxial cables except coaxial cables of the semi-solid dielectric type. Semi-solid dielectric coaxial cables shall be supported by the contour strap methods such as those shown on figures 4C23, 4C24, and 4C25.

g. For weather decks or highly corrosive areas, use CRES band, sizes and material in accordance with C.4.4.d and 5.7.3.2.1.

h. In non-magnetic minesweepers, use CRES band except that an aluminum band (0.025 inch thick, see table 4CVIII for strapping material) may be used where cables are under 2 inches in diameter and hanger spacing is 21 inches on center, maximum.

i. Material information for cable banding strapping is shown in table 4CVIII and 5.7.3.2.1.

TABLE 4CVIII. Material specification for banding strapping.

Material	Dimensions (inches)		Specifications	Finish
	Width	Thickness		
Mild steel	⅝	0.015	ASTM D3953, type 1, class B, grade 1	Zinc electro-plated
CRES	⅝	0.015	ASTM A240/A240M, ASTM A666, ASTM A693, ASTM A276/A276M	2D
Aluminum	⅝	0.025	ASTM B209	None
Mild steel	⅝	0.020	ASTM D3953, type 1, class B, grade 1	Zinc electro-plated
CRES	⅝	0.020	ASTM A240/A240M, ASTM A666, ASTM A693, ASTM A276/A276M	2D

j. When installing and cutting banding material, follow the instructions of the manufacturer of the banding tool. Tools for cutting plastic and metal cable wraps as part of wrapping cables should be selected to prevent sharp edges that could result in personnel injury and damage to equipment and cables.

k. Channel rubber shall be installed in accordance with 5.3.7. Information for channel rubber size, material, and specification is in table 4CIX.

TABLE 4CIX. Material specification for rubber channel.

Material	Size (inches)			Specification
	Width	Channel	Height	
Rubber	⅞	⅝	5⁄16	MIL-PRF-6855, class 2, group 60

l. Marine snaplock type cable clamps (hose-clamps), Ideal Clamp Products, Inc., or equal (see 4.3), may be used, with a maximum diameter as specified in table 4CX. Ideal Clamp Products “56” series, or equal (see 4.3), cable retention devices of a length not greater than 22 inches are approved as an alternate to conventional banding materials. Dimensions for Ideal Clamp Products “56” series snaplock cable clamps are detailed in table 4CX.

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TABLE 4CX. Material specification for snaplock cable clamps.

Part no.	Clamp length	Clamp diameter (max.)	Stock number
5612	4	1.250	9B 4730-01-298-5296
5620	5½	1.750	9B 4730-00-864-4299
5628	7	2.250	9B 4730-00-020-4270
5636	8½	2.750	9B 4730-00-720-1274
5648	11	3.500	9B 4730-00-988-8390
5656	12½	4.000	9B 4730-00-132-9948
5672	16	5.120	9B 4730-00-880-3539
5688	18½	6.000	9B 4730-00-617-6921
56104	22	7.120	9B 4730-01-037-1374

WARNING: Marine snaplock cable clamps are prohibited for use in reactor compartments. Justification: Portsmouth Naval Shipyard Liaison Action Request (LAR) #PNS725-51 of 9/29/98 issued to request determination on use of "Marine Snaplock Cable Clamps" in reactor compartments. In response, Nuclear Liaison Inquiry #NLI-2535 issued by EB and approved by NAVSEA 08 prohibited their use in reactor compartments.

C.4.4.1 Panduit® Pan-Steel™, or equal (see 4.3), strapping. Panduit® Pan-Steel™, or equal (see 4.3), strapping is acceptable for use on surface ships and submarines subject to the following conditions:

a. Cable straps shall be applied in conjunction with channel rubber.

b. The maximum bundle diameter shall not exceed 3 inches. Panduit banding may be used for larger bundle diameters for non-weight bearing applications with specific NAVSEA approval.

c. The maximum static weight of the cable bundle shall not exceed 6 pounds per Metal Locking Tie (MLT).

d. In horizontal installations, the cable straps shall be no greater than 16 inches on-center apart. In vertical cable installations, the cable straps shall be no greater than 12 inches apart.

e. For the installation of Panduit®, or equal (see 4.3), banding, use the appropriate tool as specified by the manufacturer.

f. Part numbers, sizes, and stock numbers for Panduit® banding are detailed in tables 4CXI and 4CXII.

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TABLE 4CXI. Panduit® Pan-Steel™ strapping.

Single wrap, 304 stainless (inside hull)				
Part number	**Length**	**Width**	**Thickness**	**Quantity**
MLT4SH-LP	17.1	⅝	0.015	50
MLT8SH-LP	29.7	⅝	0.015	50
MLT12SH-Q	42.2	⅝	0.015	50
Single wrap, 316 stainless (topside)				
Part number	**Length**	**Width**	**Thickness**	**Quantity**
MLT4EH15-LP316	17.1	½	0.015	50
MLT6EH15-LP316	23.4	½	0.015	50
MLT8EH15-LP316	29.7	½	0.015	50
Double wrap, 304 stainless (inside hull)				
Part number	**Length**	**Width**	**Thickness**	**Quantity**
MLT4DSH-Q	29.5	⅝	0.015	25
MLT6DSH-Q	41.5	⅝	0.015	25
MLT8DSH-Q	53.5	⅝	0.015	25
Double wrap, 316 stainless (topside)				
Part number	**Length**	**Width**	**Thickness**	**Quantity**
MLT4DEH15-Q316	29.5	½	0.015	25
MLT6DEH15-Q316	41.5	½	0.015	25
MLT8DEH15-Q316	53.5	½	0.015	25

TABLE 4CXII. Panduit® Pan-Steel™ strapping stock numbers.

Panduit® part number	**National stock number (NSN)**	**Panduit® part number**	**National stock number (NSN)**
MLT4EH15-LP316	5975-01-526-3677	MLT12SH-LP316	N/A
MLT6EH15-LP316	5975-01-526-3679	MLT4DSH-Q316	5975-01-526-4437
MLT8EH15-LP316	5975-01-526-3678	MLT6DSH-Q316	5975-01-526-3685
MLT10EH15-LP316	N/A	MLT8DSH-Q316	5975-01-526-3684
MLT12EH15-LP316	N/A	MS4W50T15-L6	N/A
MLT4DEH15-Q316	N/A	MS6W50T15-L6	N/A
MLT6DEH15-Q316	N/A	MS8W50T15-L6	N/A
MLT8DEH15-Q316	N/A	MS10W50T15-L6	N/A
MLT4SH-LP316	5975-01-526-3680	MS4W63T15-L6	N/A
MLT6SH-LP316	N/A	MS6W63T15-L6	N/A
MLT8SH-LP316	5975-01-526-3683	MS8W63T15-L6	N/A
MLT10SH-LP316	N/A	N/A	N/A

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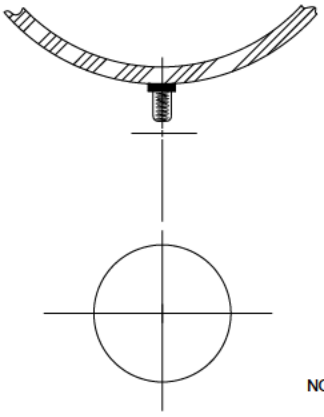
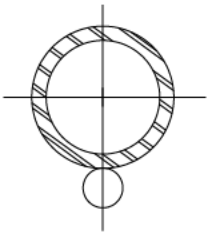
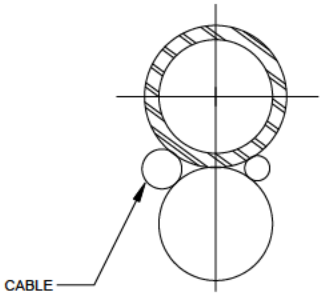
METHOD 4C-1-1
SINGLE CABLES ON STEEL STANCHIONS
HANGER SECURED WITH STUD



METHOD 4C-1-2
S NGLE CABLES ON SMALL STANCHIONS



METHOD 4C-1-3
TWO TO THREE CABLES ON
SMALL STANCHIONS



NOTE: METHODS SHOWN ON THIS SHEET ARE FOR USE WITH CABLES UP TO TWO INCHES N DIAMETER. FOR CABLES GREATER THAN TWO NCHES N DIAMETER, USE METHODS SHOWN ON FIGURE 4C2.

NOTE:

1. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4C1. Single cableway on steel stanchions.

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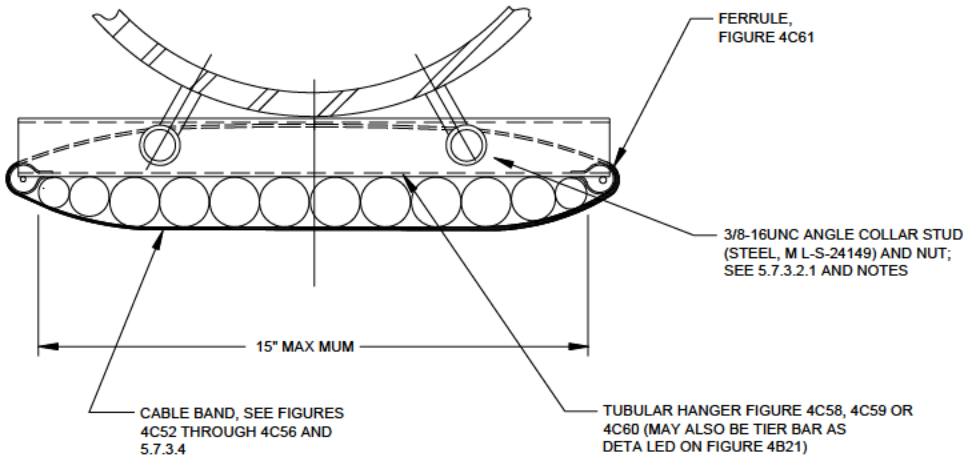
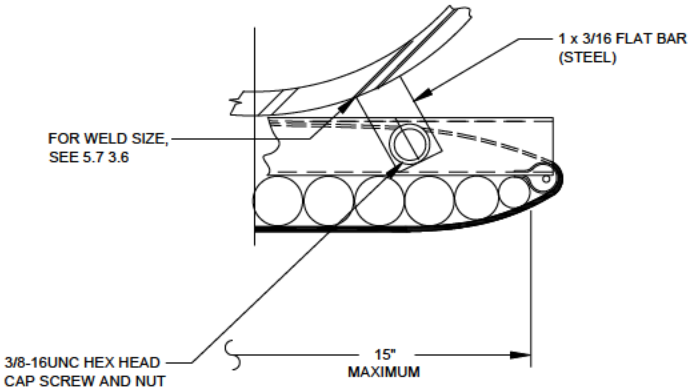
METHOD 4C-2-1
SINGLE TIER OF CABLES ON STEEL STANCHIONS SECURED
BY ANGLE COLLAR STUDS
(FOR LOCAL RUNS ONLY)



METHOD 4C-2-2
SINGLE TIER OF CABLES ON STEEL STANCHIONS SECURED
BY FLAT BAR
(FOR LOCAL RUNS ONLY)



NOTES:

1. See C.4.3, table 4CII, for angled collared stud material requirements.
2. See 5.7.3.7 for fastener and fastener material requirements.
3. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4C2. Single cableway on steel stanchion secured by angle collar studs or flat bar.

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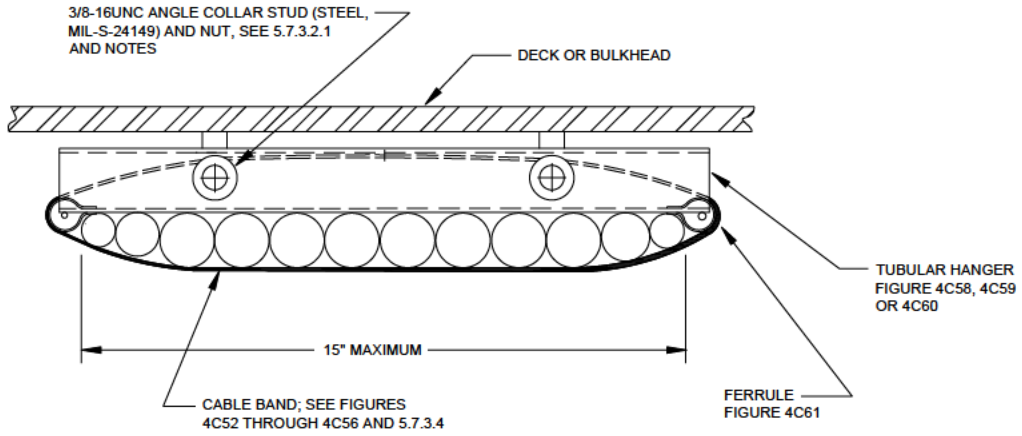
METHOD 4C-3-1
SINGLE TIER SECURED
WITH ANGLE COLLAR STUDS
(LOCAL RUNS ONLY)



NOTES:

1. See C.4.3, table 4CII, for angled collared stud material requirements.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C3. Single cableway on steel structure secured with angle collar studs.

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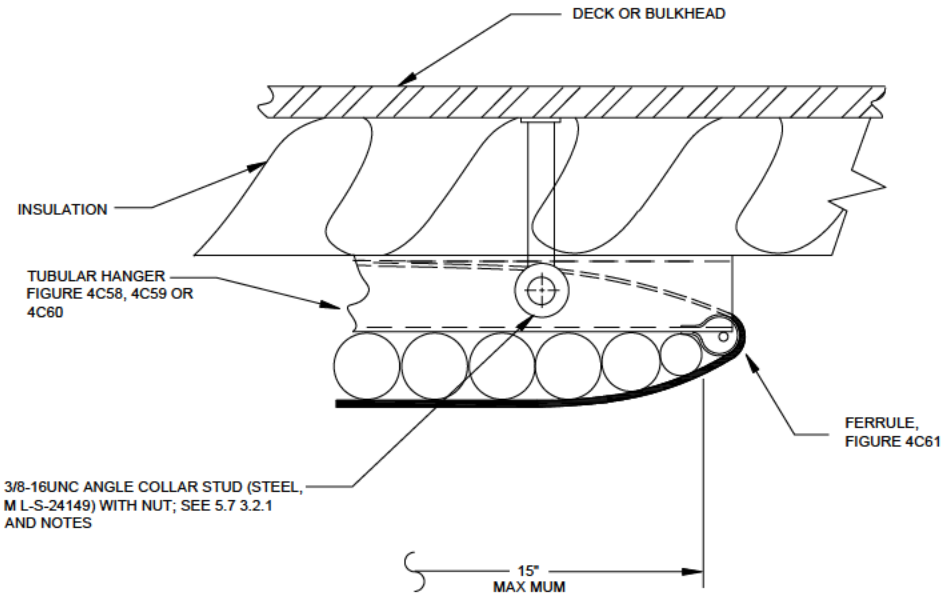
METHOD 4C-4-1
SINGLE TIER SECURED WITH ANGLE COLLAR STUDS
ON NSULATED DECKS & BULKHEADS
(LOCAL RUNS ONLY)



NOTES:

1. See C.4.3, table 4CII, for angled collared stud material requirements.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C4. Single cableway on insulated steel structure secured with angle collar studs.

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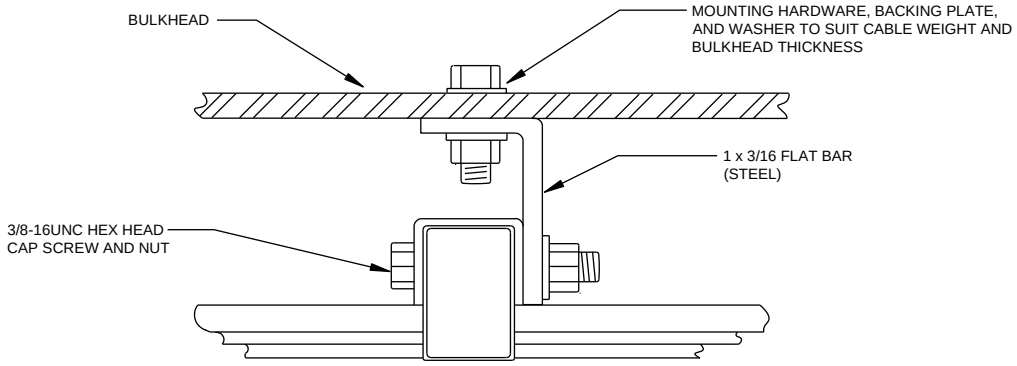
METHOD 4C-5-1
SINGLE TIER SECURED BY BOLTING
(LOCAL RUNS ONLY)



END V EW

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C5. Single cableway tier secured by bolting on steel structure.

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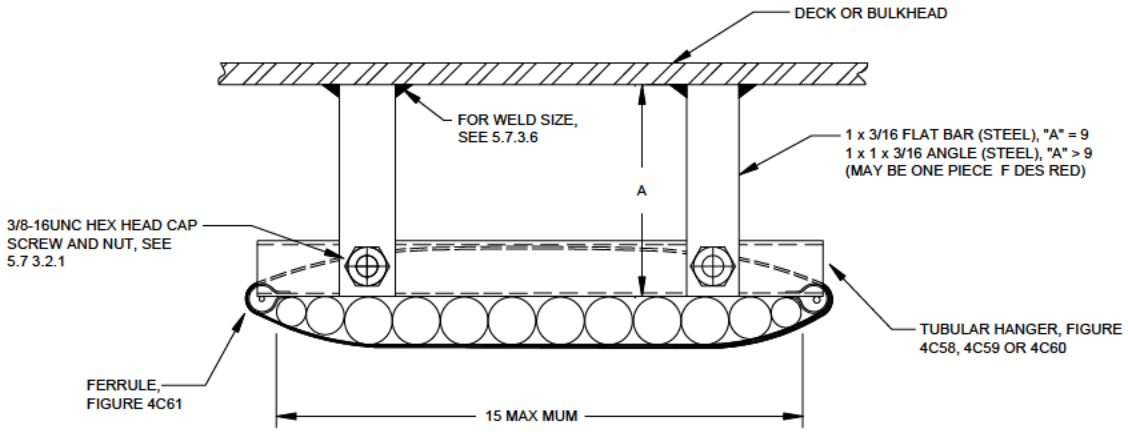
METHOD 4C-6-1
S NGLE T ER SECURED WITH FLAT BAR OR ANGLE
(LOCAL RUNS ONLY)



ALL DIMENSIONS ARE IN INCHES

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C6. Single cableway secured with flat bar or angle on steel structure.

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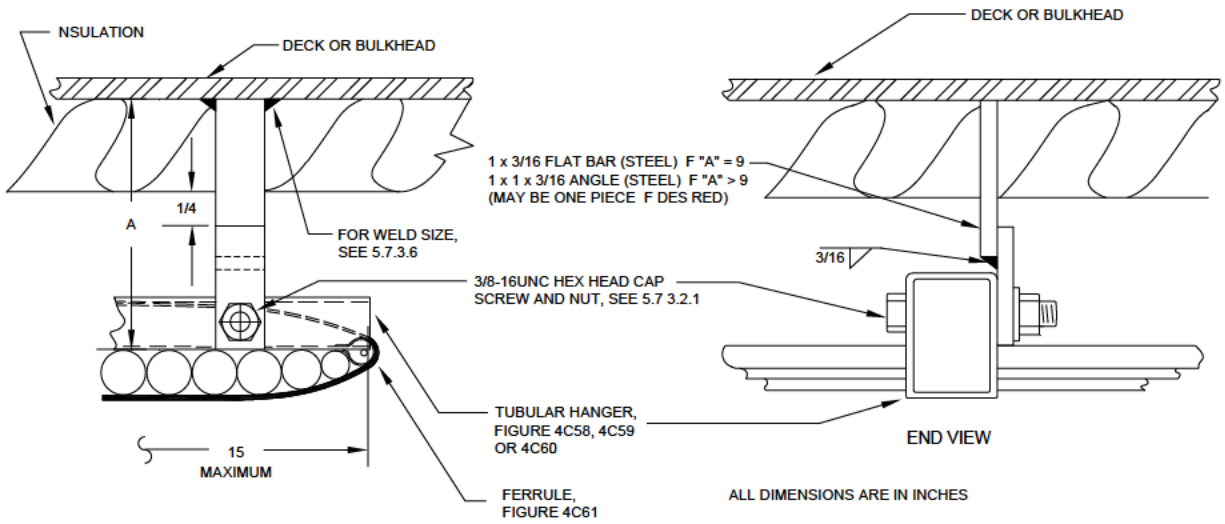
METHOD 4C-7-1
SINGLE T ER SECURED WITH FLAT BAR OR ANGLE
ON INSULATED DECKS AND BULKHEADS
(LOCAL RUNS ONLY)



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C7. Single cableway secured with flat bar or angle on insulated decks or bulkheads.

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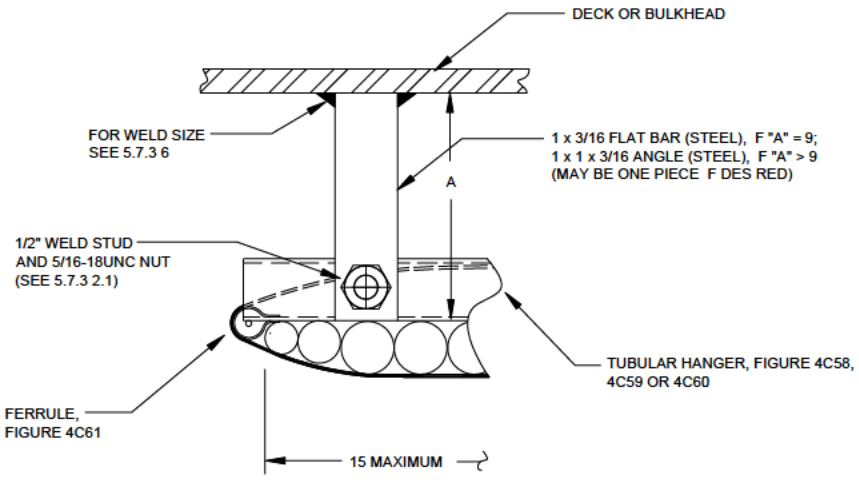
METHOD 4C-8-1
S NGLE T ER SECURED WITH FLAT BAR
OR ANGLE AND WELD STUD
(OPTIONAL TO METHOD 4C-6-1)
(LOCAL RUNS ONLY)



ALL D MENSIONS ARE N NCHES

NOTES:

1. See 5.7.3.8 for collar and welding stud requirements.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C8. Single cableway on steel structure secured with flat bar (or angle) and weld stud.

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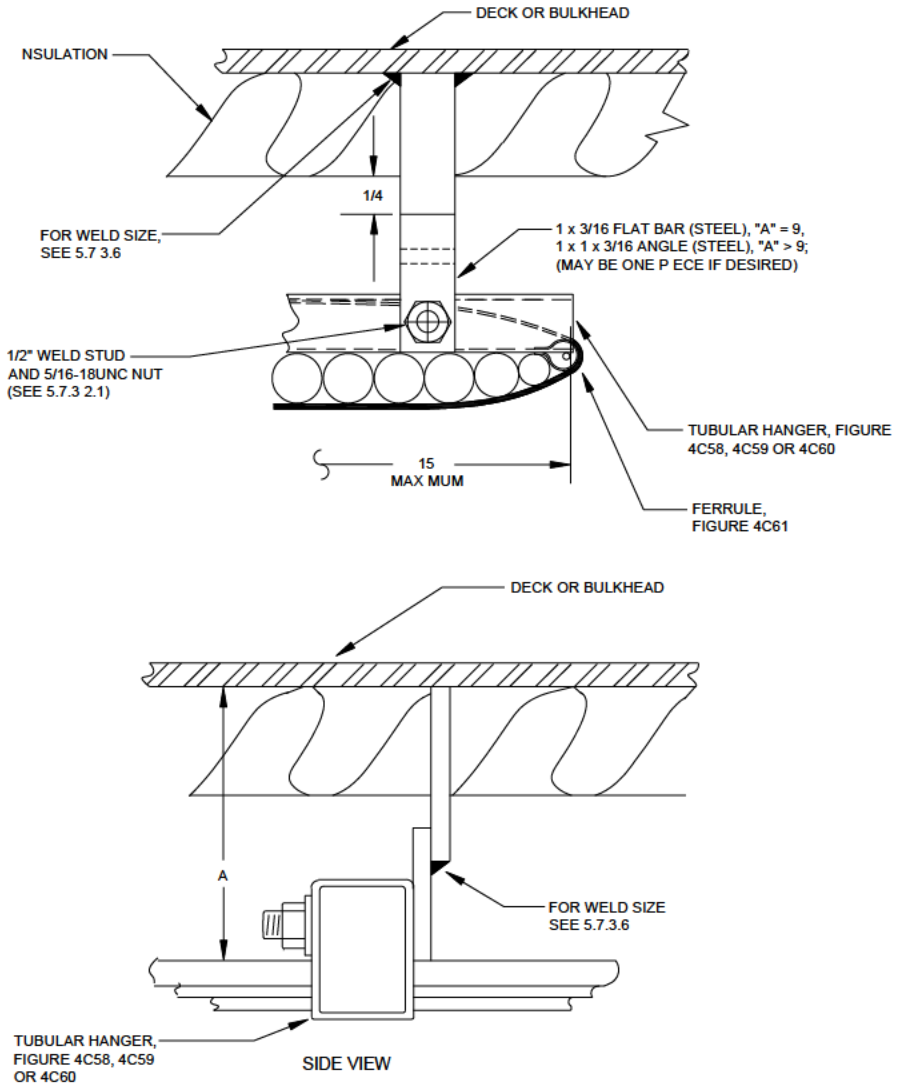
METHOD 4C-9-1
SINGLE TIER SECURED WITH FLAT BAR OR
ANGLE AND WELD STUDS
(OPTIONAL TO METHOD 4C-7-1)
(LOCAL RUNS ONLY)



NOTES:

1. See 5.7.3.8 for collar and welding stud requirements.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C9. Single cableway on steel structure secured with flat bar (or angle) and weld stud.

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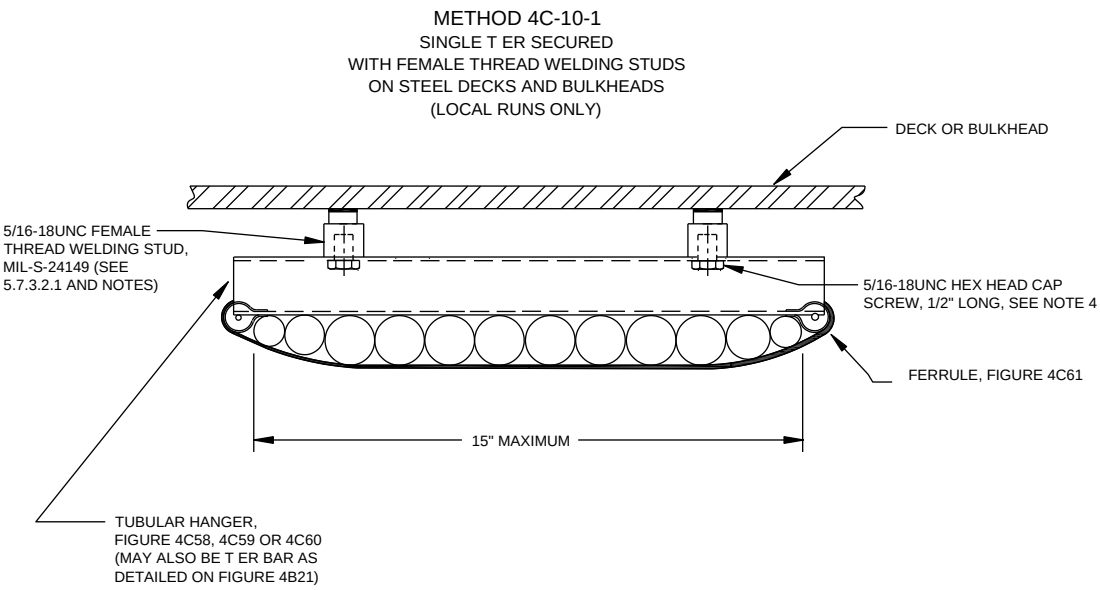

FIGURE 4C10. Single cableway on steel structure secured with female welding stud.

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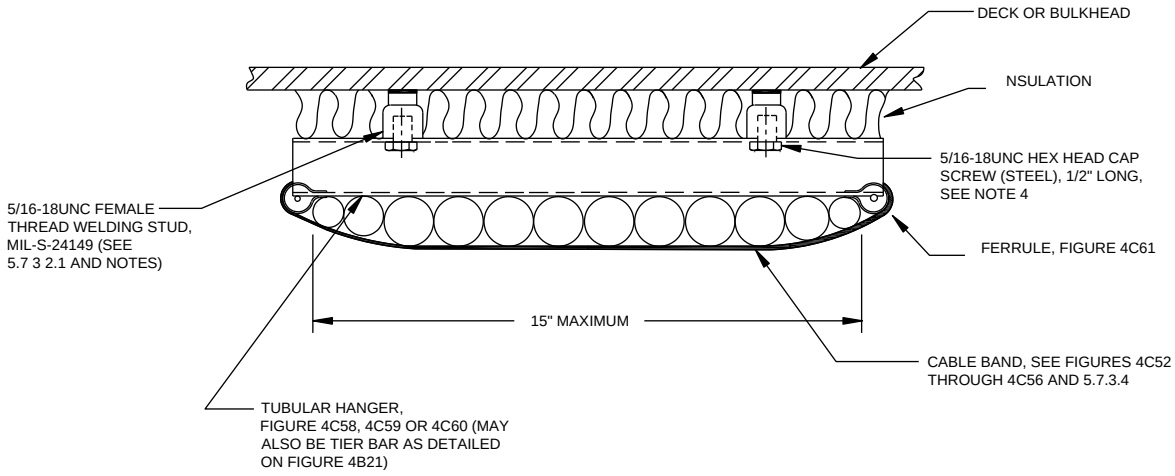
METHOD 4C-11-1
SINGLE TIER SECURED
WITH FEMALE THREAD WELDING STUDS
ON INSULATED DECKS AND BULKHEADS
(LOCAL RUNS ONLY)



NOTES:

1. See C.4.3, tables 4CIII and 4CIV, for internal thread welding stud material requirements.
2. See 5.7.3.8 for collar and welding stud requirements.
3. See 5.7.3.7 for fastener and fastener material requirements.
4. If a low profile is needed, use a button head screw.

FIGURE 4C11. Single cableway on insulated steel structure secured with female welding stud.

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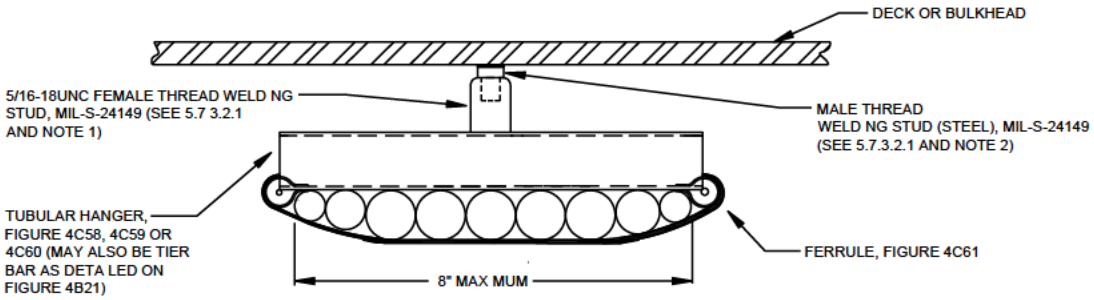
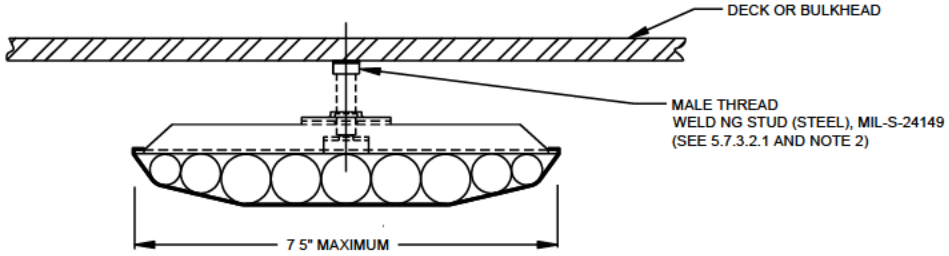
METHOD 4C-12-1
SINGLE TIER SECURED WITH WELD STUD
ON STEEL DECKS AND BULKHEADS
(MAXIMUM CABLE WEIGHT: 10 POUNDS PER SUPPORT)
(LOCAL RUNS ONLY)



METHOD 4C-12-2
SINGLE TIER SECURED WITH WELD STUD
ON STEEL DECKS AND BULKHEADS
(MAXIMUM CABLE WEIGHT: 20 POUNDS PER SUPPORT)
(LOCAL RUNS ONLY)



NOTES:

1. See C.4.3, tables 4CIII and 4CIV, for internal thread welding stud material requirements.
2. See C.4.3, table 4CV, for external thread welding stud material requirements. See 5.7.3.8 for collar and welding stud requirements.
3. For method 4C-12-2, the stud length shall not exceed 6 inches and the banding shall be single bands with no ferrules.
4. The hanger shown in method 4C-12-2 may be a Research Tool and Die RTG 7150 series or RTG 7150S series, or equal, see 4.8.

FIGURE 4C12. Single cableway on steel structure secured with welding stud.

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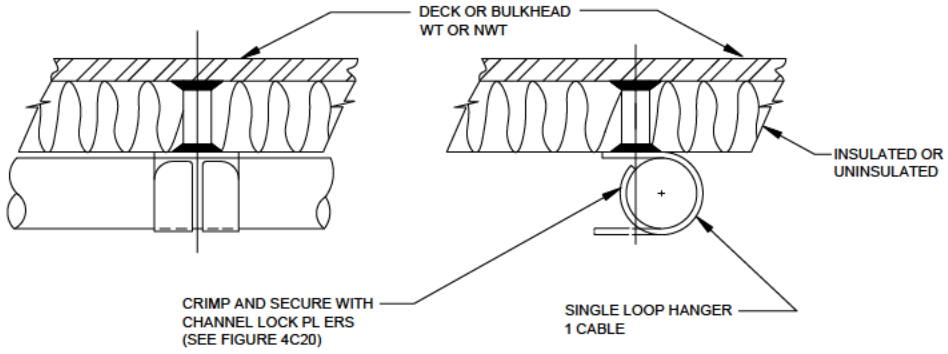
METHOD 4C-13-1
S NGLE LOOP HANGER - BOTTOM LOAD NG (ONE CABLE)
(SEE FIGURE 4C21 FOR ALTERNATE METHOD)



NOTES:

1. The crimp-on weld-stud type cable hanger may be used as an alternate to cable clamps (PCs 4C-22-1 and 4C-22-2) shown on figure 4C22. See 5.7.3.8 for collar and welding stud requirements.
2. The weight of the cables supported shall not exceed 2 pounds per stud for the single loop hanger and 4 pounds per stud for the dual-loop hanger. The spacing between studs shall not exceed 32 inches.
3. The make of hangers procured shall have passed a high-impact shock test in accordance with MIL-DTL-901, and vibration test in accordance with MIL-STD-167-1, using the maximum hanger loadings and spacing.
4. The female weld stud method (attached to either the cable strap or the ship's structure) shown in method 4C-19-1 in figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1, and the female weld stud method shown in method 4C-19-2 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1 and 4C-21-1 and 4C-21-2. The stud method in method 4C-19-3 may be used as an alternate to methods 4C-13-1 through 4C-18-1.
5. Loop hangers installed topside and in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1.
6. See C.4.3, table 4CVII, for material details and National Stock Number (NSN) of loop hangers used in this method.

FIGURE 4C13. Bottom loading hanger on steel and aluminum decks and bulkheads (one cable).

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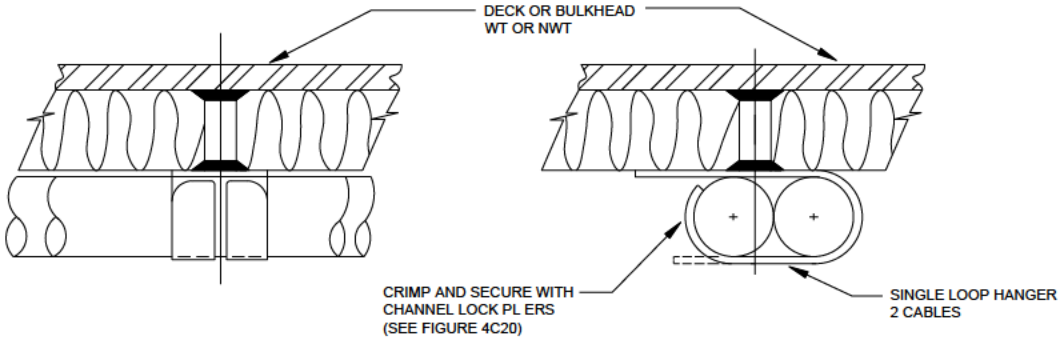
METHOD 4C-14-1
SINGLE LOOP HANGER - BOTTOM LOADING (TWO CABLES)



NOTES:

1. The crimp-on weld-stud type cable hanger may be used as an alternate to cable clamps (PCs 4C-22-1 and 4C-22-2) shown on figure 4C22. See 5.7.3.8 for collar and welding stud requirements.
2. The weight of the cables supported shall not exceed 2 pounds per stud for the single loop hanger and 4 pounds per stud for the dual-loop hanger. The spacing between studs shall not exceed 32 inches.
3. The make of hangers procured shall have passed a high-impact shock test in accordance with MIL-DTL-901, and vibration test in accordance with MIL-STD-167-1, using the maximum hanger loadings and spacing.
4. The female weld stud method (attached to either the cable strap or the ship's structure) shown in method 4C-19-1 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1, and the female weld stud method shown in 4C-19- 2 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1 and 4C-21-1 and 4C-21-2. The stud method in method 4C-19-3 may be used as an alternate to methods 4C-13-1 through 4C-18-1.
5. Loop hangers installed topside and in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1.
6. See C.4.3, table 4CVII, for material details and National Stock Numbers (NSN) of loop hangers used in this method.

FIGURE 4C14. Bottom loading hanger on steel and aluminum decks and bulkheads (two cables).

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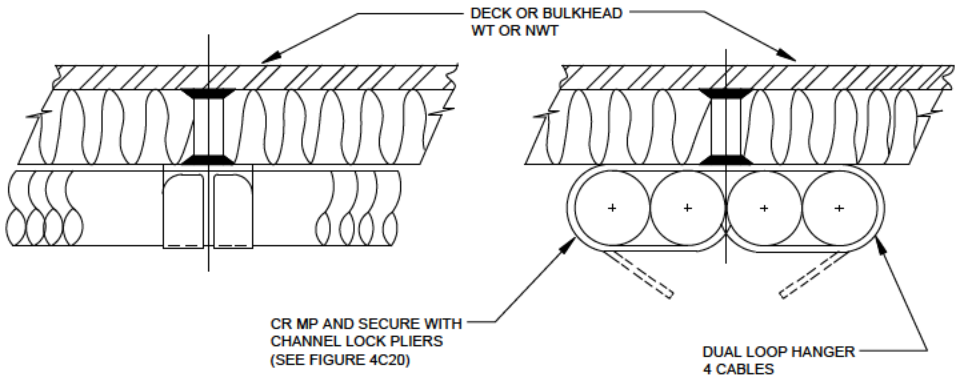
METHOD 4C-15-1
SINGLE LOOP HANGER - BOTTOM LOAD NG (FOUR CABLES)



NOTES:

1. The crimp-on weld-stud type cable hanger may be used as an alternate to cable clamps (PCs 4C-22-1 and 4C-22-2) shown on figure 4C22. See 5.7.3.8 for collar and welding stud requirements.
2. The weight of the cables supported shall not exceed 2 pounds per stud for the single loop hanger and 4 pounds per stud for the dual-loop hanger. The spacing between studs shall not exceed 32 inches.
3. The make of hangers procured shall have passed a high-impact shock test in accordance with MIL-DTL-901, and vibration test in accordance with MIL-STD-167-1, using the maximum hanger loadings and spacing.
4. The female weld stud method (attached to either the cable strap or the ship's structure) shown in method 4C-19-1 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1, and the female weld stud method shown in method 4C-19-2 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1 and 4C-21-1 and 4C-21-2. The stud method in method 4C-19-3 may be used as an alternate to methods 4C-13-1 through 4C-18-1.
5. Loop hangers installed topside and in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1.
6. See C.4.3, table 4CVII, for material details and National Stock Numbers (NSN) of loop hangers used in this method.

FIGURE 4C15. Bottom loading hanger on steel and aluminum decks and bulkheads (four cables).

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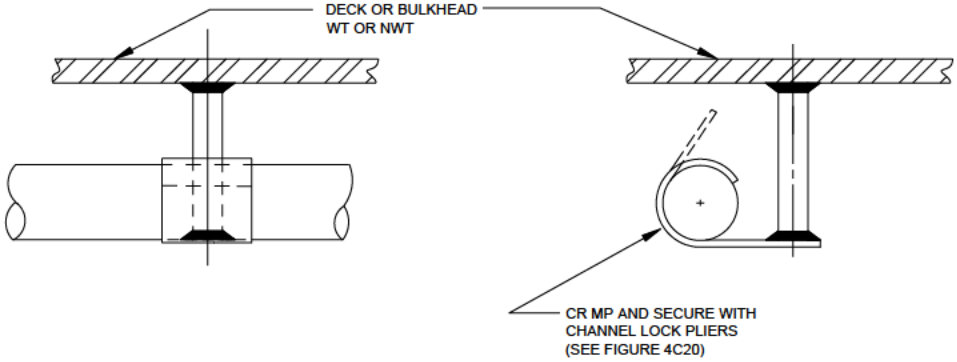
METHOD 4C-16-1
SINGLE LOOP HANGER-TOP LOADING (ONE CABLE)
(SEE FIGURE 4C21 FOR ALTERNATE METHOD)



NOTES:

1. The crimp-on weld-stud type cable hanger may be used as an alternate to cable clamps (PCs 4C-22-1 and 4C-22-2) shown on figure 4C224A22. See 5.7.3.8 for collar and welding stud requirements.
2. The weight of the cables supported shall not exceed 2 pounds per stud for the single loop hanger and 4 pounds per stud for the dual-loop hanger. The spacing between studs shall not exceed 32 inches.
3. The make of hangers procured shall have passed a high-impact shock test in accordance with MIL-DTL-901, and vibration test in accordance with MIL-STD-167-1, using the maximum hanger loadings and spacing.
4. The female weld stud method (attached to either the cable strap or the ship's structure) shown in method 4C-19-1 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1, and the female weld stud method shown in 4C-19-2 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1 and 4C-21-1 and 4C-21-2. The stud method in method 4C-19-3 may be used as an alternate to methods 4C-13-1 through 4C-18-1.
5. Loop hangers installed topside and in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1.
6. See C.4.3, table 4CVII, for material details and National Stock Numbers (NSN) of loop hangers used in this method.

FIGURE 4C16. Top loading hanger on steel and aluminum decks and bulkheads (one cable).

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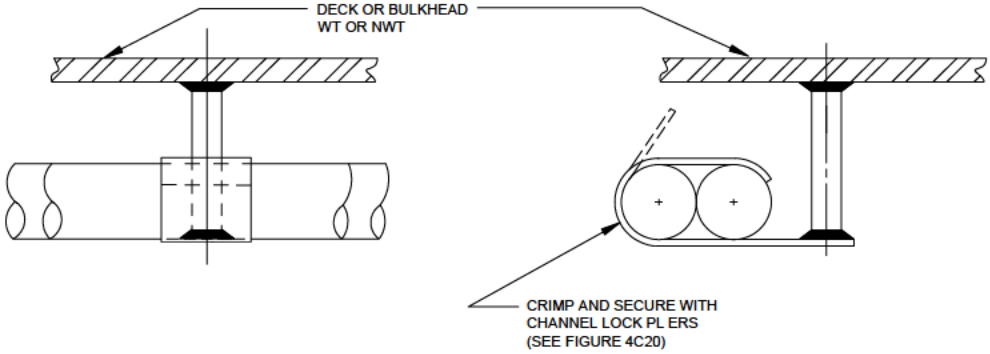
METHOD 4C-17-1
SINGLE LOOP HANGER-TOP LOADING (TWO CABLES)



NOTES:

1. The crimp-on weld-stud type cable hanger may be used as an alternate to cable clamps (PCs 4C-22-1 and 4C-22-2) shown on figure 4C22. See 5.7.3.8 for collar and welding stud requirements.
2. The weight of the cables supported shall not exceed 2 pounds per stud for the single loop hanger and 4 pounds per stud for the dual-loop hanger. The spacing between studs shall not exceed 32 inches.
3. The make of hangers procured shall have passed a high-impact shock test in accordance with MIL-DTL-901, and vibration test in accordance with MIL-STD-167-1, using the maximum hanger loadings and spacing.
4. The female weld stud method (attached to either the cable strap or the ship's structure) shown in method 4C-19-1 in figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1, and the female weld stud method shown in method 4C-19-2 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1 and 4C-21-1 and 4C-21-2. The stud method in method 4C-19-3 may be used as an alternate to methods 4C-13-1 through 4C-18-1.
5. Loop hangers installed topside and in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1.
6. See C.4.3, table 4CVII, for material details and National Stock Numbers (NSN) of loop hangers used in this method.

FIGURE 4C17. Top loading hanger on steel and aluminum decks and bulkheads (two cables).

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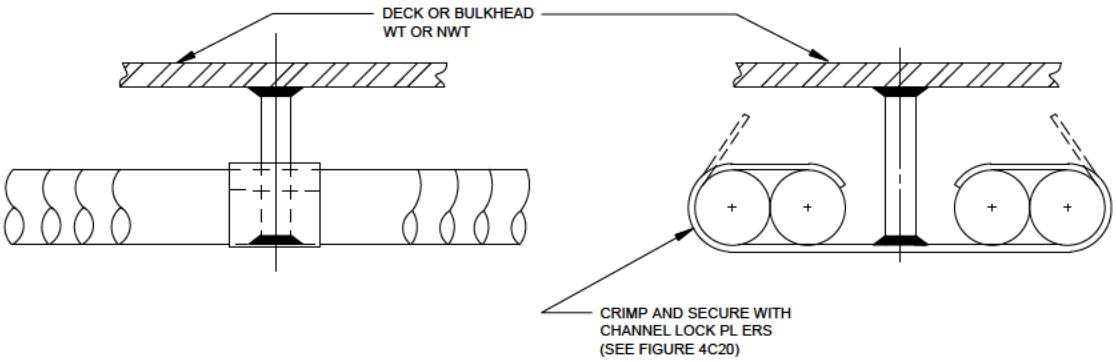
METHOD 4C-18-1
SINGLE LOOP HANGER-TOP LOAD NG (FOUR CABLES)



NOTES:

1. The crimp-on weld-stud type cable hanger may be used as an alternate to cable clamps (PCs 4C-22-1 and 4C-22-2) shown on figure 4C22. See 5.7.3.8 for collar and welding stud requirements.
2. The weight of the cables supported shall not exceed 2 pounds per stud for the single loop hanger and 4 pounds per stud for the dual-loop hanger. The spacing between studs shall not exceed 32 inches.
3. The make of hangers procured shall have passed a high-impact shock test in accordance with MIL-DTL-901, and vibration test in accordance with MIL-STD-167-1, using the maximum hanger loadings and spacing.
4. The female weld stud method (attached to either the cable strap or the ship's structure) shown in method 4C-19-1 in figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1, and the female weld stud method shown in method 4C-19-2 of figure 4C19 may be used as an alternate to methods 4C-13-1 through 4C-18-1 and 4C-21-1 and 4C-21-2. The stud method in method 4C-19-3 may be used as an alternate to methods 4C-13-1 through 4C-18-1.
5. Loop hangers installed topside and in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1.
6. See C.4.3, table 4CVII, for material details and National Stock Numbers (NSN) of loop hangers used in this method.

FIGURE 4C18. Top loading hanger on steel and aluminum decks and bulkheads (four cables).

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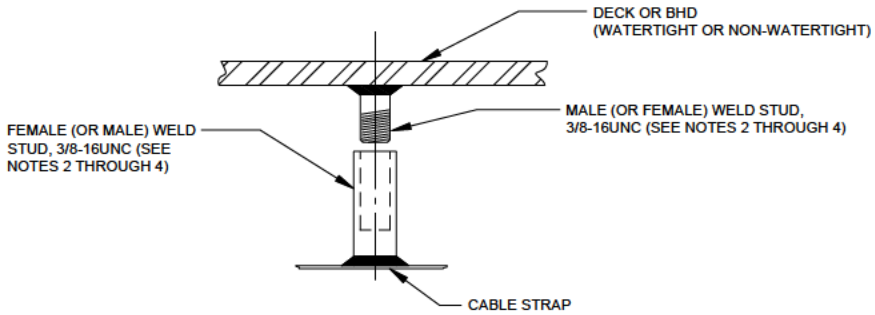
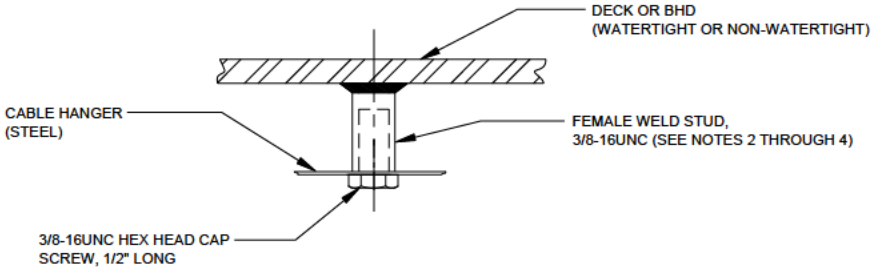
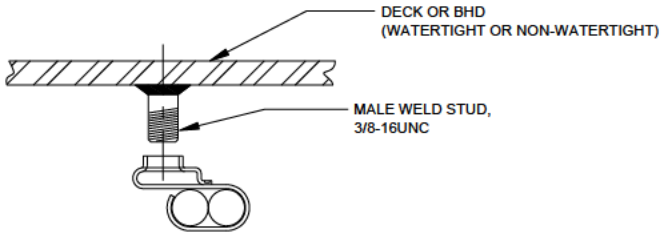
METHOD 4C-19-1
FEMALE WELD STUD METHOD
(MAY BE USED AS AN ALTERNATE TO METHODS 4C-13-1 THROUGH 4C-18-1)
SEE NOTE 1



METHOD 4C-19-2
FEMALE WELD STUD METHOD
(MAY BE USED AS ALTERNATE TO METHODS 4C-13-1 THROUGH 4C-18-1
AND 4C-21-1 AND 4C-21-2)
SEE NOTE 1



METHOD 4C-19-3
(MAY BE USED AS ALTERNATE TO METHODS 4C-13-1 THROUGH 4C-18-1)
SEE NOTE 1



NOTES:

1. The female weld stud method (attached to either the cable strap or the ship's structure) shown in method 4C-19-1 may be used as an alternate to methods 4C-13-1 through 4C-18-1, and the female weld stud method shown in method 4C-19-2 may be used as an alternate to methods 4C-13-1 through 4C-18-1 and 4C-21-1 and 4C-21-2. The stud method in method 4C-19-3 may be used as an alternate to methods 4C-13-1 through 4C-18-1.
2. Studs with aluminum male threads shall be coated with anti-seize compound.

FIGURE 4C19. Single cableway on steel and aluminum decks and bulkheads, weld stud.

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NOTES (continued):

3. The contact of steel female threads with aluminum male threads shall be coated with anti-seize compound. All thread coating shall occur after the stud welding is complete.
4. See C.4.3, table 4CV, for external thread welding stud material information.
5. For method 4C-19-3, the weight limit is 5.3 pounds per hanger.
6. See 5.7.3.8 for collar and welding stud requirements.
7. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C19. Single cableway on steel and aluminum decks and bulkheads, weld stud – Continued.

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CRIMPING METHODS

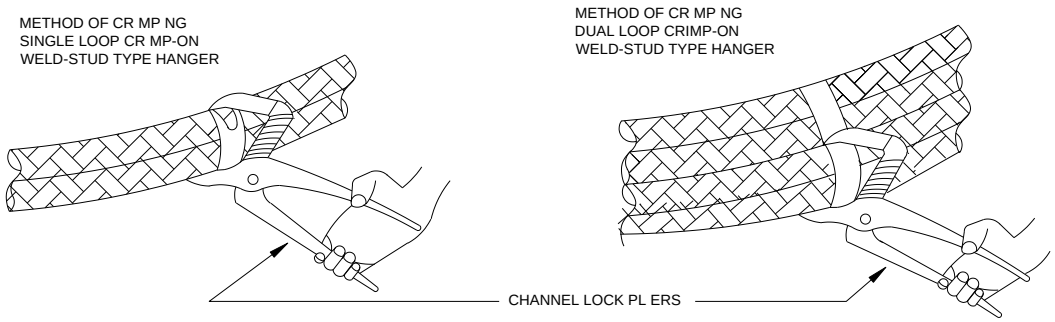

FIGURE 4C20. Single cableway on steel and aluminum decks and bulkheads, crimping methods.

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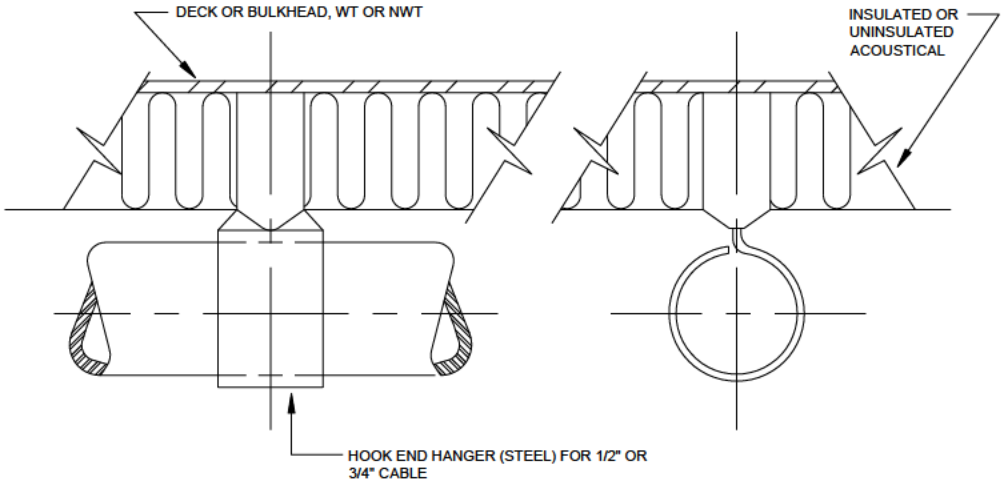
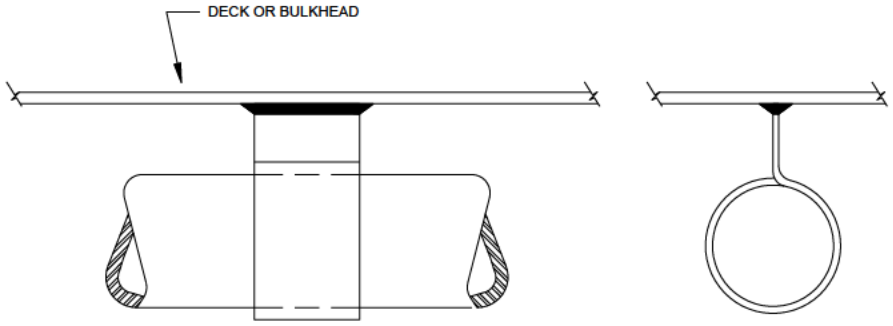
METHOD 4C-21-1
SINGLE CABLEWAY ON STEEL AND ALUMINUM DECKS, NSULATED
SEE NOTE 1



METHOD 4C-21-2
S NGLE CABLEWAY ON STEEL AND ALUM NUM DECKS, UNINSULATED
SEE NOTES 1 THROUGH 3



NOTES:

1. The female weld stud method (attached to either the cable strap or the ship's structure) shown in method 4C-19-1 may be used as an alternate to methods 4C-13-1 through 4C-18-1, and the female weld stud method shown in method 4C-19-2 may be used as an alternate to methods 4C-13-1 through 4C-18-1 and 4C-21-1 and 4C-21-2. See 5.7.3.8 for collar and welding stud requirements.
2. Cable clamp hangers detailed as PCs 4C-22-1 through 4C-22-3 shall be unplated unless otherwise specified (see 5.7.3.2.1).
3. Hangers (4C-22-1 through 4C-22-3) on figure 4C22 shall be suitable for welding by the metal arc stud welding process.

FIGURE 4C21. Single cableway on aluminum decks and bulkheads.

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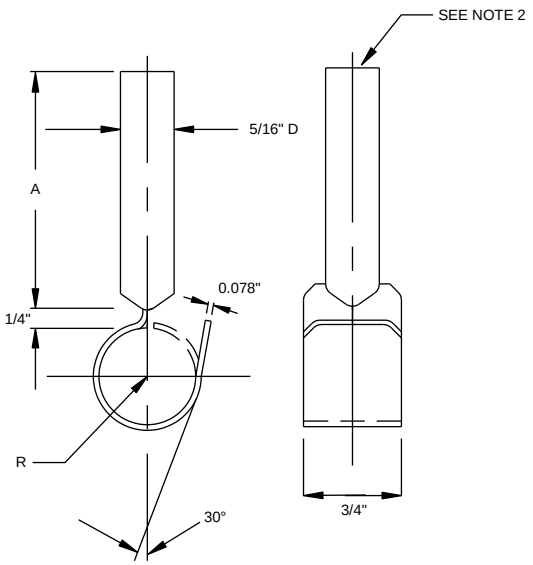
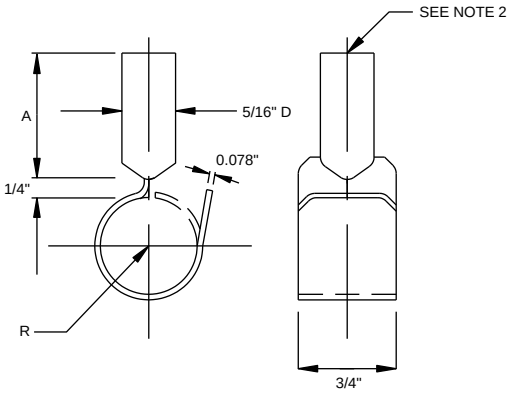
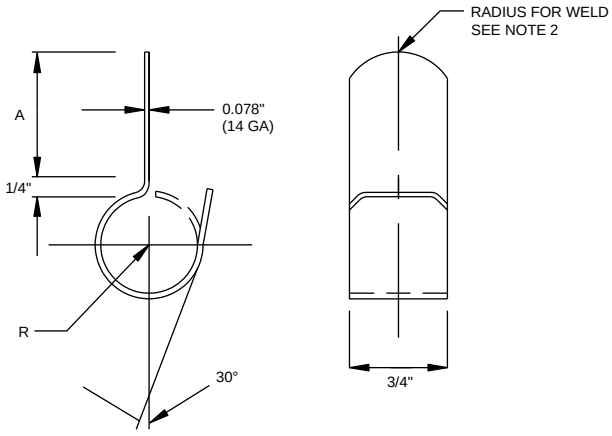
PIECE 4C-22-1
3/4 INCH CABLE CLAMP (HOOK END)



PIECE 4C-22-2
1/2 NCH CABLE CLAMP (HOOK END)



PIECE 4C-22-3
1/2 & 3/4 INCH CABLE CLAMP (HOOK END)



SEE NOTE 4 FOR DIMENSIONS OF CABLE CLAMPS (P ECES 4C-22-1, 4C-22-2 AND 4C-22-3)

FOR PIECES 4C-22-1 THROUGH 4C-22-3, SEE NOTES

NOTES:

1. Cable clamp hangers detailed as PCs 4C-22-1 through 4C-22-3 shall be unplated unless otherwise specified (see 5.7.3.2.1).
2. Hangers (4C-22-1 through 4C-22-3) shall be suitable for welding by the metal arc stud welding process.
3. See C.4.3, table 4CVII, for material details and National Stock Numbers (NSN) of loop hangers used in this method.
4. The applicable piece number and size (e.g., 4C-22-2-H) shall be stamped on each hook end hanger in ⅛-inch letters (see table 4C22-I).

FIGURE 4C22. Cable clamps for single cableway on steel and aluminum decks and bulkheads.

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TABLE 4C22-I. Cable clamp dimensions.

PC no.	Size	Style	Dimension (inches)	
			A	R
4C-22-1 4C-22-2 4C-22-3	A	½	⅜	¼
	B	½	⅝	¼
	C	½	1	¼
	D	½	2	¼
	E	½	3	¼
	F	¾	⅜	⅜
	G	¾	⅝	⅜
	H	¾	1	⅜
	J	¾	2	⅜
	K	¾	3	⅜

FIGURE 4C22. Cable clamps for single cableway on steel and aluminum decks and bulkheads – Continued.

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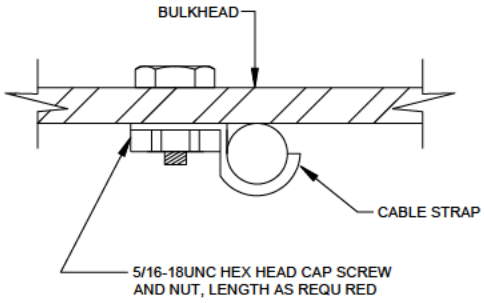
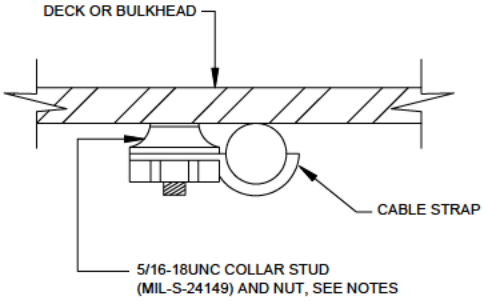
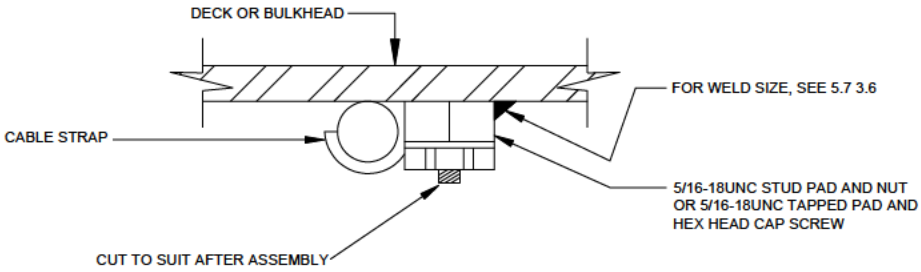
METHOD 4C-23-1
CABLES SECURED TO NON-WATER-TIGHT BULKHEADS
(FOR CABLES 5/8" DIA MAXIMUM)
(SEE NOTES 1 THROUGH 3)



METHOD 4C-23-2
CABLES SECURED WITH COLLAR STUDS
(FOR CABLES 5/8" DIA MAXIMUM)
(SEE NOTES 1 THROUGH 3)



METHOD 4C-23-3
CABLES SECURED WITH PADS
(CABLES 5/8" DIA MAXIMUM)
(SEE NOTES 1 THROUGH 3)



NOTES:

1. All hanger material shall be the same as bulkhead material.
2. Cable strap shall not dent or otherwise exert pressure on the semi-solid dielectric coaxial cables in any of these methods. Add spacer washers if necessary to keep cable free of pressure.
3. Collar studs, stud pads, and tapped pads installed topside or in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1. See 5.7.3.8 for collar and welding stud requirements.
4. See C.4.3, table 4CVI, for material details and National Stock Numbers (NSN) for collar studs used in this method.
5. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C23. Single cableway for coaxial cable.

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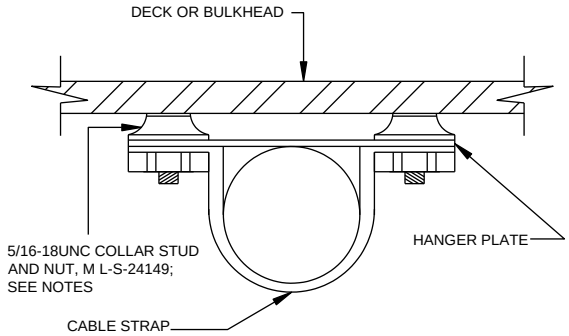
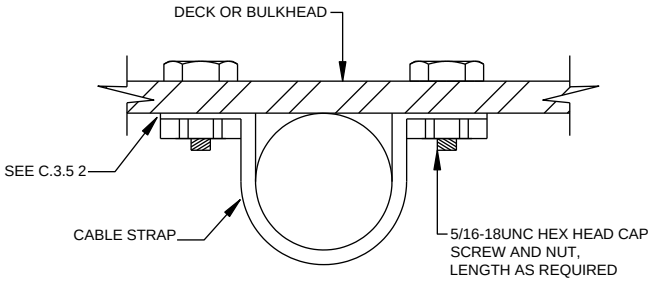
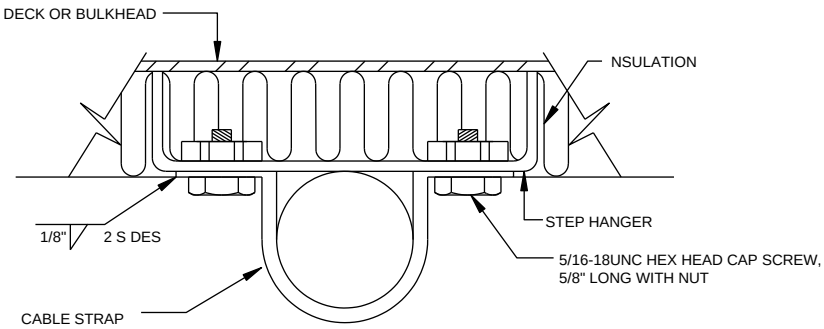
METHOD 4C-24-1
CABLES SECURED WITH COLLAR STUDS
(SEE NOTES 1 THROUGH 3)



METHOD 4C-24-2
CABLES SECURED TO NON-WATERTIGHT BULKHEADS
(SEE NOTES 1 THROUGH 3)



METHOD 4C-24-3
CABLES SECURED WITH STEP-HANGER ON INSULATED DECKS AND BULKHEADS
(SEE NOTES 1 THROUGH 3)



NOTES:

1. All hanger material shall be the same as bulkhead material.
2. Cable strap shall not dent or otherwise exert pressure on the semi-solid dielectric coaxial cables in any of these methods. Add spacer washers if necessary to keep cable free of pressure.
3. Collar studs, stud pads, and tapped pads installed topside or in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1. See 5.7.3.8 for collar and welding stud requirements.
4. See C.4.3, table 4CVI, for material details and National Stock Numbers (NSN) collar studs used in this method.
5. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C24. Single cableway for coaxial cable.

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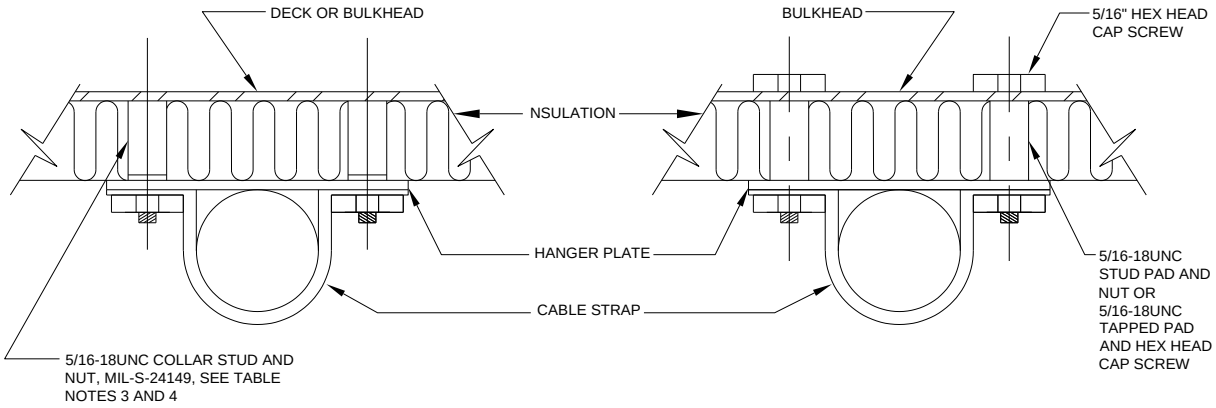
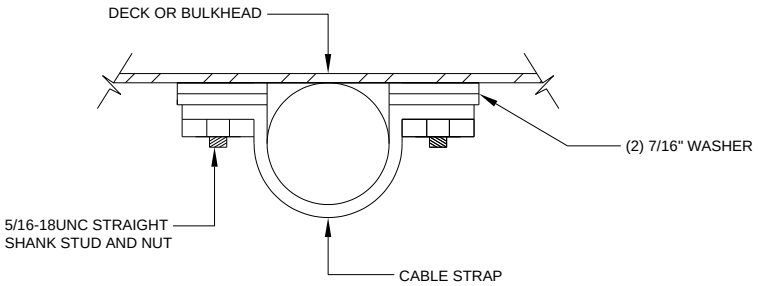
METHOD 4C-25-1
CABLES SECURED WITH COLLAR STUDS ON INSULATED DECKS OR BULKHEADS
(SEE NOTES 1 THROUGH 3)

METHOD 4C-25-2
CABLES SECURED TO NON-WATERTIGHT NSULATED BULKHEADS
(SEE NOTES 1 THROUGH 3)



METHOD 4C-25-3
CABLES SECURED WITH STRAIGHT SHANK STUDS
(SEE NOTES 1 THROUGH 3)



NOTES:

1. All hanger material shall be the same as bulkhead material.
2. Cable strap shall not dent or otherwise exert pressure on the semi-solid dielectric coaxial cables in any of these methods. Add spacer washers if necessary to keep cable free of pressure.
3. Collar studs, stud pads, and tapped pads installed topside or in locations subject to a corrosive environment shall be in accordance with 5.7.3.2.1. See 5.7.3.8 for collar and welding stud requirements.
4. See C.4.3, table 4CVI, for material details and National Stock Numbers (NSN) collar studs used in this method.
5. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C25. Single cableway for coaxial cable.

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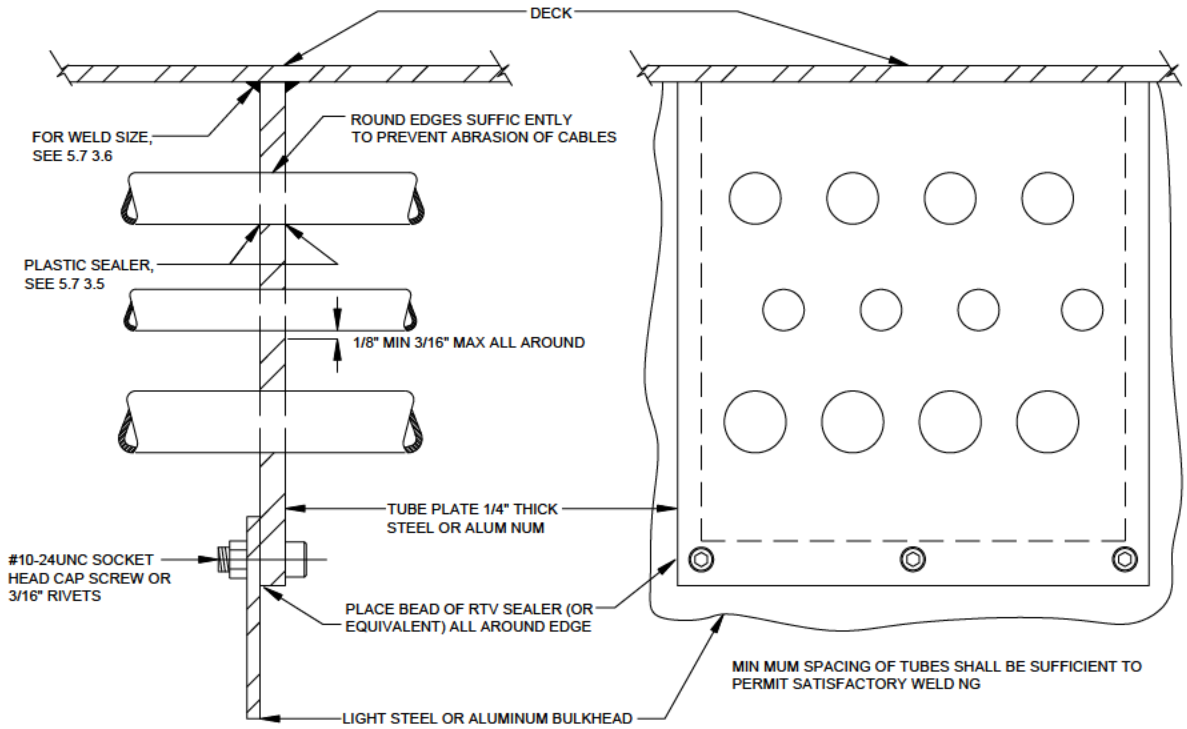
METHOD 4C-26-1
MULTIPLE T ERS OF CABLES THROUGH LIGHT BULKHEAD WITH AIR AND FUME TIGHTNESS REQUIREMENTS



NOTES:

1. When holes are cut in the ship's structure solely for the passage of cables, the replacement tube plate shall be of sufficient weight to compensate for the loss of strength due to the metal removed.
2. Spacing of cables shall be sufficient to permit satisfactory welding.
3. The space between the cable and the inside of the drilled hole shall be thoroughly packed with plastic sealer (MIL-I-3064, type HF) to form a permanent light-tight seal.
4. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C26. Cableway through non-watertight bulkheads and beams without fire stops.

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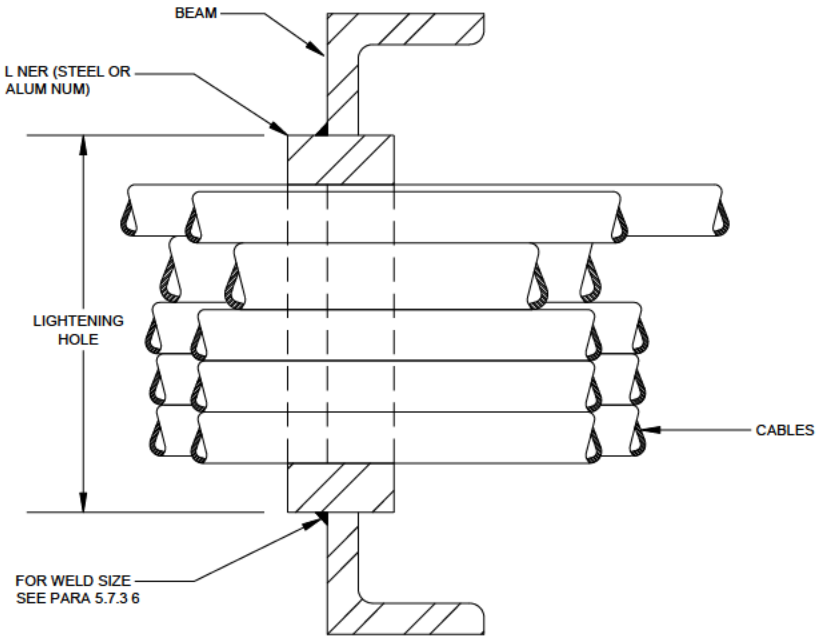
METHOD 4C-27-1
CABLES THROUGH LIGHTENING HOLES OR CABLEWAYS
IN STRUCTURAL MEMBERS (N0N-LIGHT TIGHT)



NOTES:

1. When holes are cut in the ship's structure solely for the passage of cables, the liner shall be of sufficient weight to compensate for the loss of strength due to the metal removed.
2. Liners 1/16 inch thick can be used as an alternate to half round bar.
3. Installation of liner in beams may be made in shop or on the ship.
4. Where no lightening holes are provided, cables may be run outside of beam when no interference with either equipment or normal headroom results.

FIGURE 4C27. Cableway through non-watertight bulkheads and beams without fire stops.

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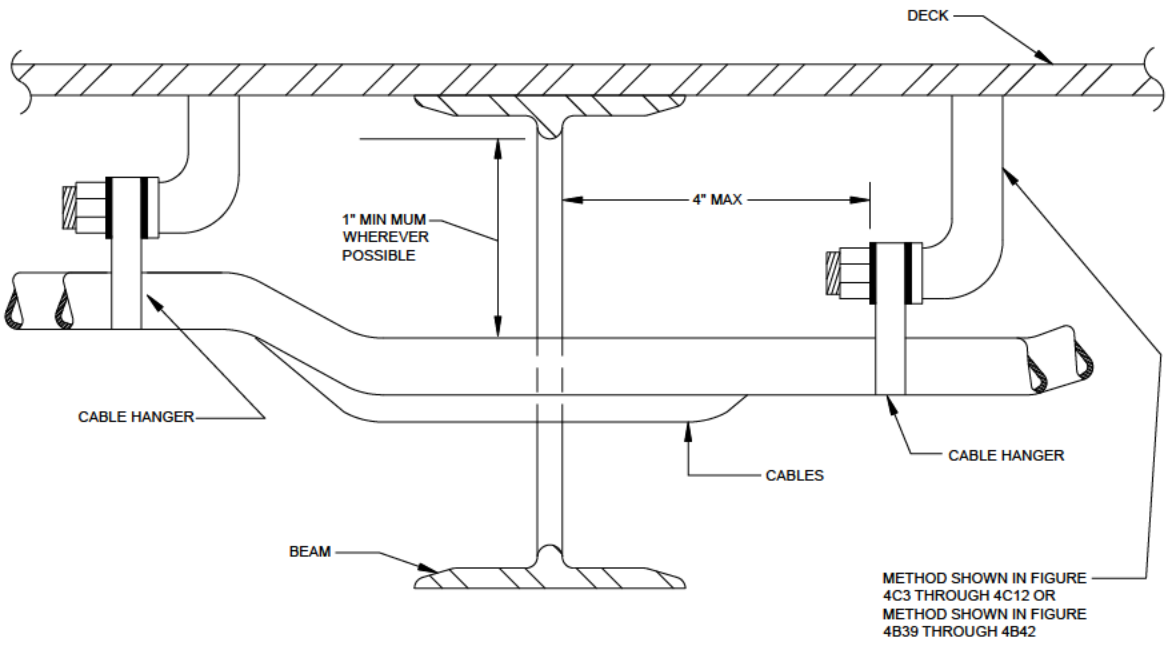
METHOD 4C-28-1
A GROUP OF CABLES
PASS NG THROUGH LIGHTEN NG HOLES
(LIGHTENING HOLES NOT USED AS SUPPORT)



NOTE:

1. Where no lightening holes are provided, cables may be run outside of beam when no interference with either equipment or normal headroom results.

FIGURE 4C28. Cableway through non-watertight bulkheads and beams without fire stops.

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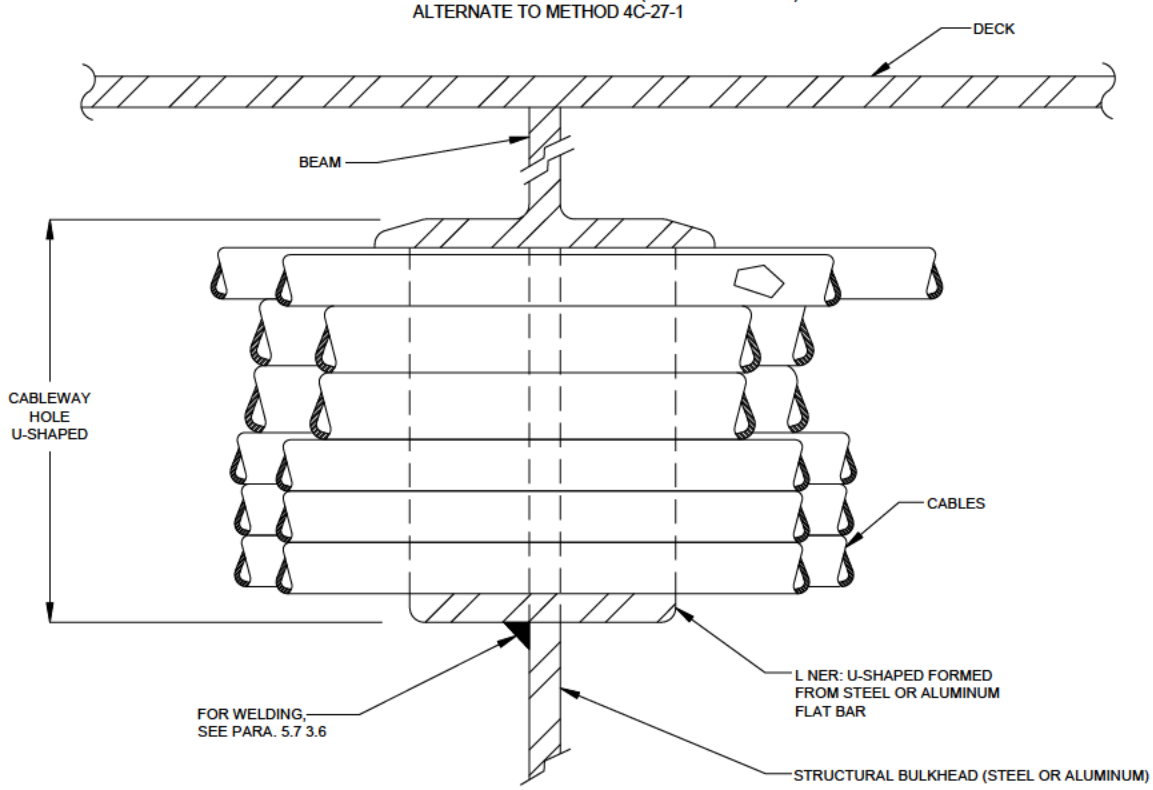
METHOD 4C-29-1

CABLEWAY IN STRUCTURAL BULKHEADS (NON-LIGHT TIGHT)
ALTERNATE TO METHOD 4C-27-1



NOTES:

1. When holes are cut in the ship's structure solely for the passage of cables, the liner shall be of sufficient weight to compensate for the loss of strength due to the metal removed.
2. Liners 1/16 inch thick can be used as an alternate to half round bar.
3. Installation of liner in beams may be made in shop or on the ship.
4. Where no lightening holes are provided, cables may be run outside of beam when no interference with either equipment or normal headroom results.

FIGURE 4C29. Cableway through non-watertight bulkheads and beams without fire stops.

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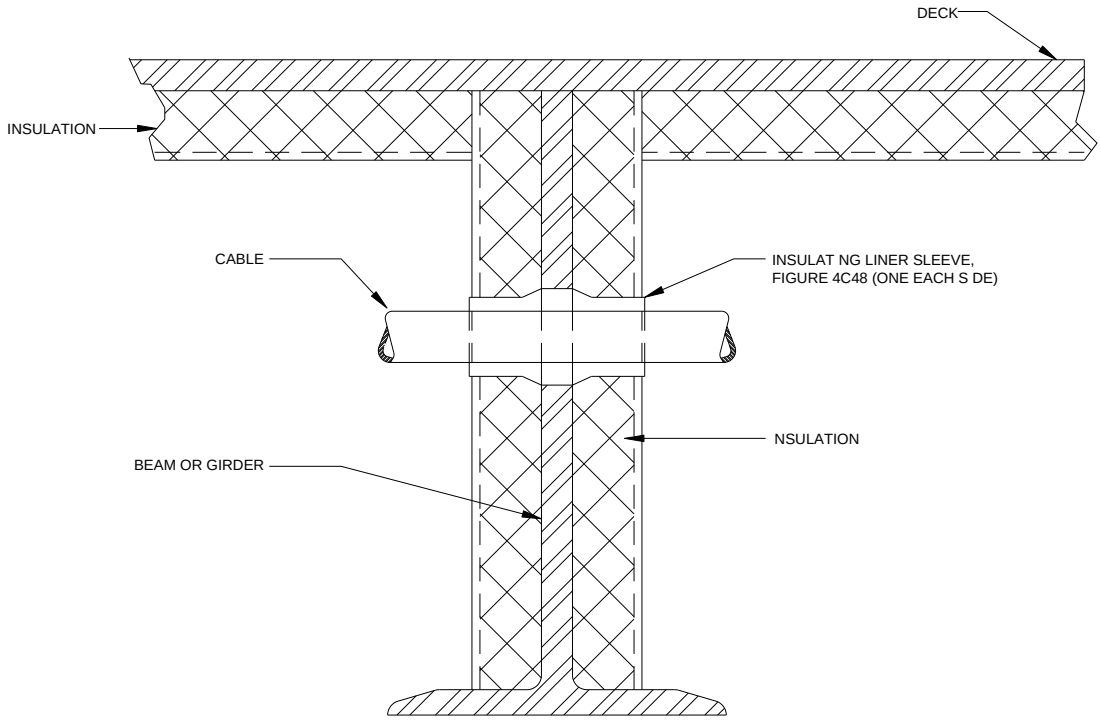
METHOD 4C-30-1

S NGLE CABLE THROUGH BEAMS AND GIRDERS WITH NSULATION WITHOUT METAL SHEATHING (ALTERNATE TO METHOD 4C-31-2)



NOTES:

1. When holes are cut in the ship's structure solely for the passage of cables, the liner shall be of sufficient weight to compensate for the loss of strength due to the metal removed.
2. Liners 1/16 inch thick can be used as an alternate to half round bar.
3. Installation of liner in beams may be made in shop or on the ship.
4. Where no lightening holes are provided, cables may be run outside of beam when no interference with either equipment or normal headroom results.

FIGURE 4C30. Cableway through non-watertight bulkheads and beams without fire stops.

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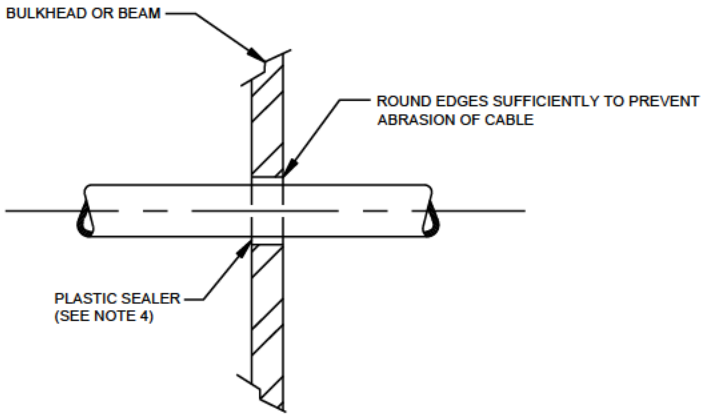
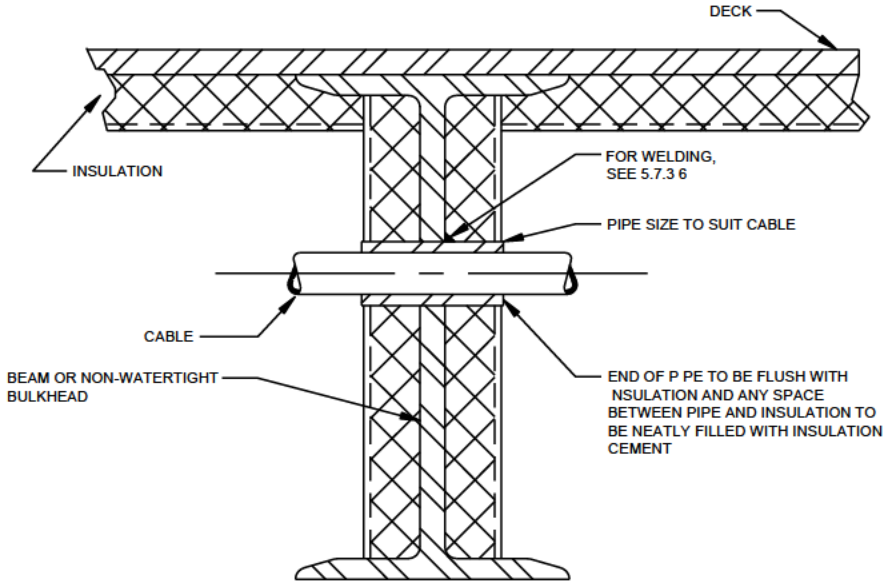
METHOD 4C-31-1
CABLES THROUGH BULKHEADS AND
BEAMS 1/4" THICKNESS AND OVER



METHOD 4C-31-2
NSULATED BULKHEAD OR BEAM CABLE THROUGH TUBING



NOTES:

1. When holes are cut in the ship's structure solely for the passage of cables, the liner shall be of sufficient weight to compensate for the loss of strength due to the metal removed.
2. Installation of liner in beams may be made in shop or on the ship.
3. Where no lightening holes are provided, cables may be run outside of beam when no interference with either equipment or normal headroom results.
4. When cables pierce non-watertight bulkheads required to be light-tight, the space between the cable and the inside of the bushing tubing or drilled hole shall be thoroughly packed with plastic sealer (MIL-I-3064, type HF) to form a permanent light-tight seal.

FIGURE 4C31. Cableway through non-watertight bulkheads and beams without fire stops.

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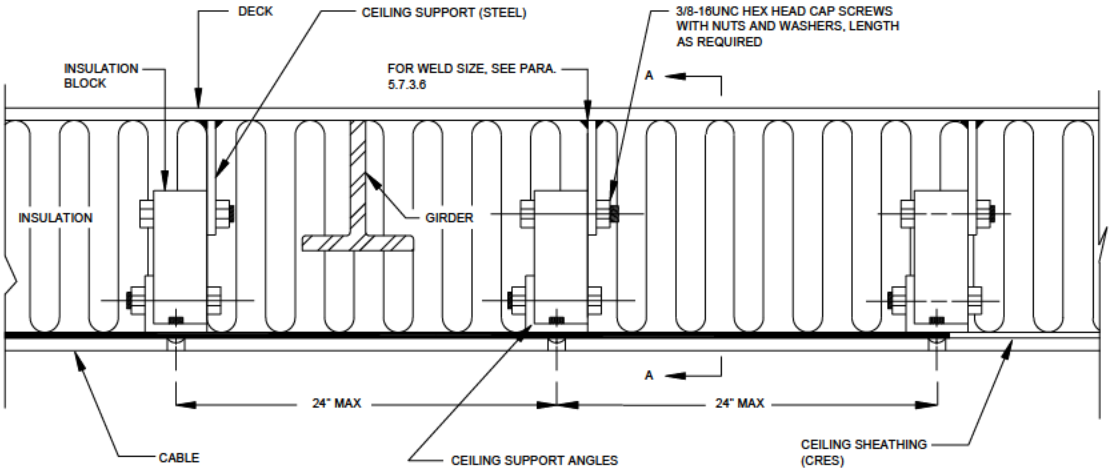
METHOD 4C-32-1
CABLE RUNS ACROSS CE LING SHEATHING SUPPORT FRAMING



FOR SECTION A-A, SEE FIGURE 4C33

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C32. Single cableway in refrigerated spaces.

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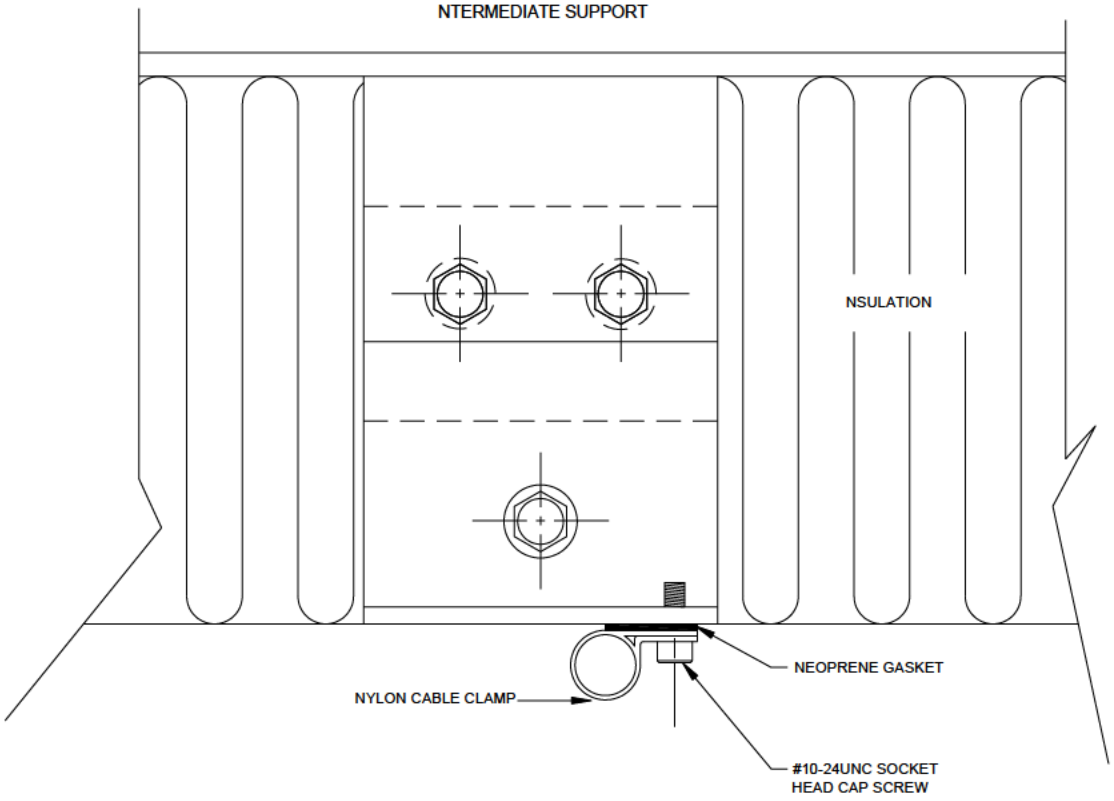
SECTION A-A FOR METHOD 4C-32-1
NTERMEDIATE SUPPORT



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C33. Single cableway in refrigerated spaces – section A-A for method 4C-32-1.

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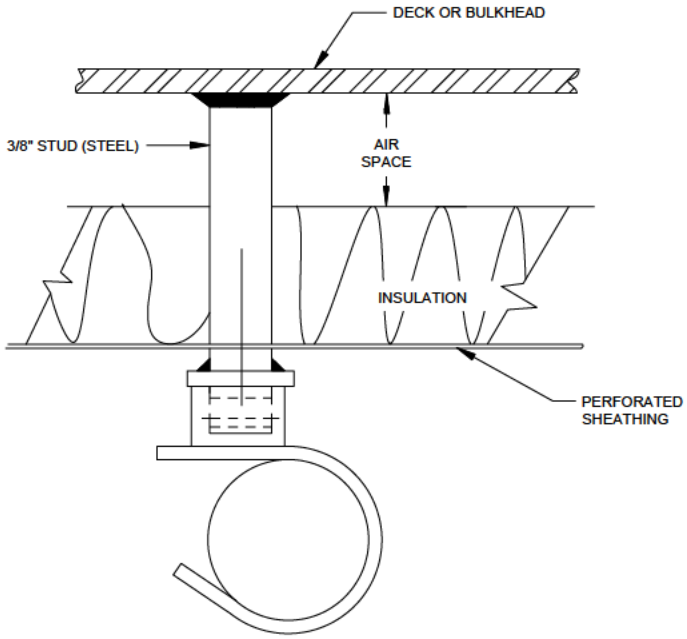
METHOD 4C-34-1
WATERTIGHT DECK OR BULKHEAD
WITH INSULATION AND SHEATH NG
HANGER SECURED WITH COLLAR STUD



NOTE: THE METHOD SHOWN ON THIS FIGURE IS FOR USE WITH CABLE UP TO TWO INCHES N DIAMETER. FOR CABLE GREATER THAN TWO INCHES N DIAMETER, USE THE METHOD SHOWN ON FIGURE 4C35.

NOTE:

1. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4C34. Single cableways in acoustical spaces secured with collar stud.

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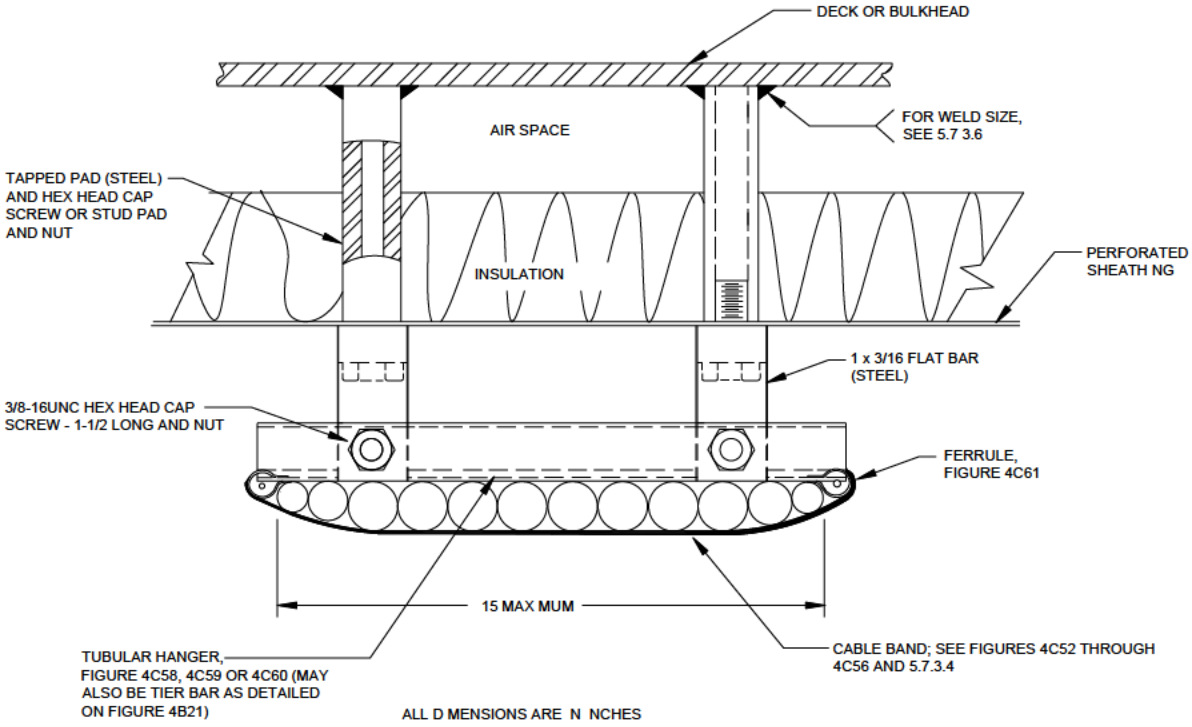
METHOD 4C-35-1
DECKS OR BULKHEADS WITH INSULATION AND SHEATH NG
CABLES SECURED TO STUD PADS OR TAPPED PADS
(LOCAL RUNS ONY)



NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. See 5.7.3.8 for collar and welding stud requirements.

FIGURE 4C35. Single cableway in acoustical spaces secured to stud pads or tapped pads.

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METHOD 4C-36-1
CABLE SECURED TO MOTOR SUPPORT

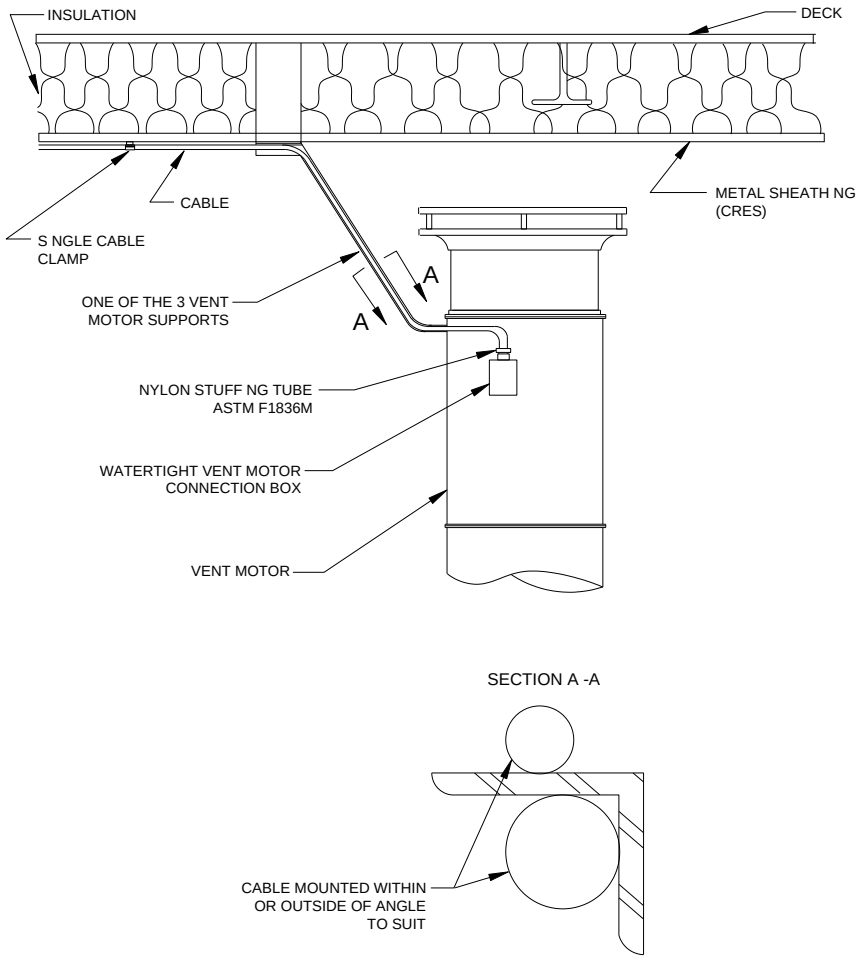

FIGURE 4C36. Single cableway to motors – cable secured to motor support.

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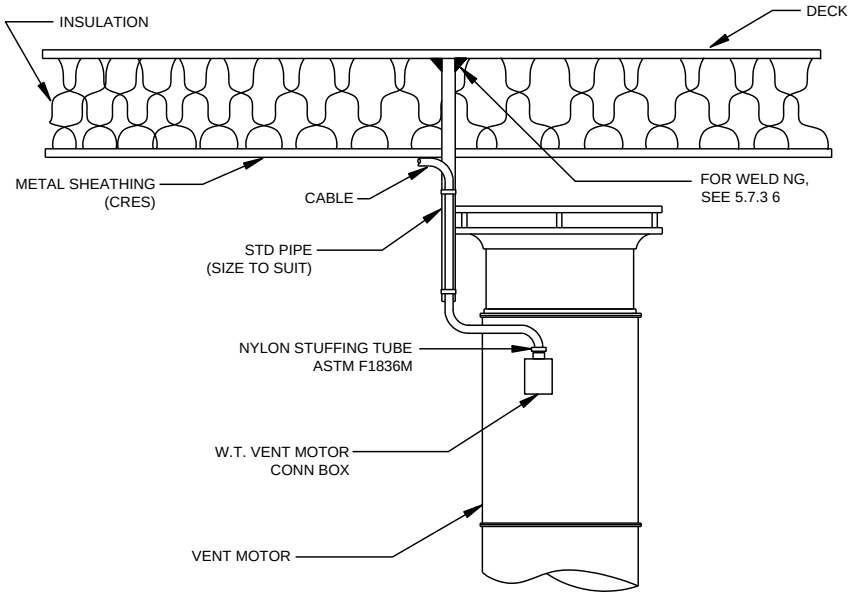
METHOD 4C-37-1
CABLE SECURED TO A PIPE SUPPORT
WHERE NO OTHER SUPPORT IS AVAILABLE



NOTE:
SPAC NG BETWEEN THE LAST CABLE HANGER AND THE MOTOR CONNECTION BOX OR POT HEAD SHALL BE 18 NCHES WITH THREE INCHES OF CABLE SLACK. CHANNEL RUBBER SHALL BE INSTALLED UNDER BANDING WHERE THE CABLE EXITS THE WIREWAY (LAST HANGER) AND UNDER ANY CABLE BAND NG THAT MAY BE NSTALLED ON THE MOTOR SUPPORTS.

FIGURE 4C37. Single cableway to motors – cable secured to pipe support.

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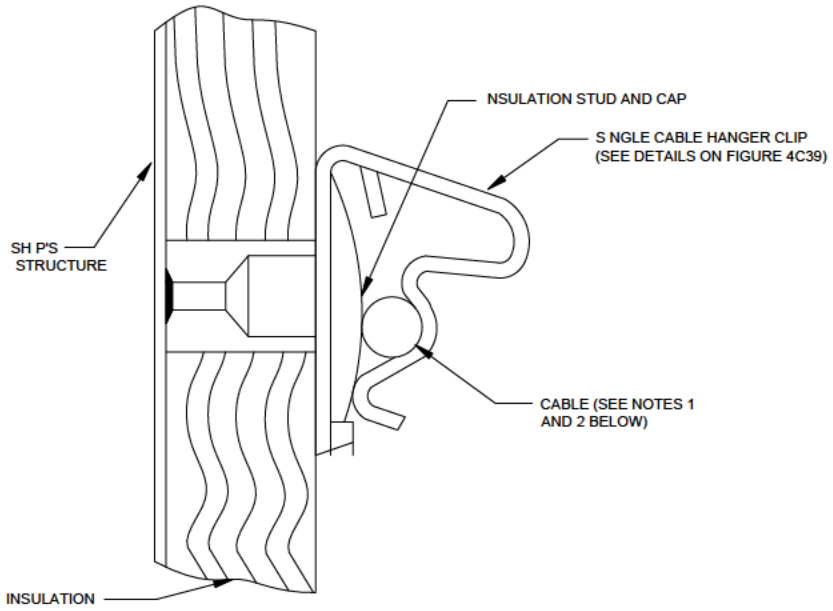
METHOD 4C-38-1
S NGLE CABLE HANGER CLIP USED IN CONJUCTION WITH INSULATION STUD CAP



NOTES:

1. This hanger clip is for cable ½ inch in diameter or less and weighing ¼ pound per foot or less.
2. Where a maximum length of the cable is installed along the surface of the hull board insulation and it is necessary to originate or terminate the run outside the insulation boundary, this hanger may be used for continuation of the run if advantageous to do so.
3. The material shall be spring steel, spheroidized, ASTM A713, Rockwell hardness 45-55, zinc electro-plated in accordance with ASTM B633, type I, thickness class FE-ZN 8 for Service Condition (SC) 2.

FIGURE 4C38. Single cableway on hullboard insulation.

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CLIP DETAILS FOR METHOD 4C-38-1
S NGLE CABLE HANGER CL P USED N CONJUCTION WITH INSULATION STUD CAP

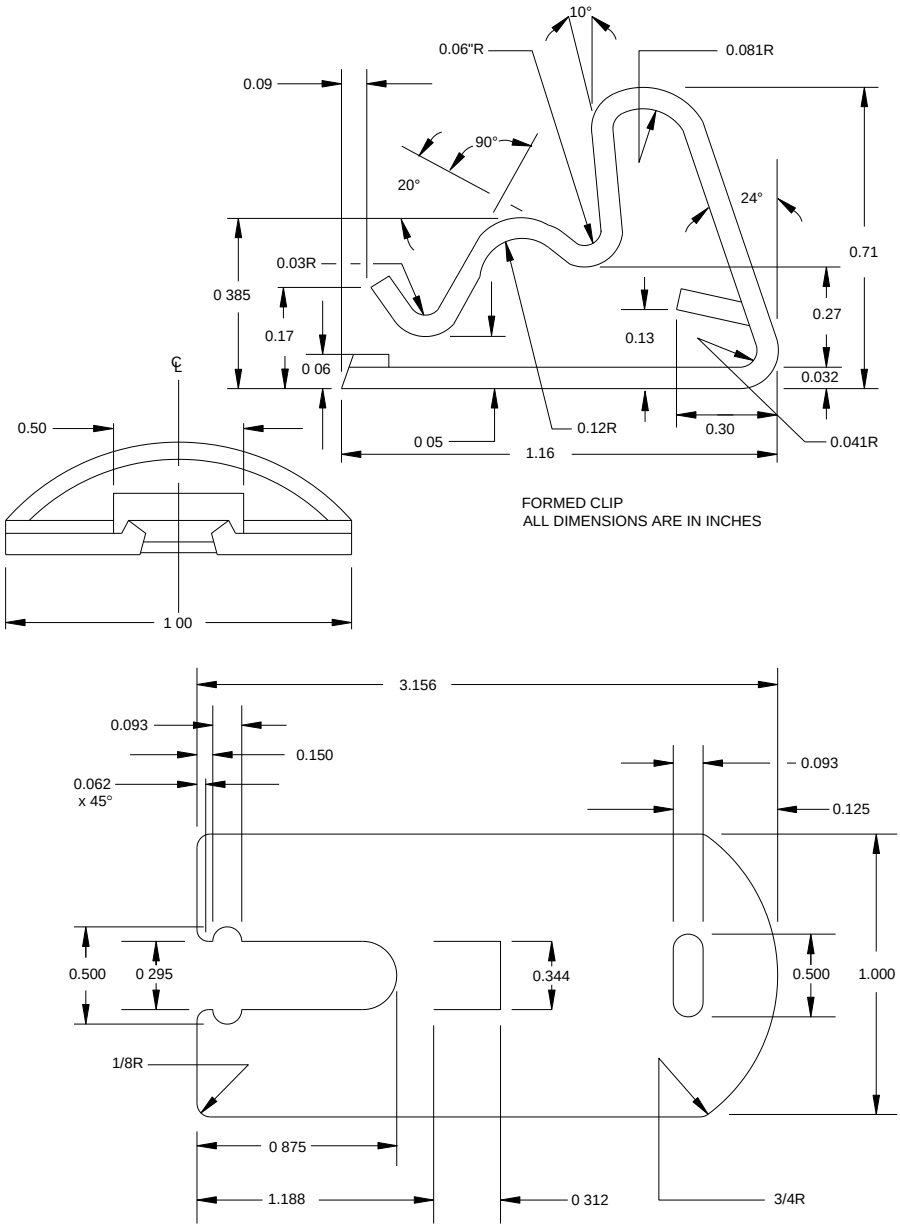

FIGURE 4C39. Clip details for single cableway on hullboard insulation.

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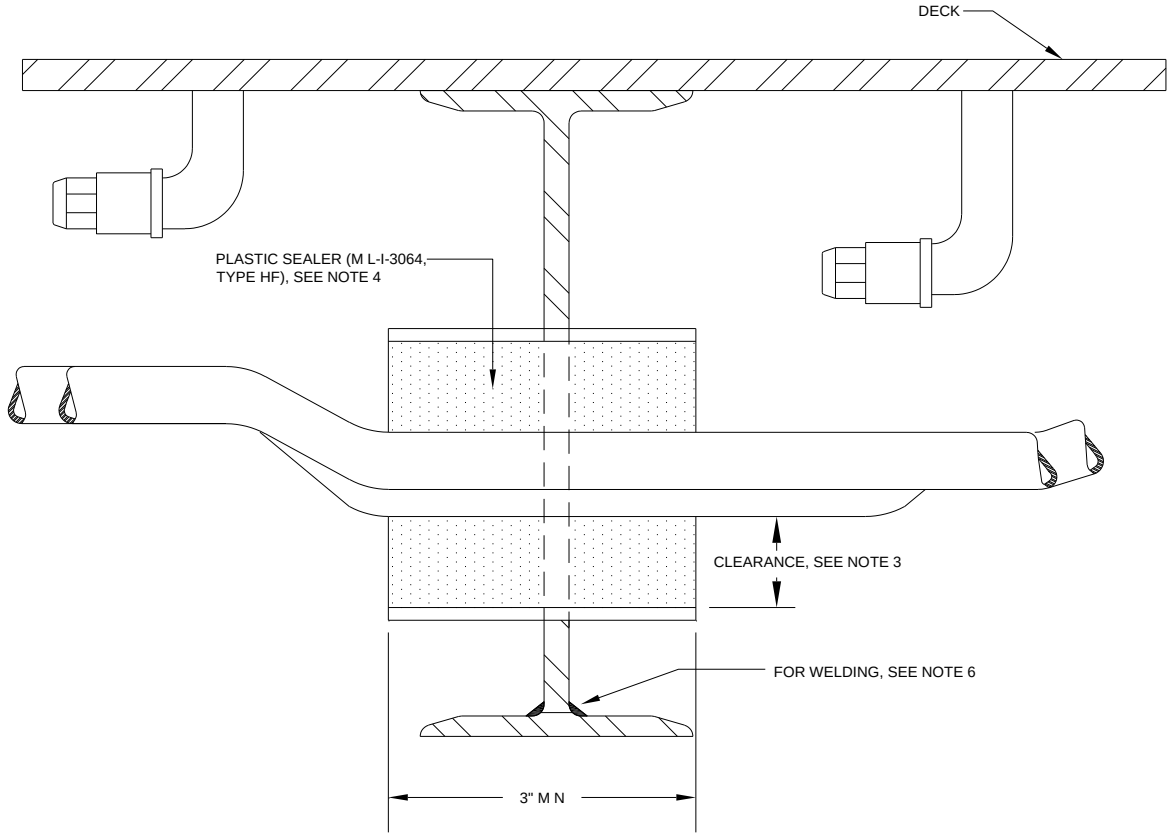
METHOD 4C-40-1
CABLES PASSING THROUGH LIGHTENING HOLES WITH FIRE STOP
(FOR NON-WATERTIGHT CABLE PENETRATIONS AND FOR A RTIGHT AND
FLAMETIGHT SPACES WHERE APPLICABLE)



NOTES:

1. Fire stop methods are for non-watertight cable penetrations and also for airtight and flametight spaces where applicable.
2. Stuffing tubes (tubing, collars, and liners) shall be steel for steel structures and aluminum for aluminum structures.
3. The minimum clearance space around cables before packing material is applied shall be ¼ inch for a single cable and 1 inch for multiple cables.
4. Pack thoroughly around and between cables with plastic sealer, MIL-I-3064, type HF.
5. Stuffing unit may be attached by all-around weld, tack weld, or fasteners provided that the attachment conforms to the structural and tightness requirements of the bulkhead or member to which it is attached.
6. All welding shall be in accordance with 5.7.3.6.
7. For existing installations, stuffing units may be split lengthwise for installing over cable.
8. See penetration stuffing requirements for airtight bulkheads and fume-tight bulkheads in MIL-STD-2003-3.

FIGURE 4C40. Cableway through non-watertight bulkheads and beams with fire stops.

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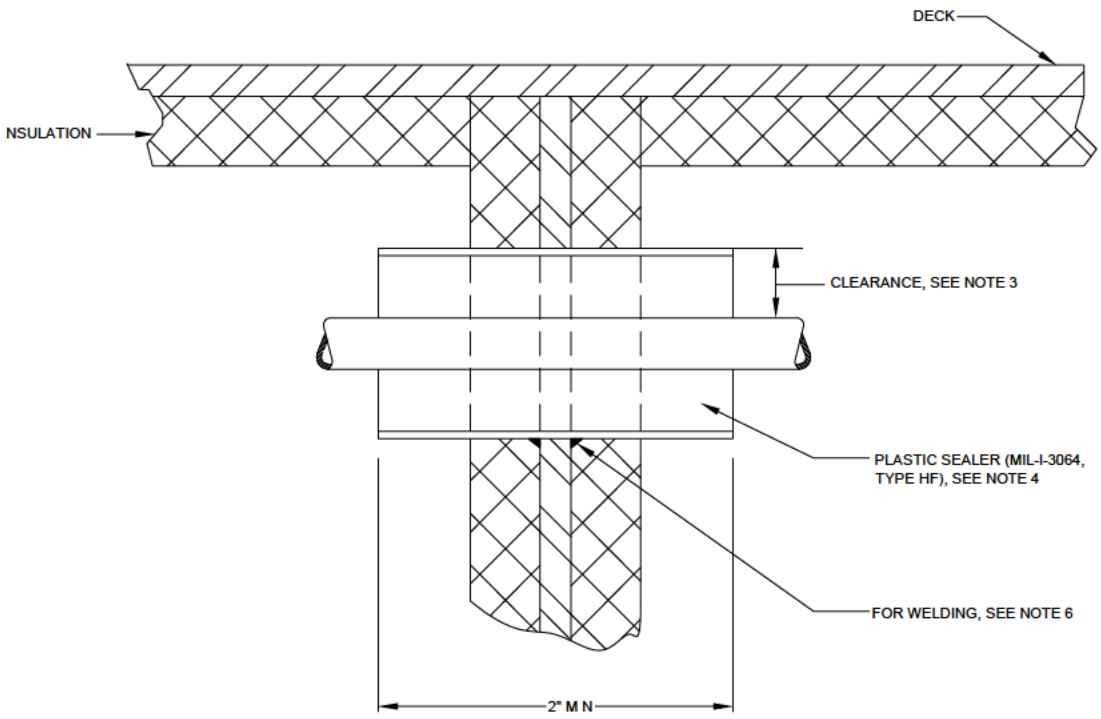
METHOD 4C-41-1
S NGLE CABLE PENETRATION THRU NON-WATERTIGHT
BULKHEADS OR STRUCTURAL MEMBERS WITH FIRE STOP



NOTES:

1. Fire stop methods are for non-watertight cable penetrations and also for airtight and flametight spaces where applicable.
2. Stuffing tubes (tubing, collars, and liners) shall be steel for steel structures and aluminum for aluminum structures.
3. The minimum clearance space around cables before packing material is applied shall be ¼ inch for a single cable and 1 inch for multiple cables.
4. Pack thoroughly around and between cables with plastic sealer, MIL-I-3064, type HF.
5. Stuffing unit may be attached by all-around weld, tack weld, or fasteners provided that the attachment conforms to the structural and tightness requirements of the bulkhead or member to which it is attached.
6. All welding shall be in accordance with 5.7.3.6.
7. For existing installations, stuffing units may be split lengthwise for installing over cable.
8. See penetration stuffing requirements for airtight bulkheads and fume-tight bulkheads in MIL-STD-2003-3.

FIGURE 4C41. Cableway through non-watertight bulkheads and beams with fire stops.

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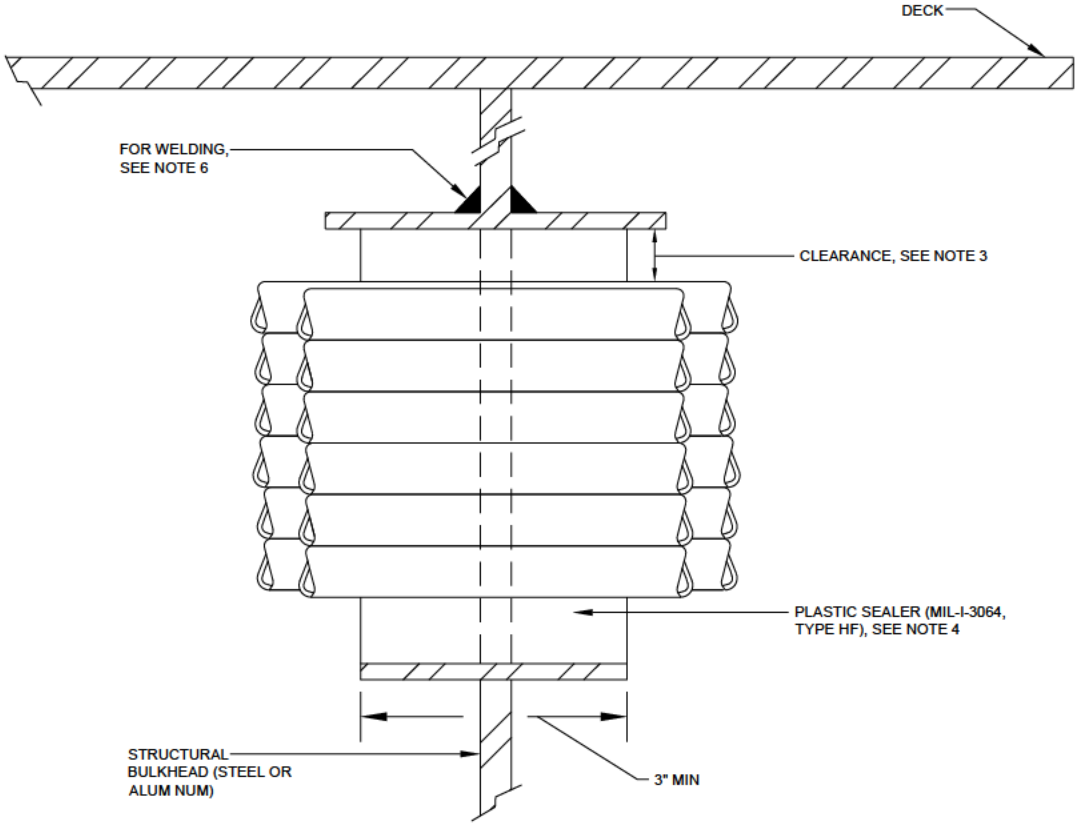
METHOD 4C-42-1
MULTIPLE CABLE PENETRATION THRU NON-WATERTIGHT
BULKHEADS OR STRUCTURAL MEMBERS WITH FIRE STOP



NOTES:

1. Fire stop methods are for non-watertight cable penetrations and also for airtight and flametight spaces where applicable.
2. Stuffing tubes (tubing, collars, and liners) shall be steel for steel structures and aluminum for aluminum structures.
3. The minimum clearance space around cables before packing material is applied shall be ¼ inch for a single cable and 1 inch for multiple cables.
4. Pack thoroughly around and between cables with plastic sealer, MIL-I-3064, type HF.
5. Stuffing unit may be attached by all-around weld, tack weld, or fasteners provided that the attachment conforms to the structural and tightness requirements of the bulkhead or member to which it is attached.
6. All welding shall be in accordance with 5.7.3.6.
7. See penetration stuffing requirements for airtight bulkheads and fume-tight bulkheads in MIL-STD-2003-3.

FIGURE 4C42. Cableway through non-watertight bulkheads and beams with fire stops.

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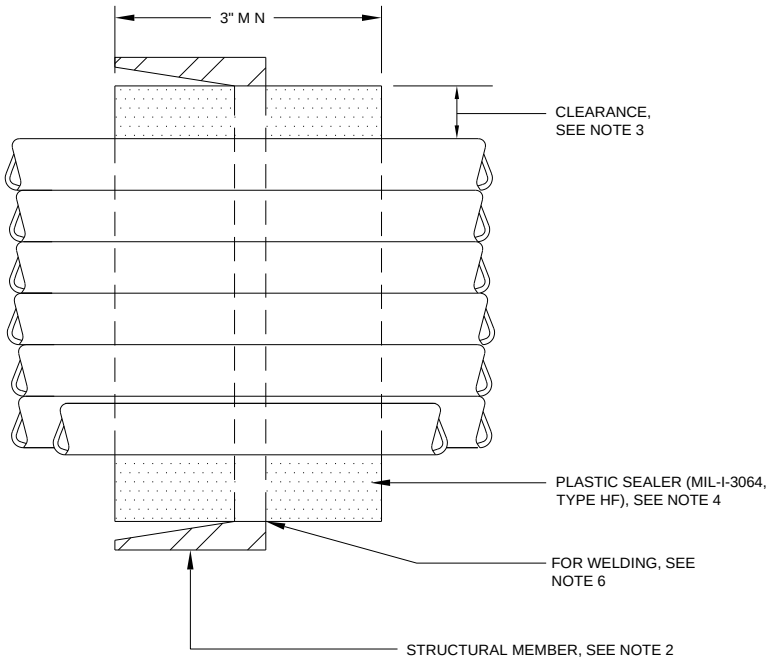
METHOD 4C-43-1
MULTIPLE CABLE PENETRATION THRU STRUCTURAL MEMBER WITH F RE STOP



NOTES:

1. Fire stop methods are for non-watertight cable penetrations and also for airtight and flametight spaces where applicable.
2. Stuffing tubes (tubing, collars, and liners) shall be steel for steel structures and aluminum for aluminum structures.
3. The minimum clearance space around cables before packing material is applied shall be ¼ inch for a single cable and 1 inch for multiple cables.
4. Pack thoroughly around and between cables with plastic sealer, MIL-I-3064, type HF.
5. Stuffing unit may be attached by all-around weld, tack weld, or fasteners provided that the attachment conforms to the structural and tightness requirements of the bulkhead or member to which it is attached.
6. All welding shall be in accordance with 5.7.3.6.
7. See penetration stuffing requirements for airtight bulkheads and fume-tight bulkheads in MIL-STD-2003-3.

FIGURE 4C43. Cableway through non-watertight bulkheads and beams with fire stops.

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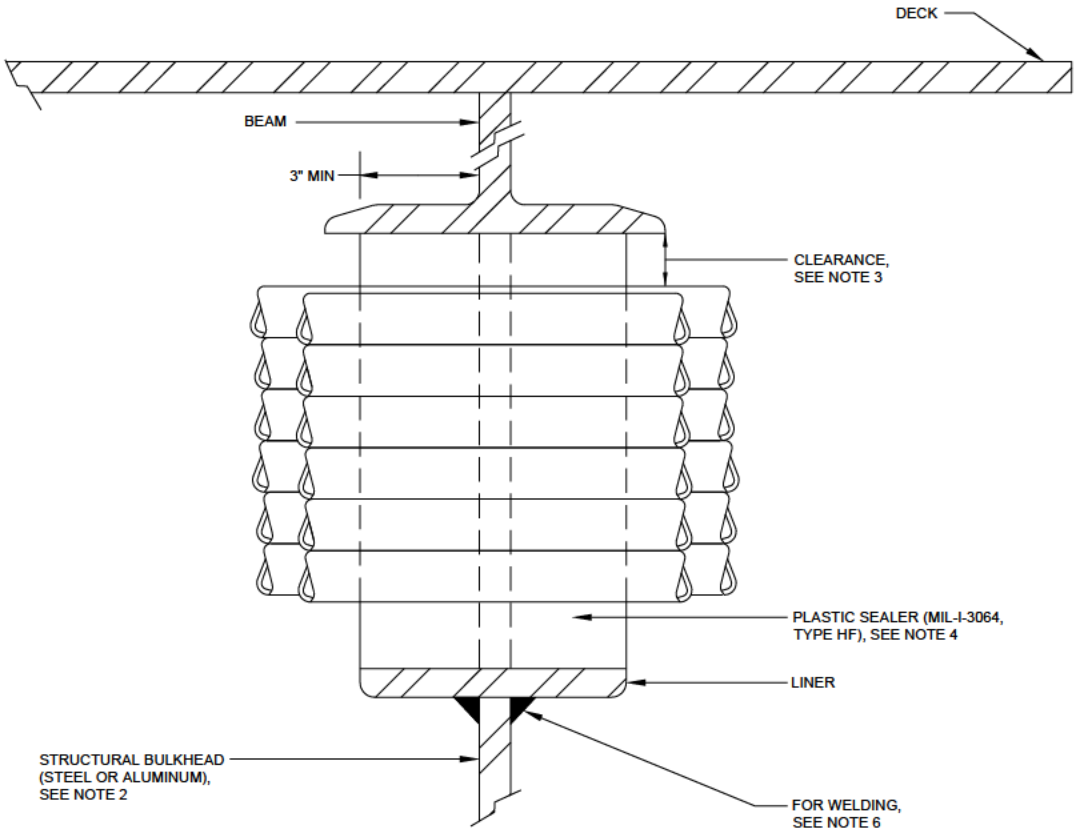
METHOD 4C-44-1
CABLEWAY IN STRUCTURAL BULKHEADS



NOTES:

1. Fire stop methods are for non-watertight cable penetrations and also for airtight and flametight spaces where applicable.
2. Stuffing tubes (tubing, collars, and liners) shall be steel for steel structures and aluminum for aluminum structures.
3. The minimum clearance space around cables before packing material is applied shall be ¼ inch for a single cable and 1 inch for multiple cables.
4. Pack thoroughly around and between cables with plastic sealer, MIL-I-3064, type HF.
5. Stuffing unit may be attached by all-around weld, tack weld, or fasteners provided that the attachment conforms to the structural and tightness requirements of the bulkhead or member to which it is attached.
6. All welding shall be in accordance with 5.7.3.6.
7. See penetration stuffing requirements for airtight bulkheads and fume-tight bulkheads in MIL-STD-2003-3.

FIGURE 4C44. Cableway through non-watertight bulkheads and beams with fire stops.

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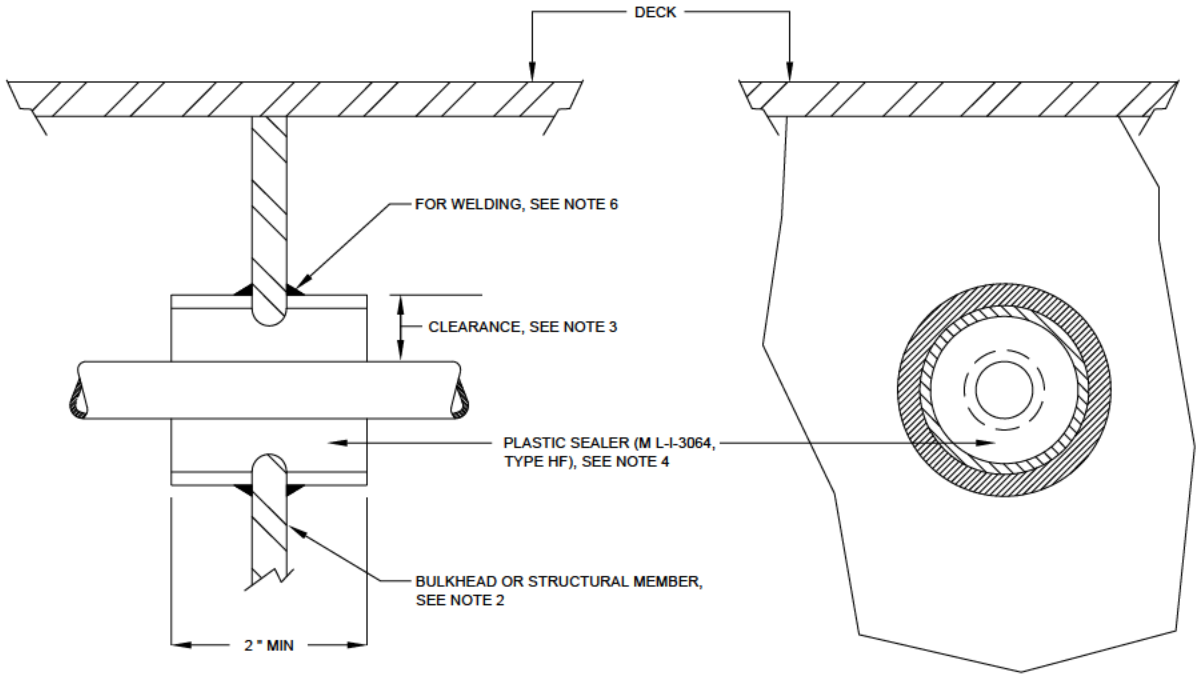
METHOD 4C-45-1
S NGLE CABLE PENETRATION THRU NON-WATERTIGHT
BULKHEADS OR STRUCTURAL MEMBERS WITH FIRE STOPS
(EXIST NG CABLE PENETRATIONS)



NOTES:

1. Fire stop methods are for non-watertight cable penetrations and also for airtight and flametight spaces where applicable.
2. Stuffing tubes (tubing, collars, and liners) shall be steel for steel structures and aluminum for aluminum structures.
3. The minimum clearance space around cables before packing material is applied shall be ¼ inch for a single cable and 1 inch for multiple cables.
4. Pack thoroughly around and between cables with plastic sealer, MIL-I-3064, type HF.
5. Stuffing unit may be attached by all-around weld, tack weld, or fasteners provided that the attachment conforms to the structural and tightness requirements of the bulkhead or member to which it is attached.
6. All welding shall be in accordance with 5.7.3.6.
7. For existing installations, stuffing units may be split lengthwise for installing over cable.
8. See penetration stuffing requirements for airtight bulkheads and fume-tight bulkheads in MIL-STD-2003-3.

FIGURE 4C45. Cableway through non-watertight bulkheads with fire stops, existing penetration.

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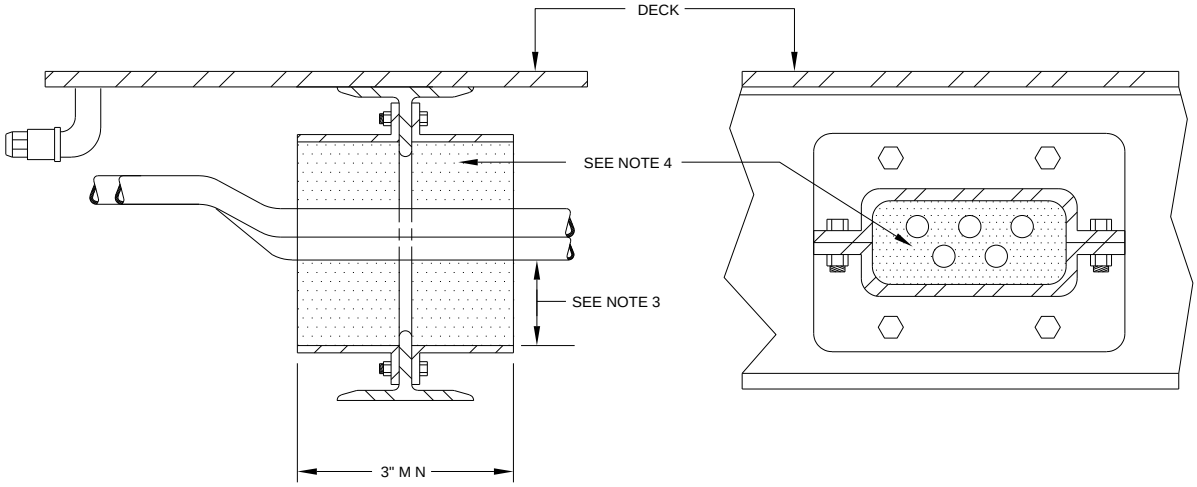
METHOD 4C-46-1
CABLE PASS NG THRU LIGHTENING HOLES WITH FIRE STOPS - MULTIPLE CABLE PENETRATIONS
(EXISTING CABLE PENETRATIONS)



NOTES:

1. Fire stop methods are for non-watertight cable penetrations and also for airtight and flametight spaces where applicable.
2. Stuffing tubes (tubing, collars, and liners) shall be steel for steel structures and aluminum for aluminum structures.
3. The minimum clearance space around cables before packing material is applied shall be ¼ inch for a single cable and 1 inch for multiple cables.
4. Pack thoroughly around and between cables with plastic sealer, MIL-I-3064, type HF.
5. Stuffing unit may be attached by all-around weld, tack weld, or fasteners provided that the attachment conforms to the structural and tightness requirements of the bulkhead or member to which it is attached.
6. All welding shall be in accordance with 5.7.3.6.
7. For existing installations, stuffing units may be split lengthwise for installing over cable.
8. See penetration stuffing requirements for airtight bulkheads and fume-tight bulkheads in MIL-STD-2003-3.

FIGURE 4C46. Cableway through non-watertight bulkheads with fire stops, existing penetration.

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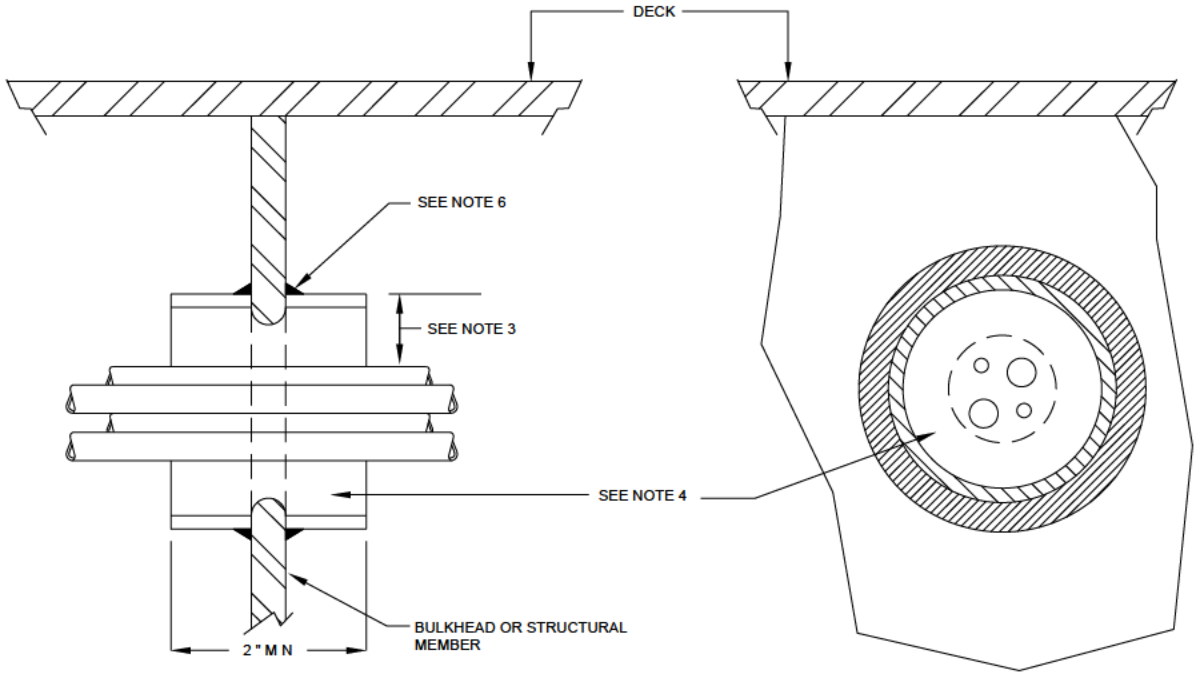
METHOD 4C-47-1
MULT PLE CABLE PENETRATION THRU NON-WATERTIGHT
BULKHEADS OR STRUCTURAL MEMBERS WITH F RE STOPS
(EXISTING CABLE PENETRATIONS)



NOTES:

1. Fire stop methods are for non-watertight cable penetrations and also for airtight and flametight spaces where applicable.
2. Stuffing tubes (tubing, collars, and liners) shall be steel for steel structures and aluminum for aluminum structures.
3. The minimum clearance space around cables before packing material is applied shall be ¼ inch for a single cable and 1 inch for multiple cables.
4. Pack thoroughly around and between cables with plastic sealer, MIL-I-3064, type HF.
5. Stuffing unit may be attached by all-around weld, tack weld, or fasteners provided that the attachment conforms to the structural and tightness requirements of the bulkhead or member to which it is attached.
6. All welding shall be in accordance with 5.7.3.6.
7. For existing installations, stuffing units may be split lengthwise for installing over cable.
8. See penetration stuffing requirements for airtight bulkheads and fume-tight bulkheads in MIL-STD-2003-3.

FIGURE 4C47. Cableway through non-watertight bulkheads with fire stops, existing penetration.

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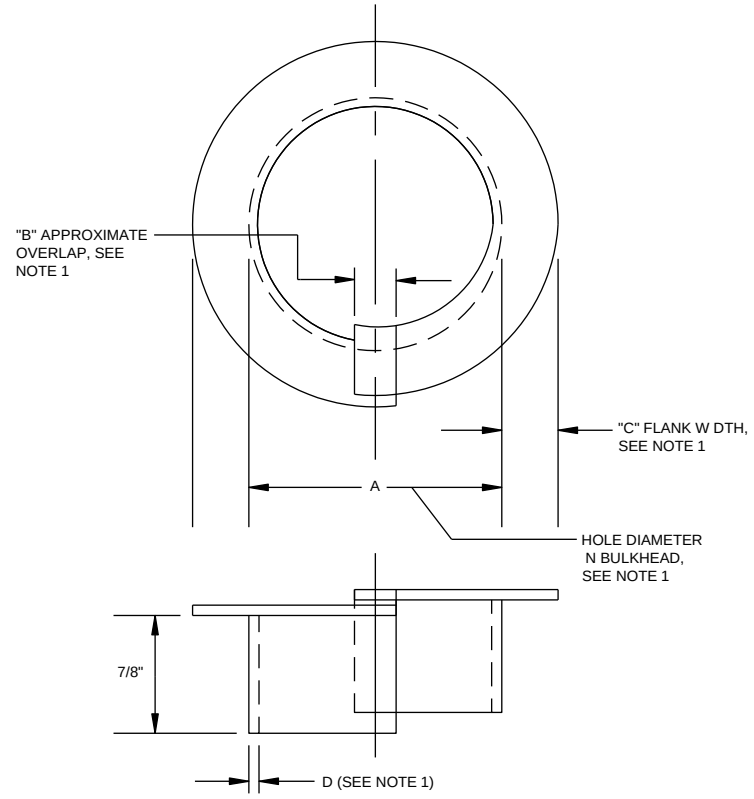
INSULATING LINERS FOR CABLE HOLES
(L NERS MAY BE COMMERCIAL SIZES. MATERIAL SHALL BE VULCANIZED F BER OR OTHER NON-TOXIC TYPE PLASTIC MATERIAL)
SEE NOTE 1 FOR DIMENSIONS



NOTES:

1. Dimensions (in inches) for insulating liners are as follows:

A	B	C	D
¾	3⁄16	1⁄8	0.025
1 5⁄32	3⁄16	1⁄8	0.025
1 7⁄16	3⁄16	5⁄32	0.025
1 13⁄16	¼	5⁄32	0.030
2 1⁄16	¼	5⁄32	0.030
2 19⁄32	5⁄16	5⁄32	0.030
3 5⁄16	⅜	7⁄32	0.040
3 ⅜	⅜	7⁄32	0.040
4 ¼	7⁄16	7⁄32	0.040

2. For details of the use of this liner, refer to method 4C-30-1, figure 4C30.

FIGURE 4C48. Insulating liners for cable holes in beams and girders.

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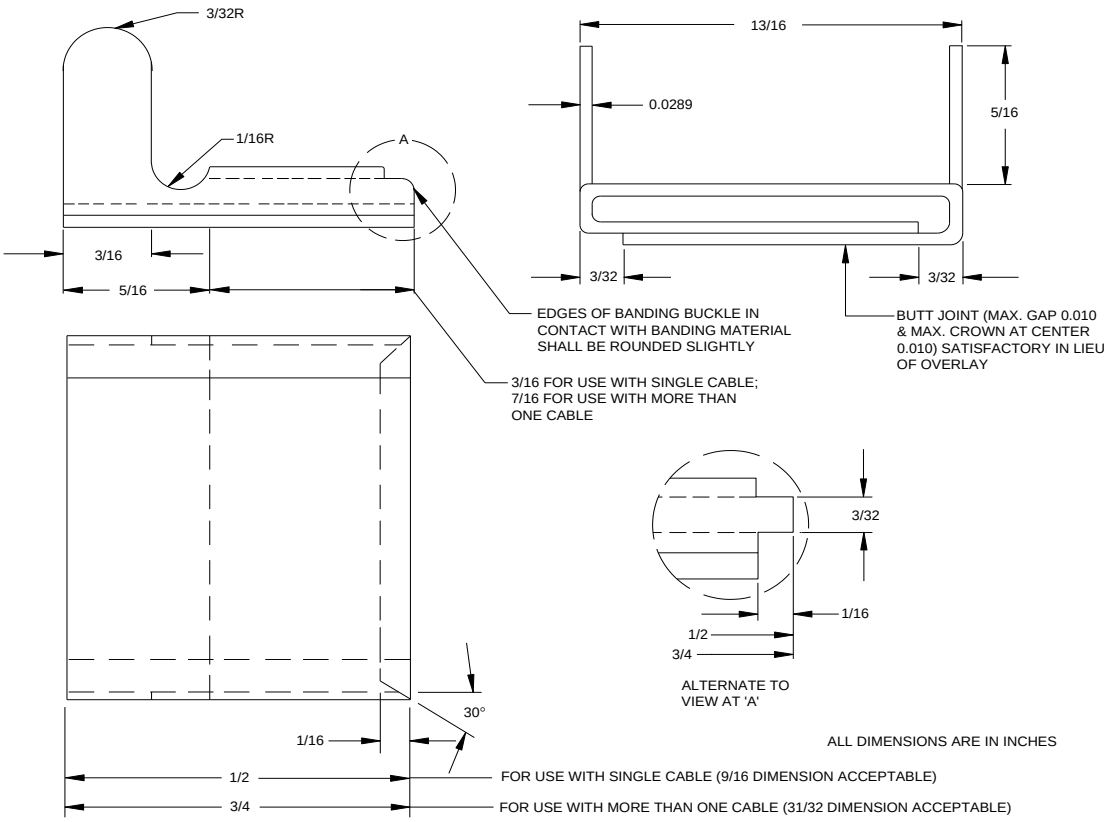
METHOD 4C-49-1
BAND NG BUCKLE
(SEE NOTES 1 THROUGH 3)



NOTES:

1. Banding buckles shall be made of corrosion-resistant steel, ASTM A240/A240M, ASTM A666, and ASTM A693.
2. The edges of the banding buckle in contact with the banding material shall be rounded slightly.
3. Specifications, vendor information, and part numbers for selected banding buckles are as specified in table 4C49-I:

TABLE 4C49-I. Banding buckle sources and part numbers.

Buckle length (inch)	Commercial source (see 4.3)	Description/part number
½	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	"Inverted Wing Seal" 202SS (stainless steel)
¾	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	"Wing Seal" 204SS (stainless steel)
¾	Independent Metal Strap Company, Inc. 34 Lumber Road, Roslyn, NY 11576-0334, or equal	"Royal Wing Seal" (stainless steel)
⅝ × ½	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	213SS (stainless steel); NSN 8135-01-030-1632
⅝ × ¾	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	203SS (stainless steel); NSN 8135-01-120-8754

FIGURE 4C49. Cable banding buckle and miscellaneous details.

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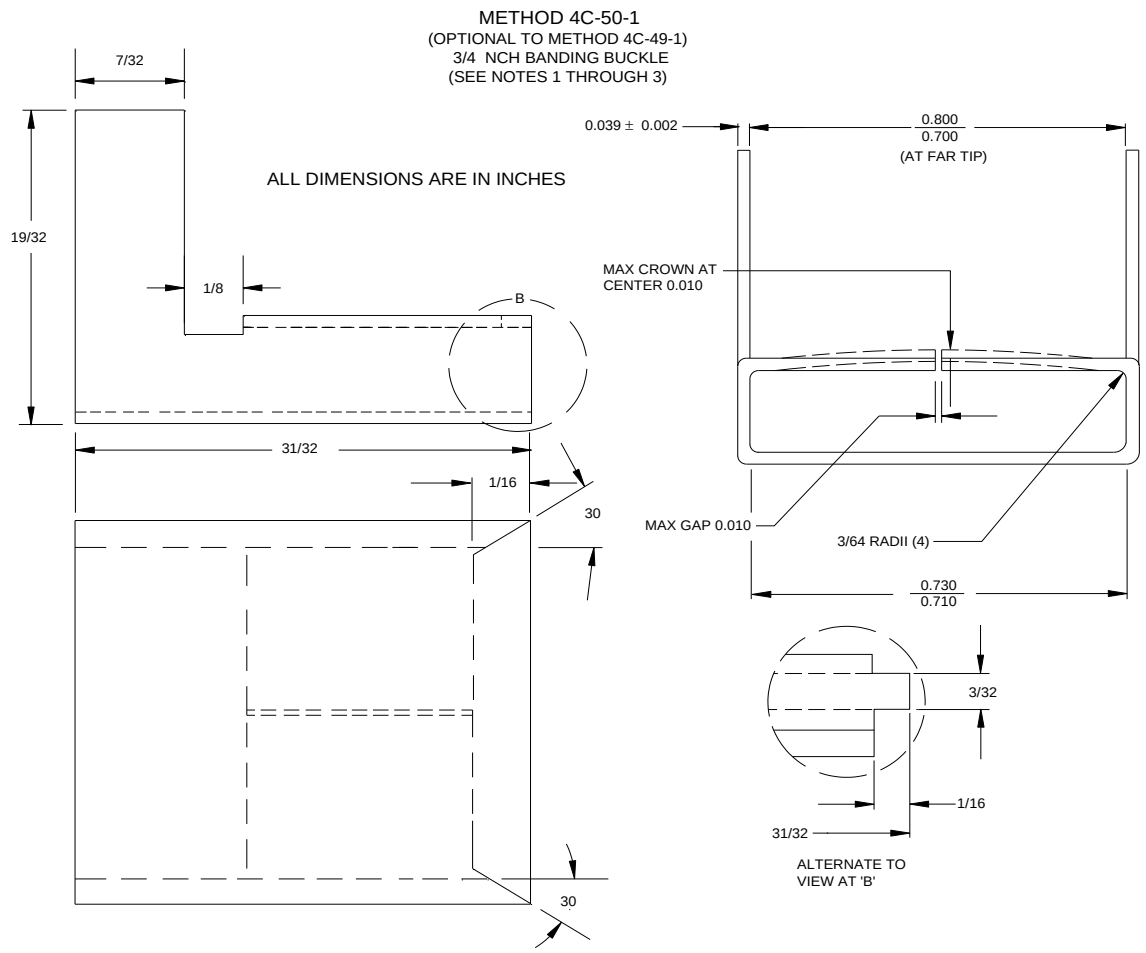

NOTES:

1. Banding buckles shall be made of corrosion-resistant steel, ASTM A240/A240M, ASTM A666, and ASTM A693.
2. The edges of the banding buckle in contact with the banding material shall be rounded slightly.
3. Specifications, vendor information, and part numbers for selected banding buckles are as specified in table 4C50-I.

TABLE 4C50-I. Banding buckle sources and part numbers.

Buckle length (inch)	Commercial source (see 4.3)	Description/part number
½	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	"Inverted Wing Seal" 202SS (stainless steel)
¾	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	"Wing Seal" 204SS (stainless steel)
¾	Independent Metal Strap Company, Inc. 34 Lumber Road, Roslyn, NY 11576-0334, or equal	"Royal Wing Seal" (stainless steel)
⅝ × ½	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	213SS (stainless steel); NSN 8135-01-030-1632
⅝ × ¾	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	203SS (stainless steel); NSN 8135-01-120-8754

FIGURE 4C50. Cable banding buckle and miscellaneous details.

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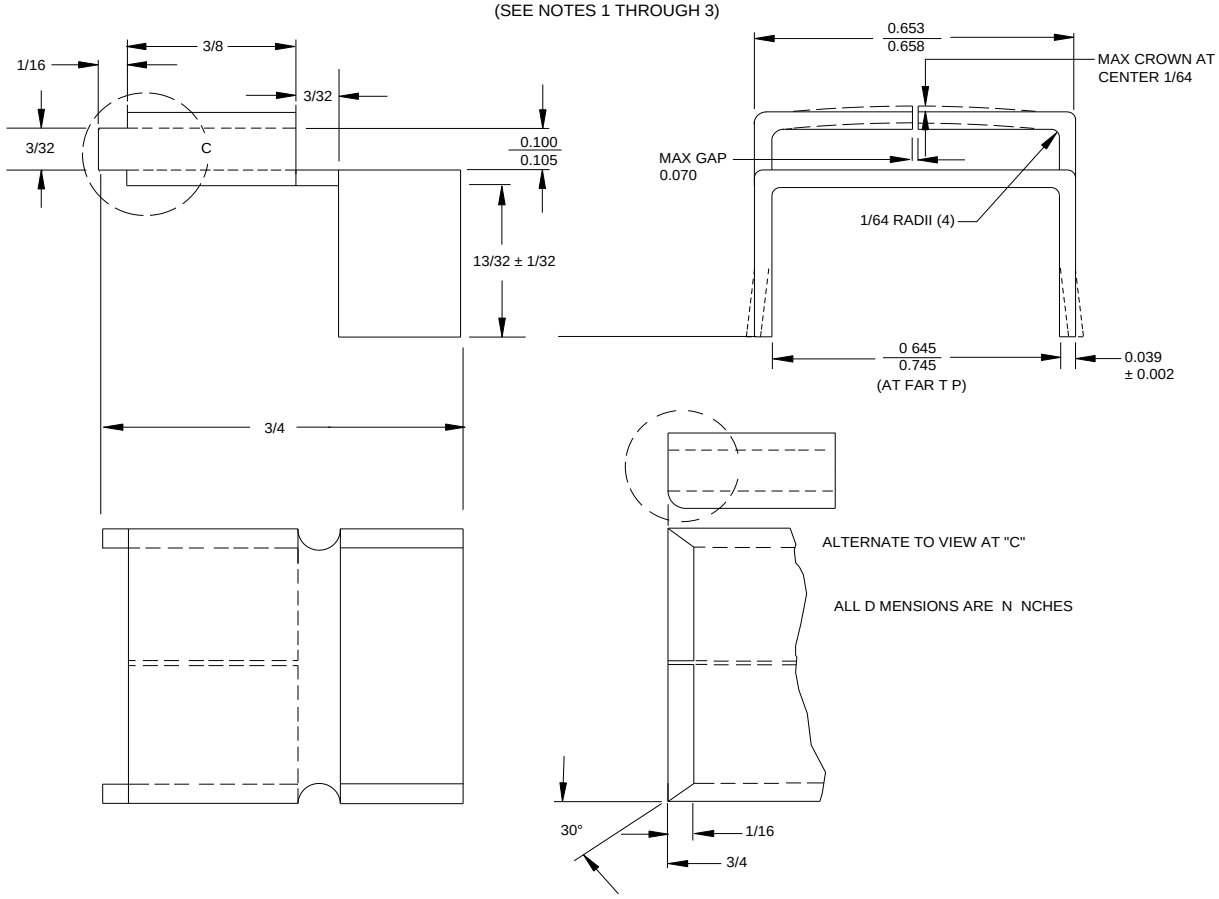
METHOD 4C-51-1
OPTIONAL TO METHOD 4C-49-1
BANDING BUCKLE (INVERTED), 1/2 INCH
(SEE NOTES 1 THROUGH 3)



NOTES:

1. Banding buckles shall be made of corrosion-resistant steel, ASTM A240/A240M, ASTM A666, and ASTM A693.
2. The edges of the banding buckle in contact with the banding material shall be rounded slightly.
3. Specifications, vendor information, and part numbers for selected banding buckles are as specified in table 4C51-I:

TABLE 4C51-I. Banding buckle sources and part numbers.

Buckle length (inch)	Commercial source (see 4.3)	Description/part number
½	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	"Inverted Wing Seal" 202SS (stainless steel)
¾	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	"Wing Seal" 204SS (stainless steel)
¾	~~Independent Metal Strap Company, Inc.~~ 34 Lumber Road, Roslyn, NY 11576-0334, or equal	~~"Royal Wing Seal"~~ (stainless steel)
⅝ × ½	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	213SS (stainless steel); NSN 8135-01-030-1632
⅝ × ¾	Gerrard Packaging 2451 South Wolf Road, Des Plaines, IL 60018-2608, or equal	203SS (stainless steel); NSN 8135-01-120-8754

FIGURE 4C51. Cable banding buckle (inverted) and miscellaneous details.

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Method 4C-52-1
Banding of Cables in Cableways

ATTACHING BAND TO BUCKLE

1. Pull the banding material from the container and cut the desired length with a cable banding tool.
2. Place the banding material through the buckle towards the tabs on the buckle. See illustration 1.

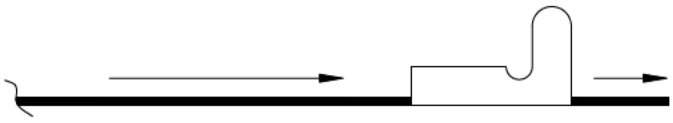

Illustration 1

3. Fold and crimp the end of the banding material under the buckle at the tabs using a pair of channel locks. See illustration 2.

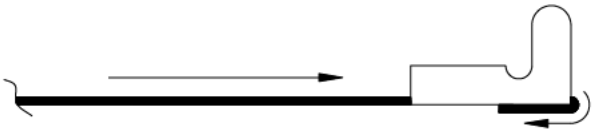

Illustration 2

4. Fold and crimp the banding material at the end of the buckle. See illustration 3.

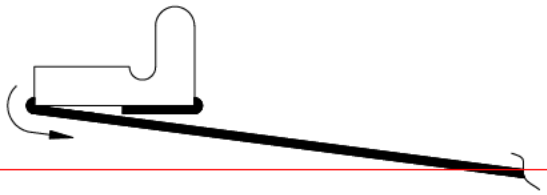

Illustration 3

5. Run the end of the banding material through the tabs of the buckle. See illustration 4.

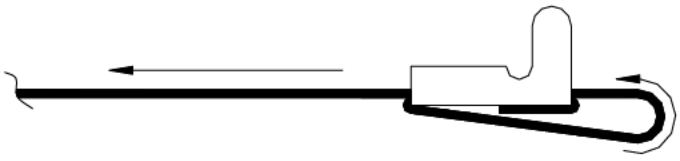

Illustration 4

FIGURE 4C52. Applying banding material.

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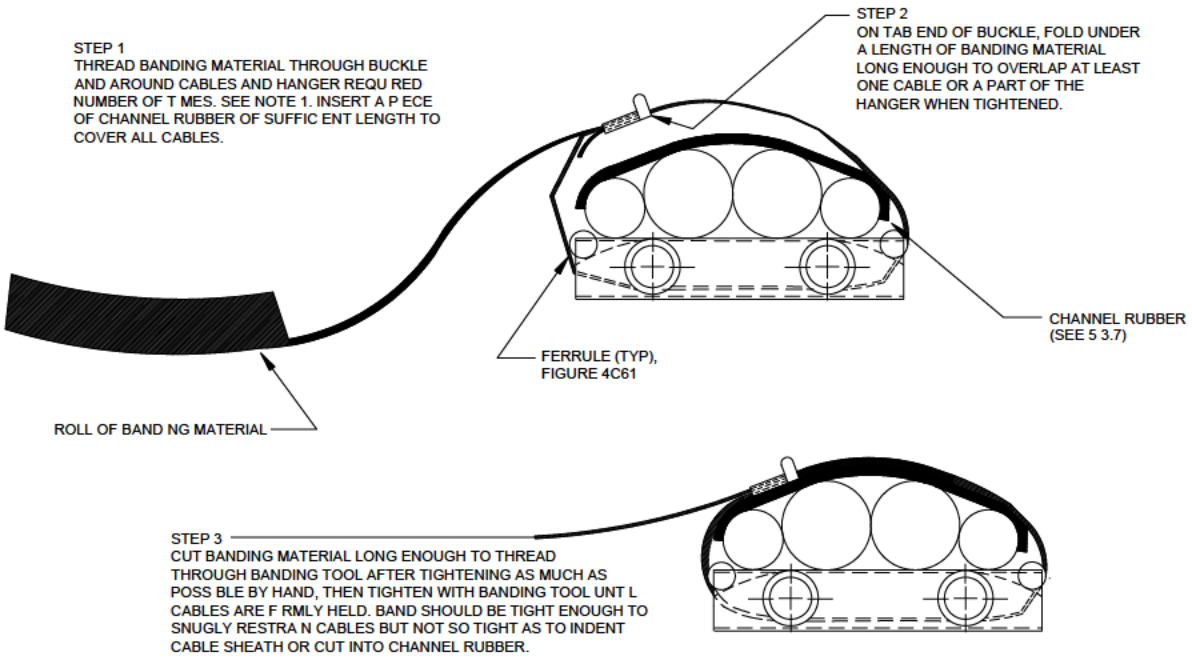
ATTACHING BAND TO BUCKLE (continued):

6. Pull tight and crimp the banding material at the tabs of the buckle. See illustration 5.

Illustration 5

APPLICATION OF BANDING MATERIAL



NOTES:

1. Banding general notes in C.4.4 apply.
2. Figure 4C53 is a continuation of the banding steps in this figure.
3. Cable banding and channel rubber material are detailed in C.4.4, tables 4CVIII through 4CXI.

FIGURE 4C52. Applying banding material – Continued.

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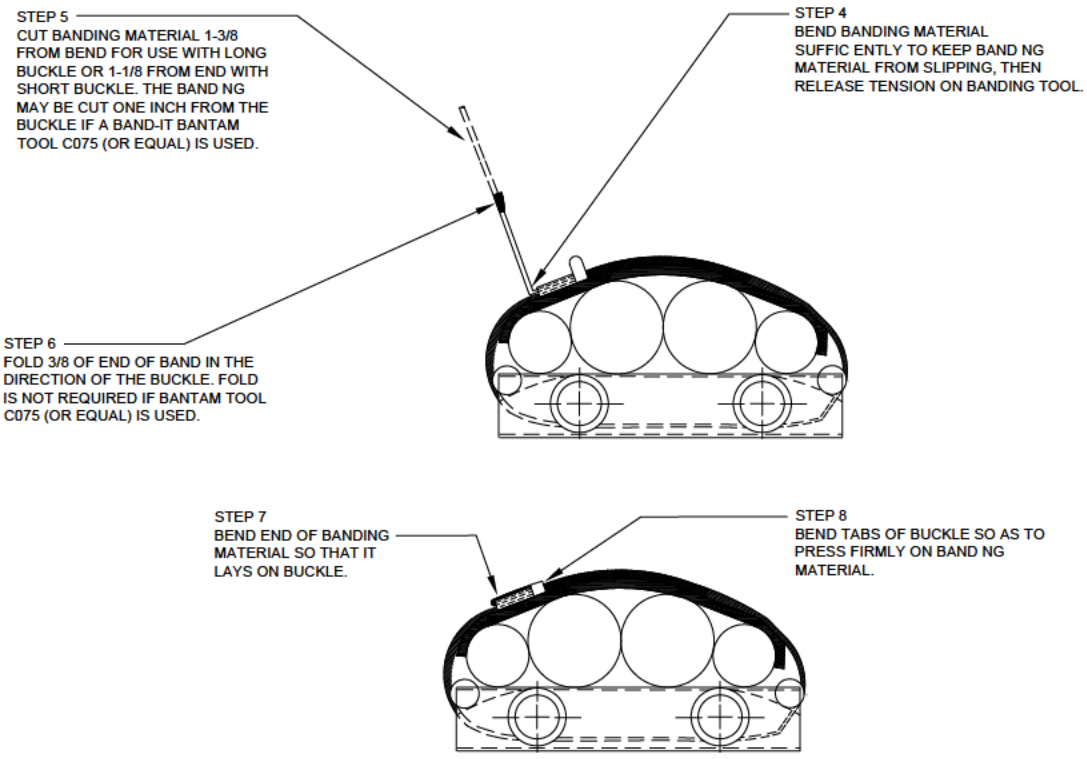
Continuation of Method 4C-52-1

APPLICATION OF BANDING MATERIAL (CONTINUED)



NOTES:

1. Banding general notes in C.4.4 apply.
2. Cable banding and channel rubber material are detailed in C.4.4, tables 4CVIII through 4CXI.
3. This figure is a continuation of the steps in figure 4C52.

FIGURE 4C53. Applying banding material – continuation from figure 4C52.

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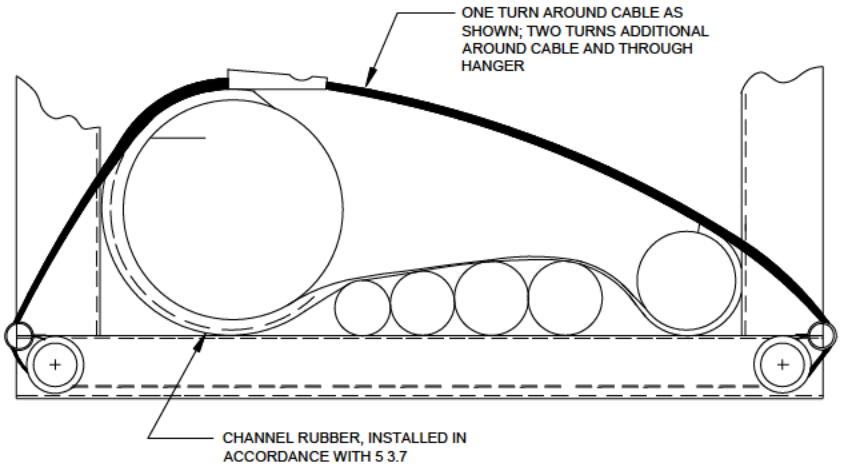
METHOD 4C-54-1
HANGERS WITH LARGE & SMALL
CABLES INTERMIXED



NOTES:

1. Banding general notes in C.4.4 apply.
2. Cable banding and channel rubber material are detailed in C.4.4 and tables 4CVIII through 4CXI.

FIGURE 4C54. Details of partially and fully loaded banding hangers.

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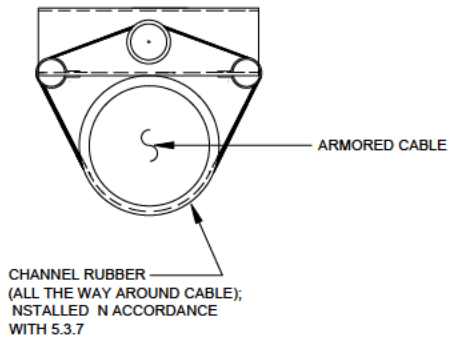
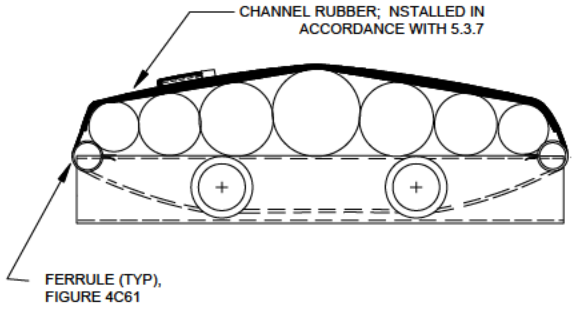
METHOD 4C-55-1
USE OF CHANNEL RUBBER FOR SOUND ISOLATION



METHOD 4C-55-2
FULLY LOADED HANGERS



NOTES:

1. Banding general notes in C.4.4 apply.
2. Cable banding and channel rubber material are detailed in C.4.4 and tables 4CVIII through 4CXI.

FIGURE 4C55. Details of partially and fully loaded banding hangers.

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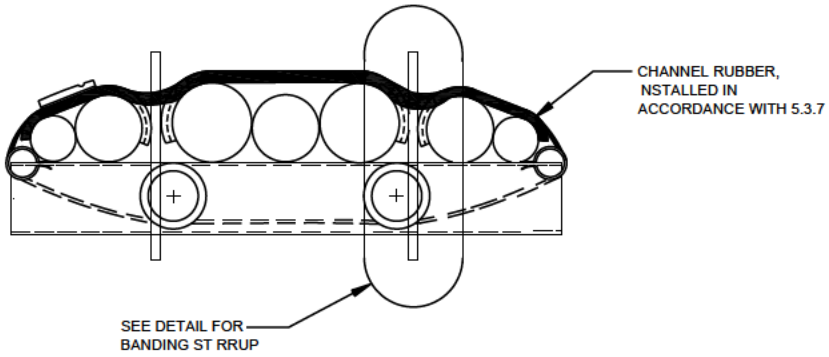
METHOD 4C-56-1
PARTIALLY LOADED HANGERS



BANDING STIRRUP

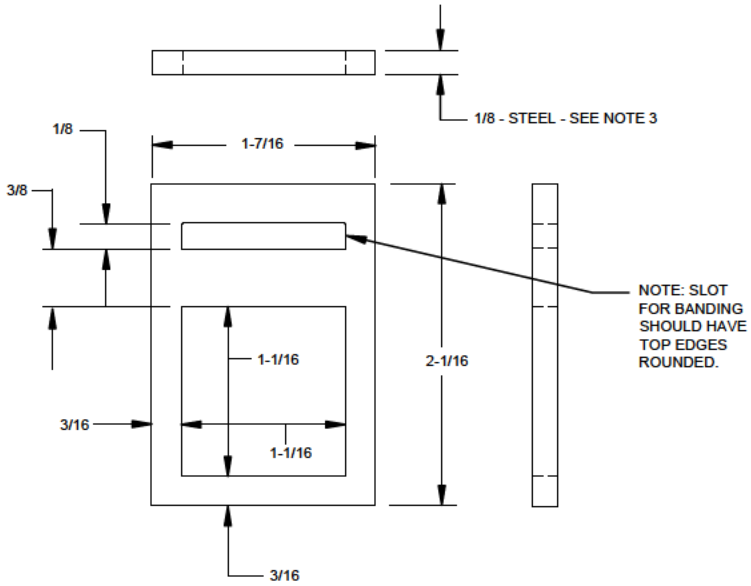


FIGURE 4C56. Details of partially and fully loaded banding hangers.

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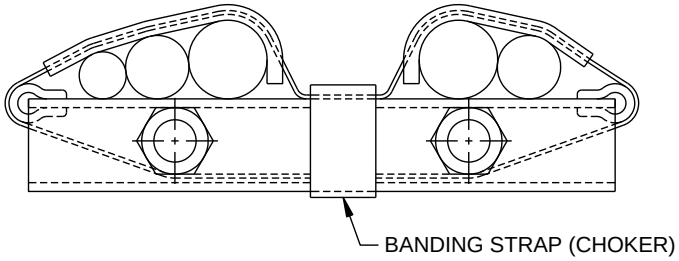
Method 4C-56-2
Partially Loaded Hangers with Choker
Alternate to Method 4C-56-1



NOTES:

1. Banding general notes in C.4.4 apply.
2. Cable banding and channel rubber material are detailed in C.4.4, tables 4CVIII through 4CXI.
3. The steel shall be in accordance with ASTM A568/A568M, zinc-plated in accordance with ASTM B633.

FIGURE 4C56. Details of partially and fully loaded banding hangers – Continued.

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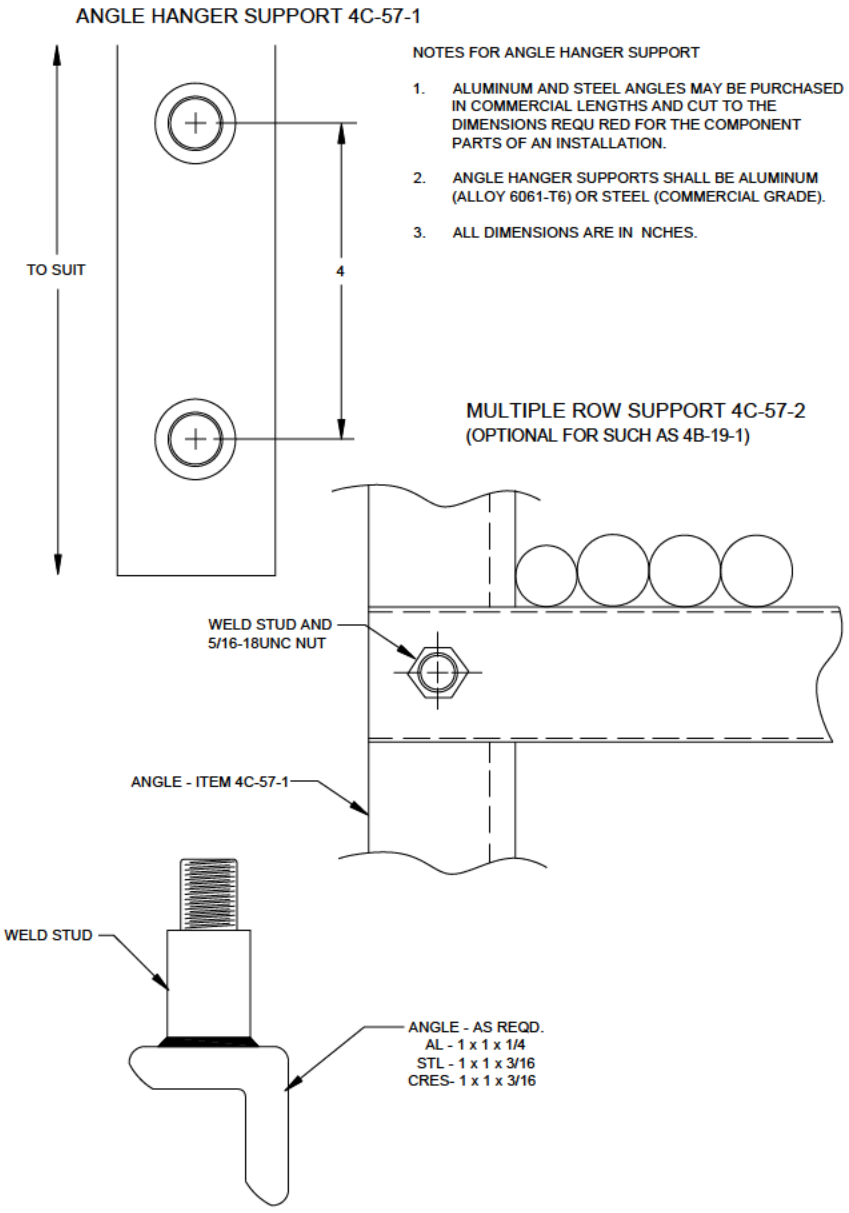

NOTES:

1. See 5.7.3.8 for weld stud and collar stud requirements.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4C57. Angle hanger support details.

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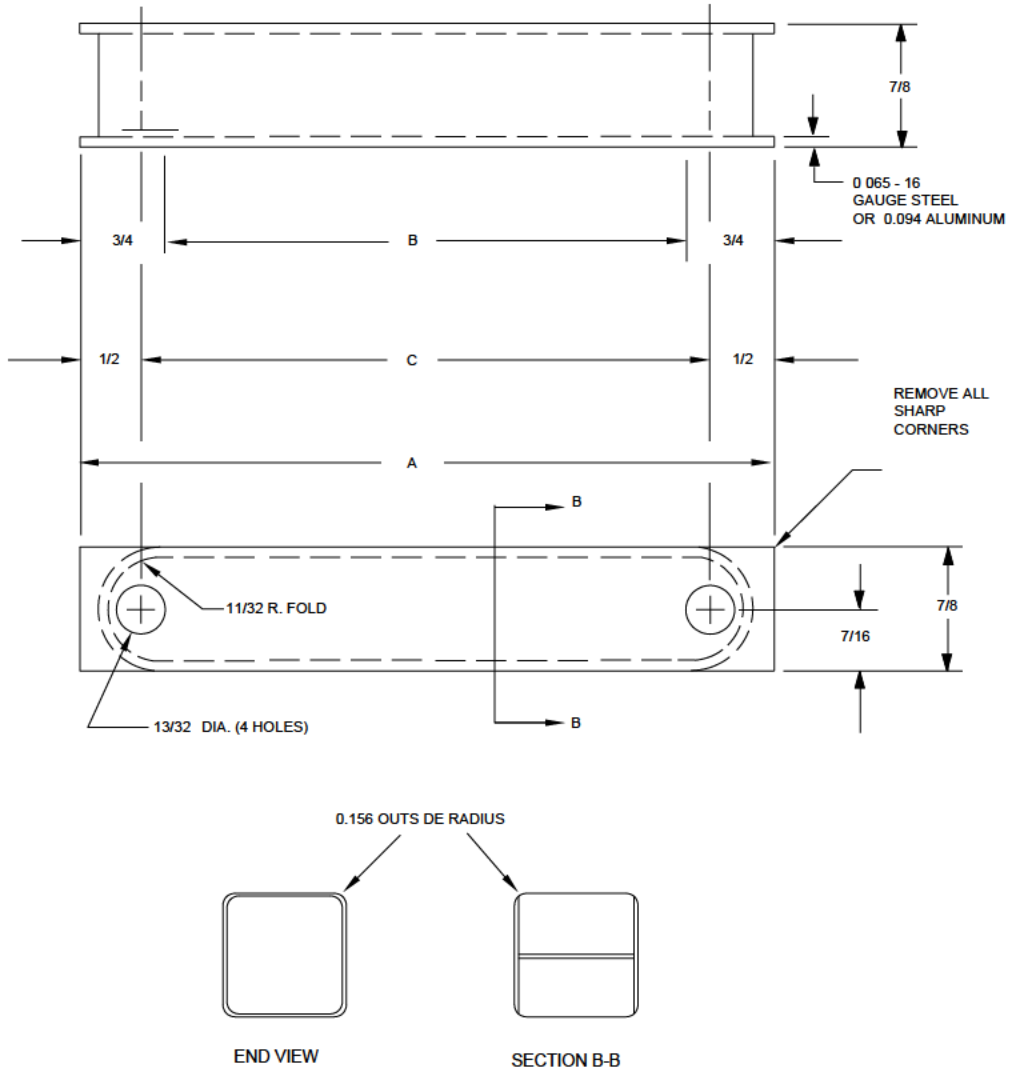
SIDE MOUNTED TUBULAR HANGER
4C-58-1 - ALUMINUM
4C-58-2 - STEEL
4C-58-3 - CRES

(CUT TUBULAR HANGERS TO LENGTHS REQUIRED IN TABULATIONS)
TUBULAR HANGER DETAILED BELOW MAY BE USED AS ALTERNATE TO
ITEMS 4C-59-1, 4C-59-2 AND 4C-59-3
FERRULES ARE NOT REQUIRED FOR ITEMS 4C-58-1, 4C-58-2 AND 4C-58-3



NOTES:

1. Square tubing may be purchased in commercial lengths. Cut tubular hangers to the lengths required in tabulations.

FIGURE 4C58. Details of side mounted tubular hangers.

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NOTES (continued):

2. Dimensions for tubular hangers are as follows:

Item no.	Dimensions (inches)		
	A	B	C
4C-58-1 4C-58-2 4C-58-3	3	1½	2
	4	2½	3
	5	3½	4
	6	4½	5
	7	5½	6
	8	6½	7
	9	7½	8
	10	8½	9
	11	9½	10
	12	10½	11
	13	11½	12
	14	12½	13
	15	13½	14
	16	14½	15
	17	15½	16

3. Aluminum tubing shall be seamless drawn and in accordance with ASTM B241/B241M, temper 6.
4. Steel tubing shall be hot rolled, weld seamflash in commercial grade.

FIGURE 4C58. Details of side mounted tubular hangers – Continued.

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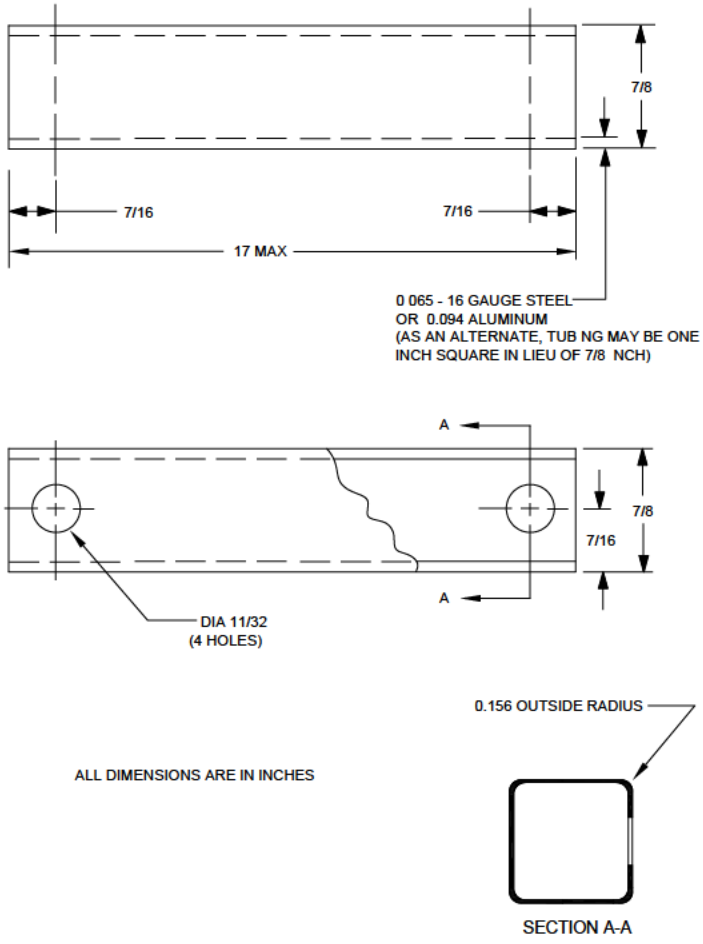
SIDE MOUNTED TUBULAR HANGER
4C-59-1 - ALUMINUM
4C-59-2 - STEEL
4C-59-3 - CRES
(4C-59-1, 4C-59-2 AND 4C-59-3 TO BE USED AS
ALTERNATE TO 4C-58-1, 4C-58-2 AND 4C-58-3)



NOTES:

1. Square tubing may be purchased in commercial lengths. Cut tubular hangers to the lengths required in tabulations.
2. Aluminum tubing shall be seamless drawn and in accordance with ASTM B241/B241M, temper 6.
3. Steel tubing shall be hot rolled, weld seamflash in commercial grade.

FIGURE 4C59. Details of side mounted tubular hanger – alternate design.

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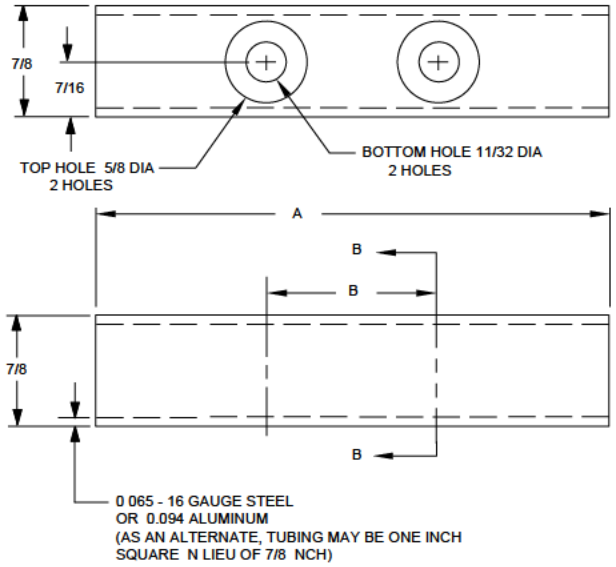
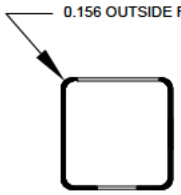
BOTTOM MOUNTED TUBULAR HANGER
4C-60-1 - ALUMINUM
4C-60-2 - STEEL
4C-60-3 - CRES





SECTION B-B

ALL DIMENSIONS ARE IN NCHES

SEE NOTE 2 FOR DIMENSIONS

NOTES:

1. Square tubing may be purchased in commercial lengths. Cut tubular hangers to the lengths required in tabulations.
2. Dimensions for tubular hangers are as follows:

Dimensions (inches)	
Hanger length A	**Hole spacing B**
3	2
4	2
5	2
6	2
7	6½
8	6½
9	5½
10 to 17 maximum	Dim A minus 7/16

3. Aluminum tubing shall be seamless drawn and in accordance with ASTM B241/B241M, temper 6.
4. Steel tubing shall be hot rolled, weld seamflash in commercial grade.

FIGURE 4C60. Details of bottom mounted tubular hanger.

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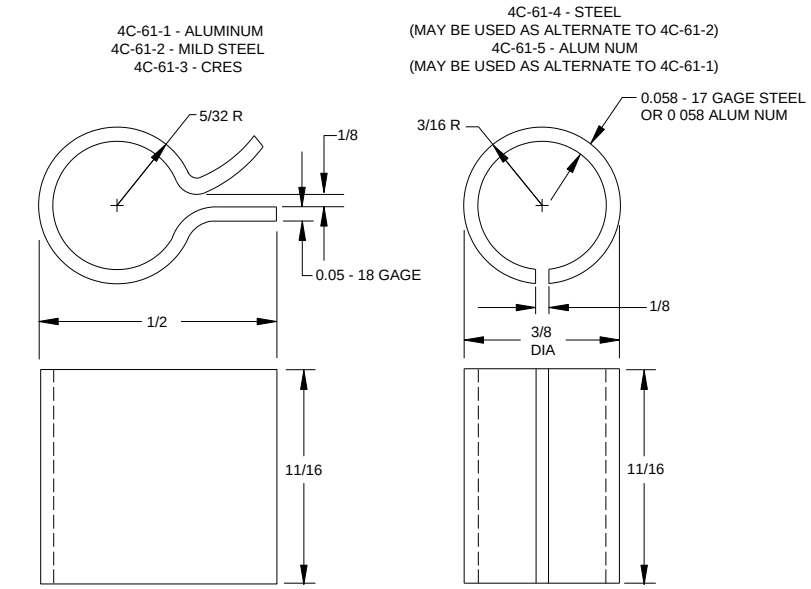
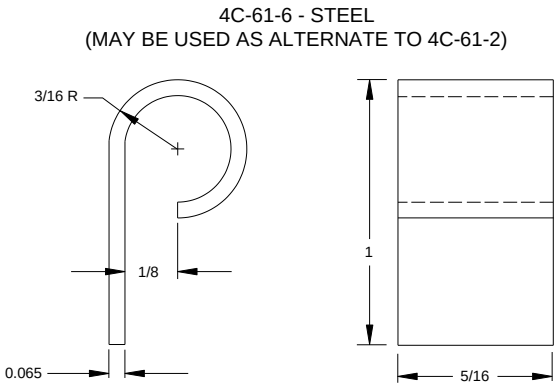
FERRULE DETAILS
(SEE NOTES 1 AND 2 BELOW)





NOTES:

1. Ferrules shall be formed or extruded steel, aluminum, or nylon, commercial grade.
2. All dimensions are in inches.

FIGURE 4C61. Tubular banding hangers ferrule details.

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NOTE:

1. The purpose of this figure is to illustrate implementation of the formula given in 5.7.3.1.g for cable spacing from a hard-mounted component to the first hanger.

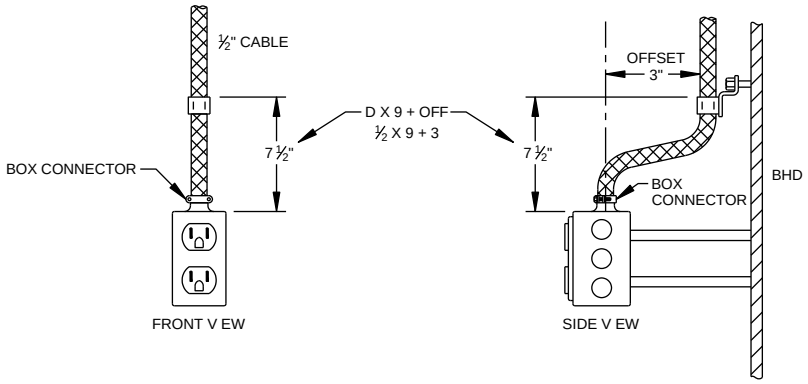

FIGURE 4C62. Illustration of distance to first hanger for hard mounted equipment.

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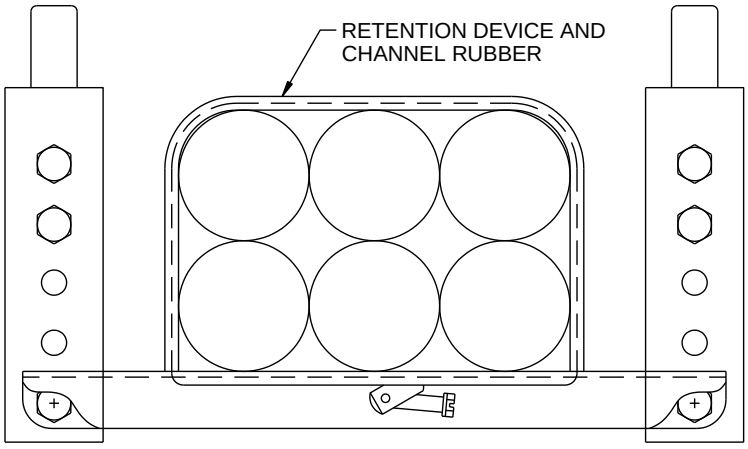
NOTES:

1. Purpose: This method is applicable to the installation of single conductor, medium and high-voltage electrical cable up to a 15 kilovolt rating and to dedicated medium and high-voltage cableways.
2. This method is intended to provide guidance. Engineered Class or individual NAVSEA approved ship drawings take precedence over this drawing.
3. Single conductor medium and high-voltage cables should be routed in dedicated cableways or in separate tiers in a cableway to the maximum extent practicable, separated from other cables. This preference is to prevent effects of cable heating and to prevent electro-magnetic interference effects on other cables. This separation in cableways is covered by this standard by routing other cables in separate tiers no less than 6 inches from the single conductor medium and high-voltage cables.
4. Electrical cables, other than medium or high-voltage cables, installed in cableways parallel to and beneath dedicated medium or high-voltage cableways, should maintain at least 6 inches of separation.
5. No more than a single row of three conductor or triads of single conductor medium or high-voltage cables should be installed in a cableway hanger tier.
6. Cableway hangers should have sufficiently wide tiers to allow adjacent triads of single conductor medium or high-voltage cables to be separated by at least one cable diameter.
7. For 15 kilovolt cableways, the inside radius of bend should be at least 31 inches.
8. Each triad of single conductor medium or high voltage cables shall contain one cable of each phase of power. Phases of the single conductor cables within a triad should suit ship arrangements.
9. Follow spacing requirements of 5.7.3.1 as amended by applicable ship specifications and NAVSEA approved ship drawings.
10. Each triad should be banded together at an evenly spaced location between hanger assemblies or penetrations when spacing is between 16 and 32 inches.
11. See 4.8 for cable bundling and ampacity requirements.



OPTIONAL ARRANGEMENT FOR 2 TRIADS ON HANGER
PRIOR TO GOING THROUGH A PENETRATION

FIGURE 4C63. Installation of medium and high voltage cableways.

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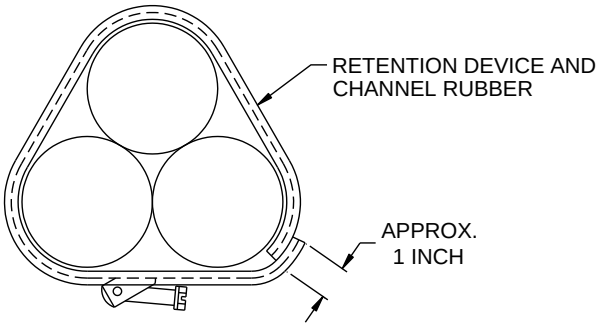
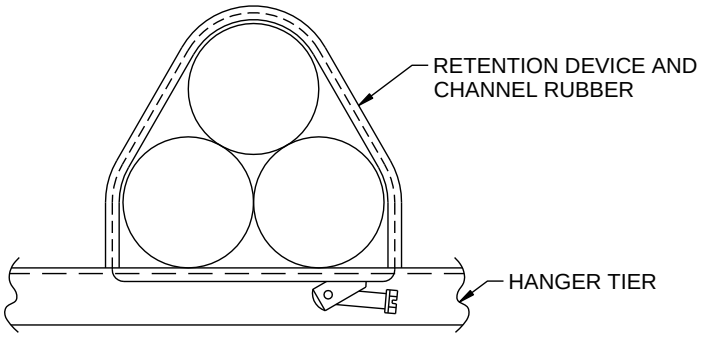


TYPICAL TRIAD RETENTION BETWEEN SUPPORTS
NOTE: TO OBTAIN AN APPROX. 1 INCH OVERLAP, A 15 INCH LENGTH OF CHANNEL RUBBER MAY BE USED.



TYPICAL TRIAD RETENTION
AT EVERY HANGER SUPPORT

FIGURE 4C63. Installation of medium and high voltage cableways – Continued.

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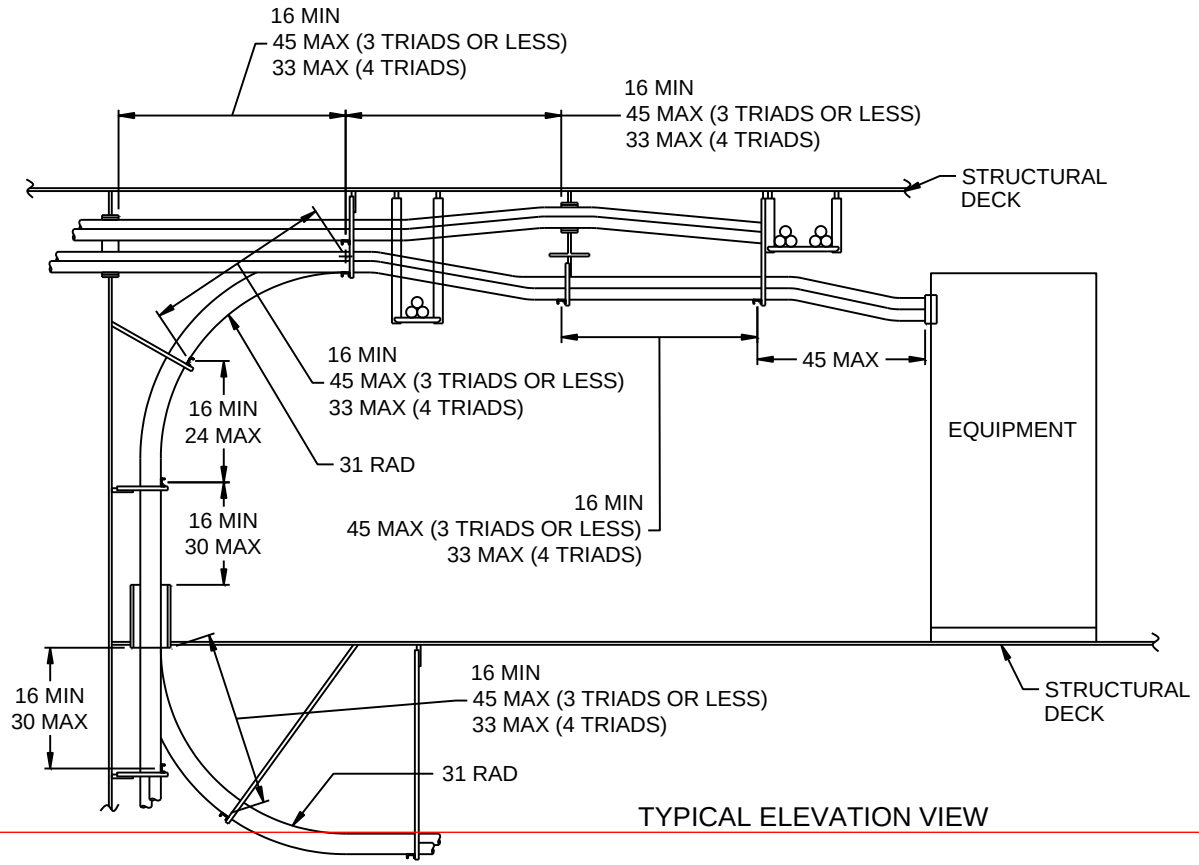
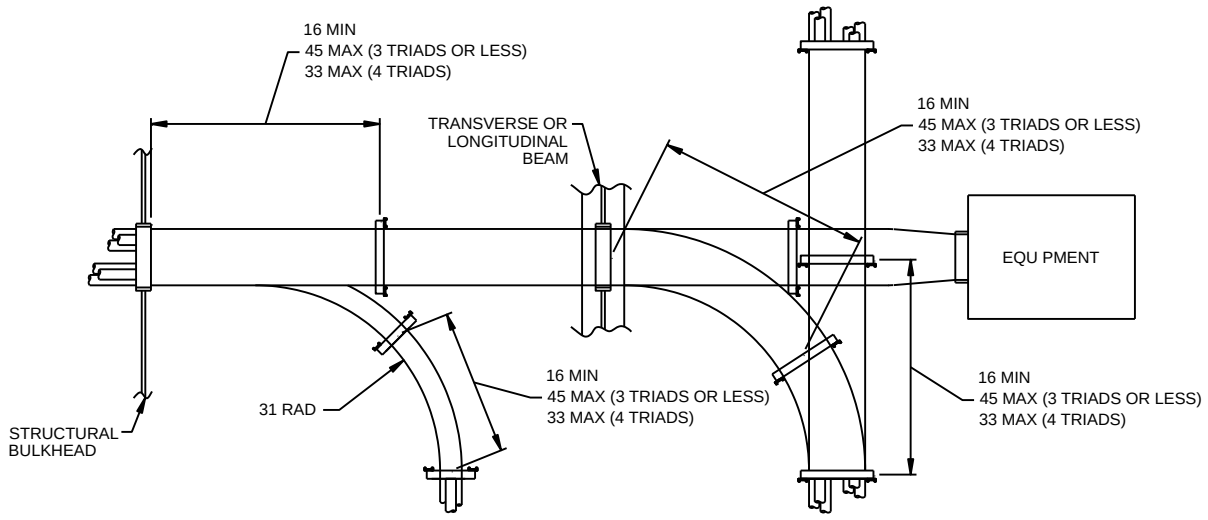


TYPICAL ELEVATION VIEW



TYPICAL PLAN VIEW

FIGURE 4C63. Installation of medium and high voltage cableways – Continued.

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APPENDIX 4D – CABLE PROTECTION

D.1 SCOPE

D.1.1 Scope. This appendix describes cable protection procedures related to the installation of cableways on submarines and surface ships. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

D.2. APPLICABLE DOCUMENTS

D.2.1 General. The documents listed in this section are specified in this appendix. 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 this appendix, whether or not they are listed.

D.2.2 Government documents.

D.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.

COMMERCIAL ITEM DESCRIPTIONS

A-A-3041	-	Wrench, Open End Ratchet (TAC Pattern) for Tube Fitting, Electrical Cable Terminals, and Stuffing Tube Gland Nuts

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-Y-1140	-	Yarn, Cord, Sleeving, Cloth and Tape-Glass
MIL-R-17882	-	Repair Kits, Metallic Pipe and General Purpose, Damage Control
MIL-R-21607	-	Resins, Polyester, Low Pressure Laminating, Fire-Retardant
MIL-P-21929	-	Plastic Material, Cellular Polyurethane, Foam-in-Place, Rigid (2 Pounds Per Cubic Foot)
MIL-PRF-23236	-	Coating Systems for Ship Structures
MIL-S-24235	-	Stuffing Tubes, Metal, and Packing Assemblies for Electric Cables, General Specification for

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-2003-3	-	Electric Plant Installation Standard Methods for Surface Ship and Submarines (Penetrations)
MIL-STD-2042-4	-	Fiber Optic Cable Topology Installation Standard Methods for Surface Ships and Submarines (Cableways)

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

D.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.

D.3 REQUIRED EQUIPMENT AND MATERIALS

D.3.1 Required equipment and materials. The equipment and materials in the tables and referenced in the text of this section shall be used for the protection of cables. For fiber optic cable, refer to MIL-STD-2042-4. Refer to 5.7.3.7 for requirements regarding the use of mounting fasteners.

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D.4 NOTES AND PROCEDURES

D.4.1 Dimensions. For tables and figures in this appendix, all dimensions are in inches unless otherwise noted.

D.4.2 Figures. Table 4DI provides information for the figures in this appendix. The details and methods shown on figures 4D1 through 4D29 specify protection requirements and procedures for cables installed on surface ships and submarines as specified on the figures.

TABLE 4DI. Figures for cable protection surface ships and submarines.

Figure number	Title	Page
4D1	Protection of cables penetrating watertight decks	290
4D2	Protection of cables penetrating watertight decks – wet spaces	291
4D3	Protection of cables penetrating watertight decks – dry areas	293
4D4	Protection of cables penetrating watertight decks – alternate method	295
4D5	Protection of cables penetrating watertight decks (alternate method) – section A-A	296
4D6	Protection of cables penetrating non-watertight (N.W.T.) decks	298
4D7	Protection of cables from mechanical injury	299
4D8	Protection of degaussing cables from mechanical injury – horizontal run	300
4D9	Protection of degaussing cables from mechanical injury – vertical run	301
4D10	Protection of degaussing cables from mechanical injury	302
4D11	Protection of degaussing cables from mechanical injury	303
4D12	Protection of cables on mast (surface ships) – forward view	304
4D13	Protection of cables on mast (surface ships) – port view	306
4D14	Protection of cables on mast (surface ships) – section “A-A”	307
4D15	Protection of cables on mast (surface ships) – section “B-B”	308
4D16	Protection of cables on mast (surface ships) – section “C-C”	309
4D17	Protection of cables on mast (surface ships) – section “D-D”	310
4D18	Protection of cables on mast (surface ships) – section “E-E”	311
4D19	Protection of cables on mast (surface ships) – section “F-F”	312
4D20	Protection of cables on mast (surface ships) – section “G-G”	313
4D21	Protection of cables on mast (surface ships) – section “J-J”	314
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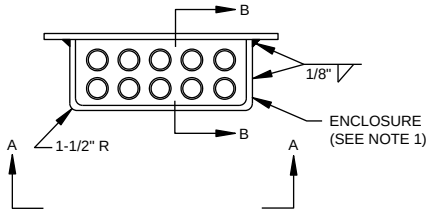
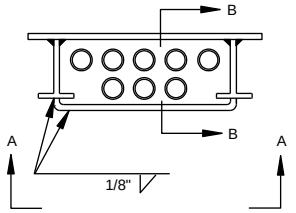
NOTE: Figures 4D1 through 4D3 provide information for the protection of cables penetrating watertight decks. The length and width of the enclosure shall suit the cable group. The size of the stuffing tube group in decks and bulkheads shall be limited such as to permit re-tightening of all gland nuts in the group by ships force using a stuffing tube wrench set (NSN 5120-00-293-0013), A-A-3041.

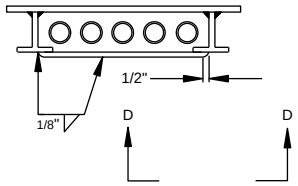


PLAN OF TYPICAL NSTALLATION

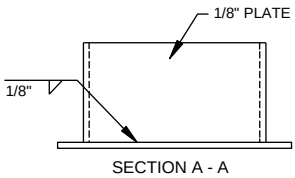


PLAN IN WAY OF DEEP STIFFENERS

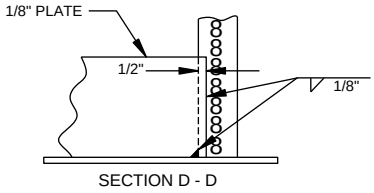
FOR SECTION B-B, SEE FIGURE 4D2



PLAN IN WAY OF SHALLOW STIFFENERS



SECTION A - A



SECTION D - D

SEE METHODS 4D-2-1 AND 4D-3-1

NOTES:

1. Surfaces in contact with plastics shall be thoroughly cleaned and free of oil or grease.
2. The finished 15-degree surface shall be smooth.
3. These enclosures may be used on steel or aluminum alloy structures using ⅛-inch steel or ⅛-inch aluminum to suit.
4. These enclosures shall not be installed until after all cables are installed and compartments are checked for tightness.
5. These enclosures shall not be installed on the weather decks.
6. Collar height shall be 3 inches in dry areas below decks.
7. Collar height shall be 9 inches in wet deck spaces below decks such as washrooms and sculleries.
8. A glass-reinforced collar may be used in lieu of a metal collar.

FIGURE 4D1. Protection of cables penetrating watertight decks.

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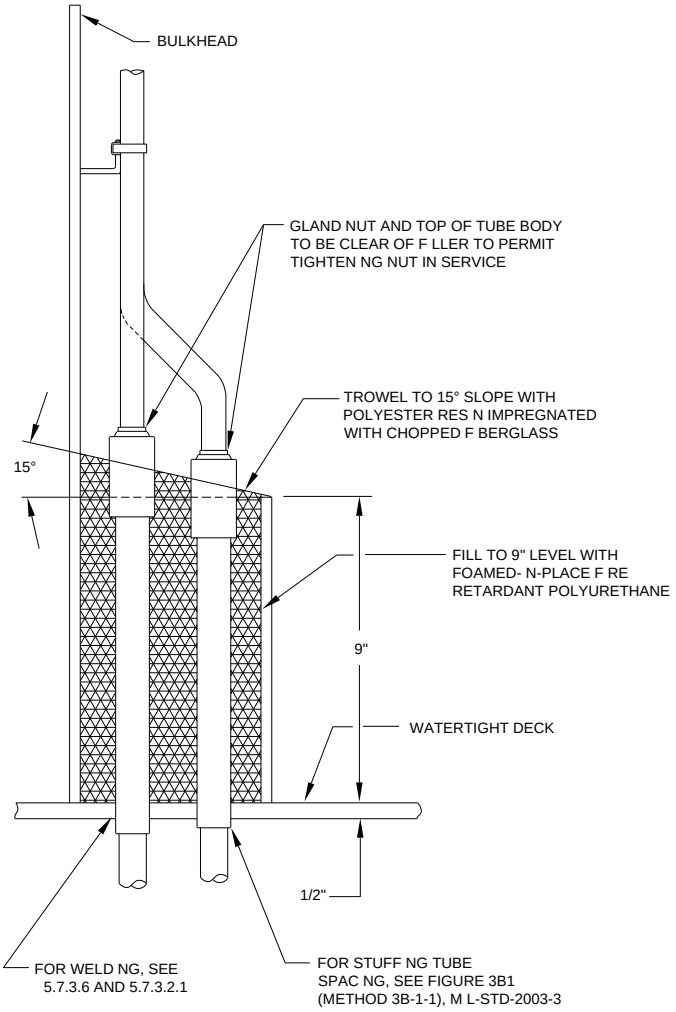
NOTE: Figures 4D1 through 4D3 provide information for the protection of cables penetrating watertight decks. The length and width of the enclosure shall suit the cable group. The size of the stuffing tube group in decks and bulkheads shall be limited such as to permit re-tightening of all gland nuts in the group by ships force using a stuffing tube wrench set (NSN 5120-00-293-0013), A-A-3041.

METHOD 4D-2-1
WET DECK SPACES BELOW DECKS



SECTION B - B
(SEE FIGURE 4D1)

NOTES:

1. This method is not for use in weather applications.
2. Collar height shall be 9 inches in wet deck spaces below decks such as washrooms and sculleries.
3. Surfaces in contact with plastics shall be thoroughly cleaned and free of oil or grease.
4. The finished 15-degree surface shall be smooth.

FIGURE 4D2. Protection of cables penetrating watertight decks – wet spaces.

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NOTES (continued):

5. Material shall be in accordance with table 4D2-I:

TABLE 4D2-I. Material for protection of cables penetrating watertight decks.

Material	Specification
Polyester resin	MIL-R-21607
Chopped fiberglass	MIL-Y-1140
Fire retardant polyurethane foam	MIL-P-21929

6. These enclosures may be used on steel or aluminum alloy structures using ⅛-inch steel or ⅛-inch aluminum to suit.
7. These enclosures shall not be installed until after all cables are installed and compartments are checked for tightness.
8. A glass-reinforced collar may be used in lieu of a metal collar.

FIGURE 4D2. Protection of cables penetrating watertight decks – wet spaces – Continued.

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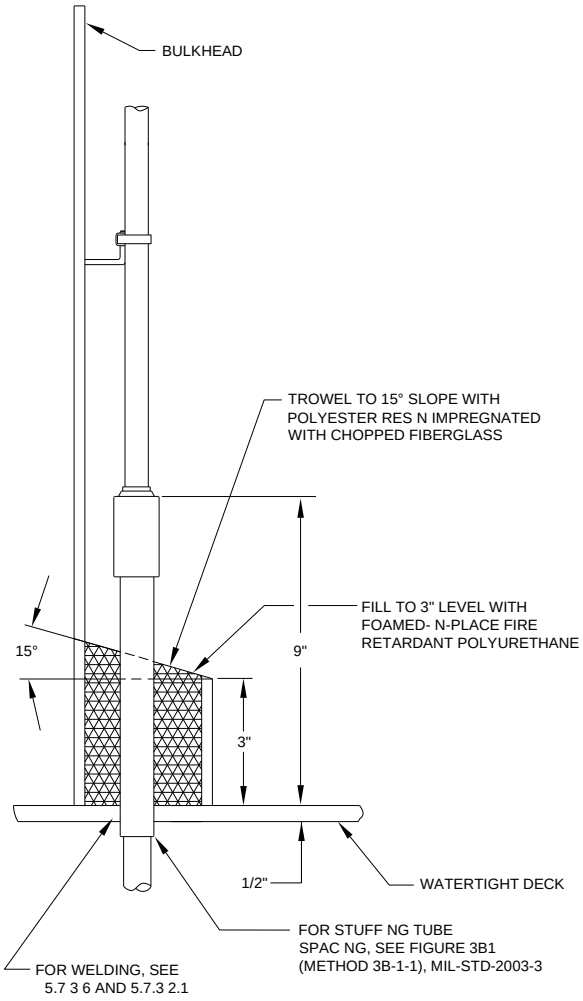
~~NOTE: Figures 4D1 through 4D3 provide information for the protection of cables penetrating watertight decks.~~ The length and width of the enclosure shall suit the cable group. The size of the stuffing tube group in decks and bulkheads shall be limited such as to permit re-tightening of all gland nuts in the group by ships force using a stuffing tube wrench set (NSN 5120-00-293-0013), A-A-3041.

METHOD 4D-3-1
DRY AREAS BELOW DECKS



NOTES:

1. This method is not for use in weather applications.
2. Collar height shall be 3 inches in dry areas below decks.
3. Surfaces in contact with plastics shall be thoroughly cleaned and free of oil or grease.
4. The finished 15-degree surface shall be smooth.

FIGURE 4D3. Protection of cables penetrating watertight decks – dry areas.

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NOTES (continued):

5. Material shall be in accordance with table 4D2-I:
6. These enclosures may be used on steel or aluminum alloy structures using ⅛-inch steel or ⅛-inch aluminum to suit.
7. These enclosures shall not be installed until after all cables are installed and compartments are checked for tightness.
8. A glass-reinforced collar may be used in lieu of a metal collar.

FIGURE 4D3. Protection of cables penetrating watertight decks – dry areas – Continued.

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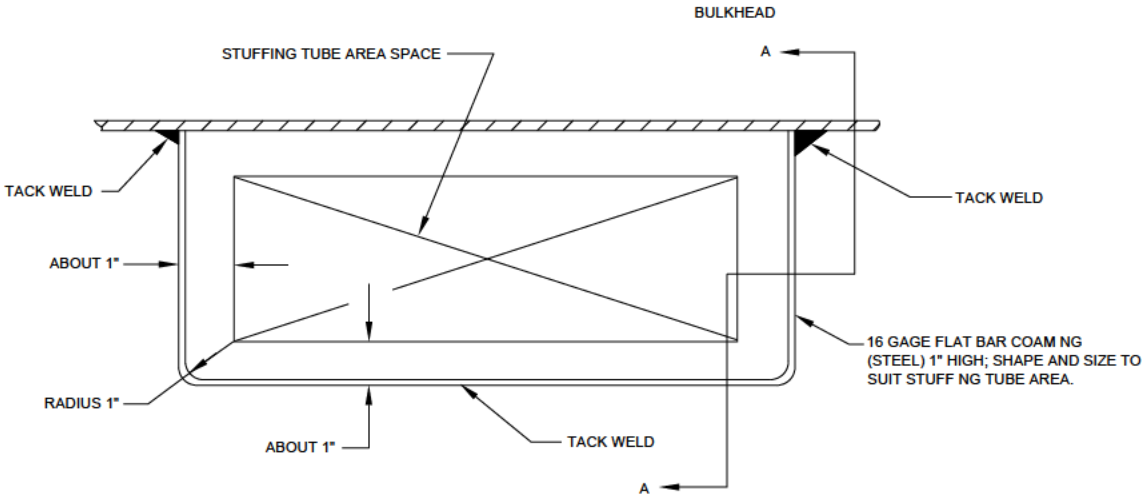
METHOD 4D-4-1
ALTERNATE METHOD FOR WATERTIGHT DECKS



PLAN V EW

TYPICAL DECK STUFF NG TUBE AREA
SEE FIGURE 4D5 FOR SECTION A-A

NOTE:

1. See 5.7.3.6 for welding requirements.

FIGURE 4D4. Protection of cables penetrating watertight decks – alternate method.

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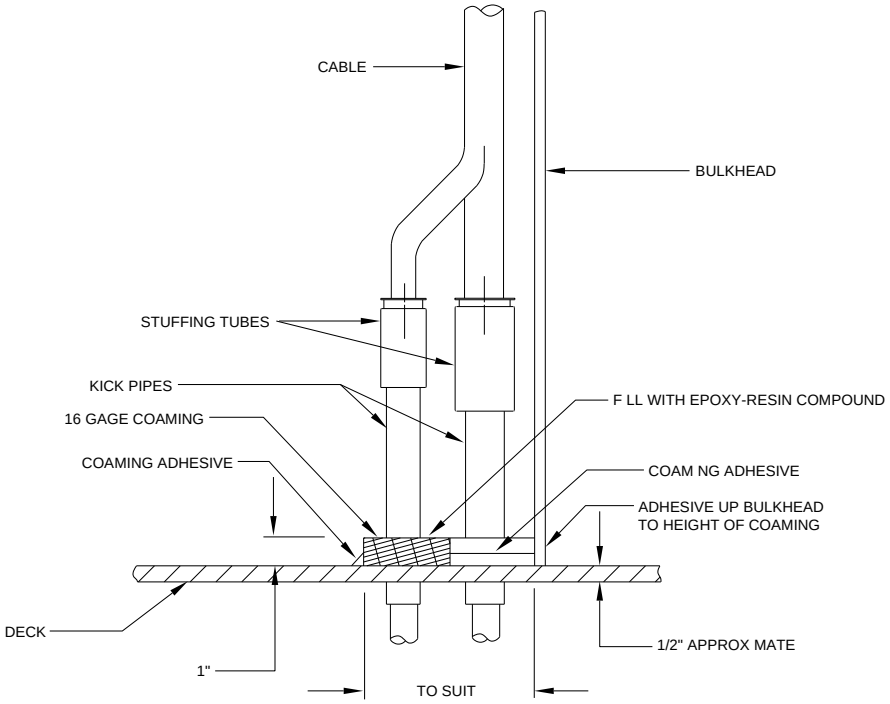
SECTION A-A FOR METHOD 4D-4-1
ALTERNATE METHOD FOR WATERTIGHT DECKS



TYPICAL SECTION A - A

NOTES:

1. Figures 4D4 and 4D5 provide an alternate method for protecting cables penetrating watertight decks, and the following procedure applies.
2. For stuffing tube areas other than in the weather, a method using an epoxy compound resin in accordance with MIL-R-17882 on the deck around the kick-pipes shall be accomplished as follows:
   a. After the kick-pipe and stuffing tubes have been installed and the cables pulled in, the 16-gauge steel coaming shall be fabricated to suit and tack-welded. Where decks have camber/shear, the coaming shall be fabricated to match the slope of the deck so that the epoxy compound will be level with the top edge of the entire coaming. This may necessitate that the coaming be made and tack welded in three separate pieces in lieu of one continuous flat bar as shown in plan view in figure 4D4. The high side of this type of coaming shall not exceed 1½ inches, and the corners shall be rounded.
   b. The deck around the kick-pipes within the coaming enclosure and the deck around the outside of the coaming shall be thoroughly cleaned as follows (it is not necessary to remove paint):
      (1) Blow out all dirt and loose material.
      (2) Scrub with a detergent solution.
      (3) Rinse with fresh water.
      (4) Blow out excess water.
   c. Put adhesive resin in accordance with MIL-R-17882 into a container or on a flat plate. Add adhesive hardener and mix thoroughly until the mixture is ready to be applied. Use adhesive resin manufacturer's instructions for the hardening and application process.

FIGURE 4D5. Protection of cables penetrating watertight decks (alternate method) – section A-A.

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NOTES (continued):

d. Apply this adhesive "putty" around the outside of the coaming with a rounded-end ¾-inch wide spatula or an equivalent tool and shape the putty to a fillet with the end of the spatula or equivalent tool. Dip the spatula or equivalent tool in water to provide a smooth surface.
e. Prepare adhesive resin in accordance MIL-R-17882 per manufacturer's instructions.
f. Pour this mixture into the kick-pipe area enclosure until it begins to overflow the coaming. Wipe excess off outside of coaming. Allow to cure hard before painting.

3. The table below provides approximate cure times for the resin. For temperatures below 60 °F, heat lamps shall be used for curing the epoxy resin. The pot life for the resin is 45 minutes, which means that the epoxy-resin compound should be used within 45 minutes after mixing. Shelf-life of the material before mixing is per manufacturer's instructions.

Temperature (°F)	Cure time (hours)
85	4
75	8
65	12

4. Local exhaust ventilation is not necessary when using these epoxy materials, however, good personnel hygiene habits should be used and contact with the skin should be avoided. After using the epoxy material, wash with borax soap or waterless skin cleaner. Solvents should be avoided as a skin cleaner, but, if necessary, alcohol should be used (denatured ethyl or isopropyl are preferred). In no case should petroleum solvents or chlorinated hydrocarbons such as gasoline, kerosene, benzene, degreasing solvents, or dry cleaning fluids be used for cleaning the skin.

FIGURE 4D5. Protection of cables penetrating watertight decks (alternate method) – section A-A – Continued.

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METHOD 4D-6-1

FOR PROTECT NG THREE OR MORE CABLES
PASSING THROUGH NON-WATERIGHT DECKS

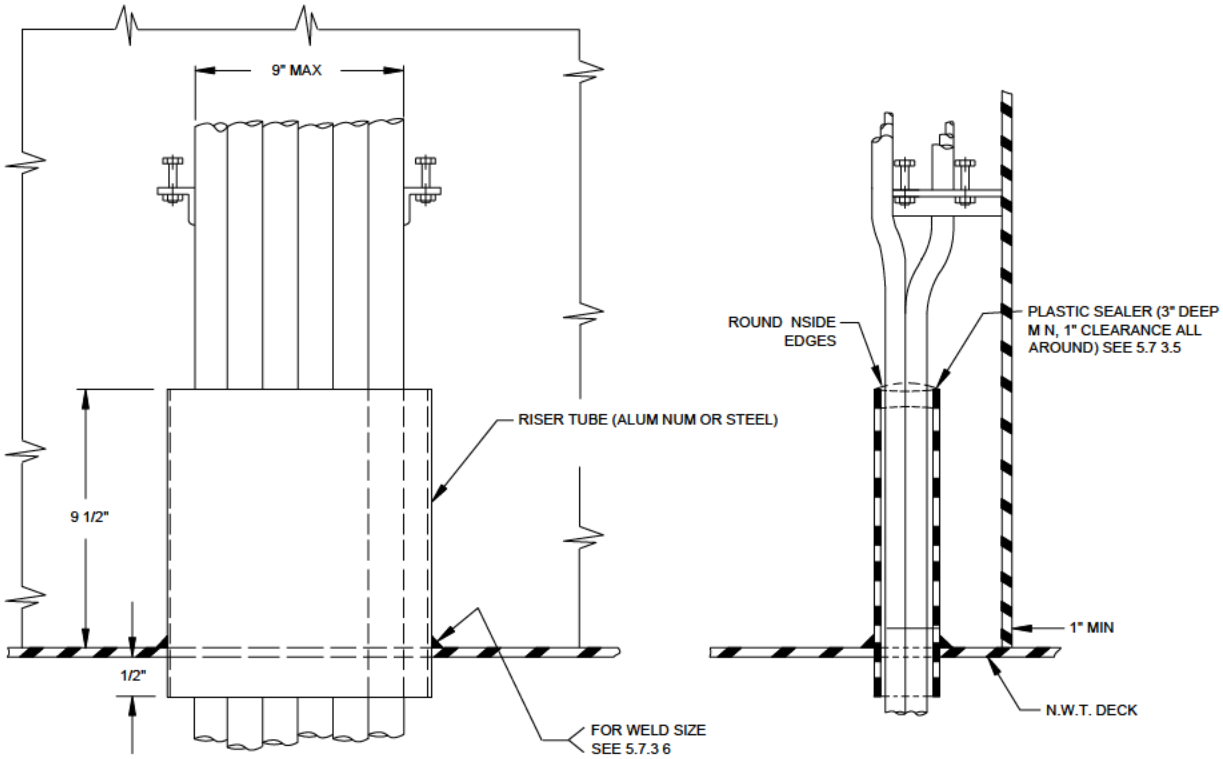

FIGURE 4D6. Protection of cables penetrating non-watertight (N.W.T.) decks.

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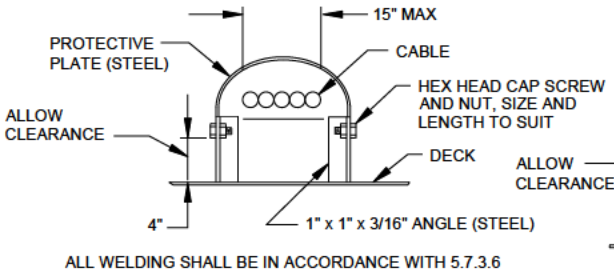
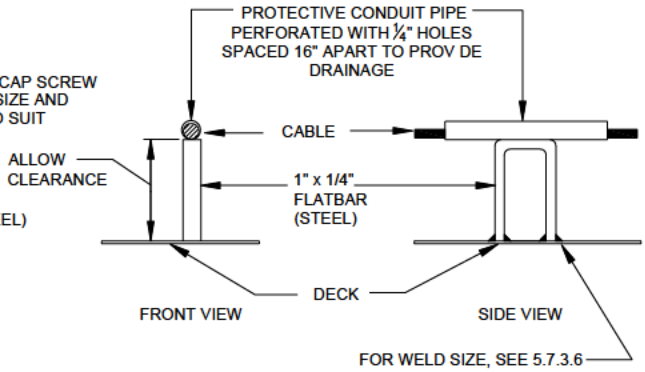
METHOD 4D-7-1
CABLE RUNS ON DECK WITH PROTECTIVE CASING MAY ALSO BE USED FOR VERTICAL RUNS ON BULKHEADS
(HANGER SPACING 21" ON CENTERS)
SINGLE T ER

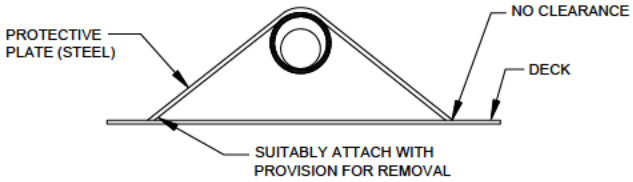


ALL WELDING SHALL BE IN ACCORDANCE WITH 5.7.3.6

METHOD 4D-7-2
CABLE RUNS ON DECK WITH PROTECTIVE CONDUIT PIPE MAY ALSO BE USED FOR VERTICAL RUNS ON BULKHEADS
(HANGER SPACING 21" ON CENTERS)
S NGLE CABLE



METHOD 4D-7-3
TRIP PLATE
OVER CONDUIT OR CABLE



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D7. Protection of cables from mechanical injury.

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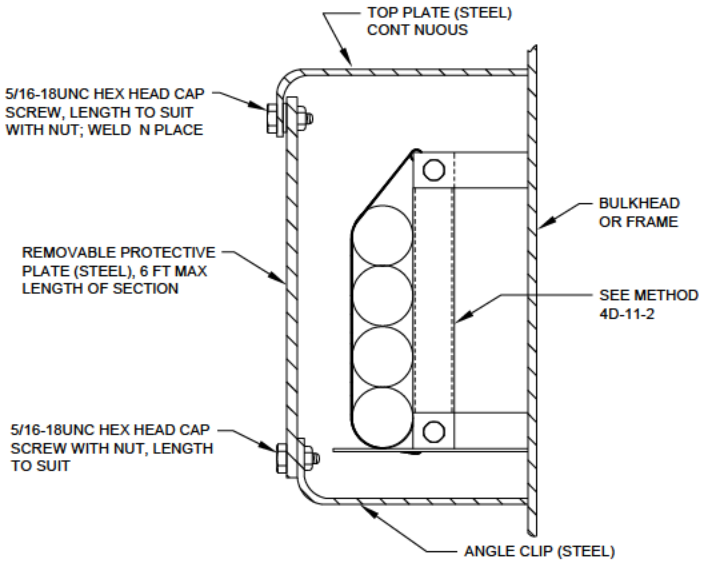
METHOD 4D-8-1
HORIZONTAL RUNS
SINGLE TIER OF CABLES



ELEVATION

NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. The screws and nuts may be tack welded to capture the nuts and to secure the screws. If tack welding is used, the fasteners shall meet the material requirements in 5.7.3.7.

FIGURE 4D8. Protection of degaussing cables from mechanical injury – horizontal run.

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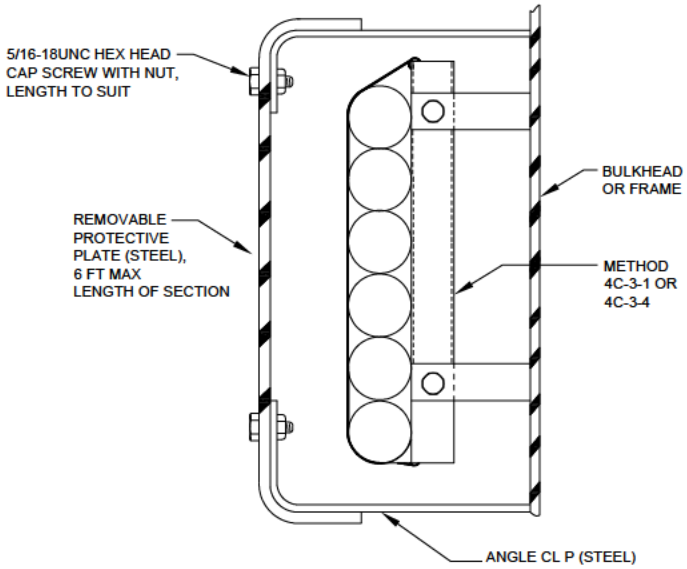
METHOD 4D-9-1
VERTICAL RUNS
SINGLE T ER OF CABLE



PLAN VIEW

NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. The screws and nuts may be tack welded to capture the nuts and to secure the screws. If tack welding is used, the fasteners shall meet the material requirements in 5.7.3.7.

FIGURE 4D9. Protection of degaussing cables from mechanical injury – vertical run.

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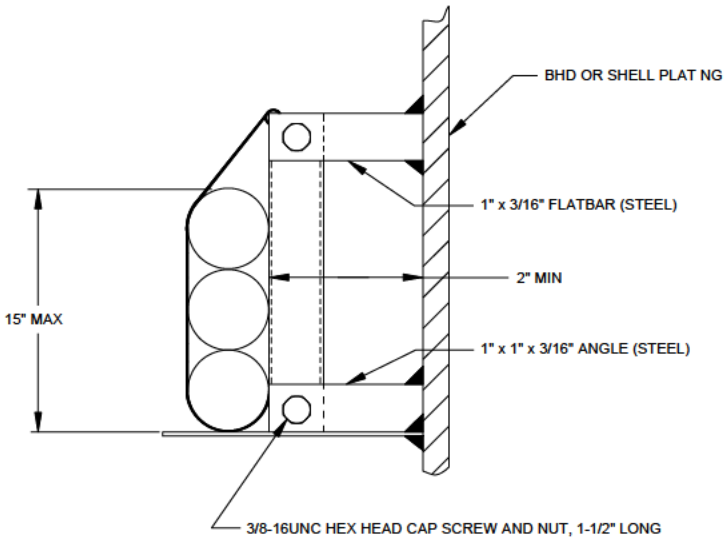
METHOD 4D-10-1
CABLE HANGER DETAIL
FOR S NGLE TIER



ATTACHMENT TO OUTER SHELL PLAT NG OF VESSEL
ALSO ATTACHMENT TO BALLISTIC BULKHEADS

NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. Welding shall be in accordance with 5.7.3.6.

FIGURE 4D10. Protection of degaussing cables from mechanical injury.

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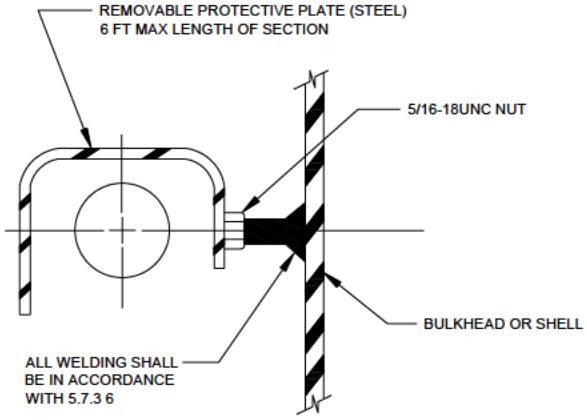
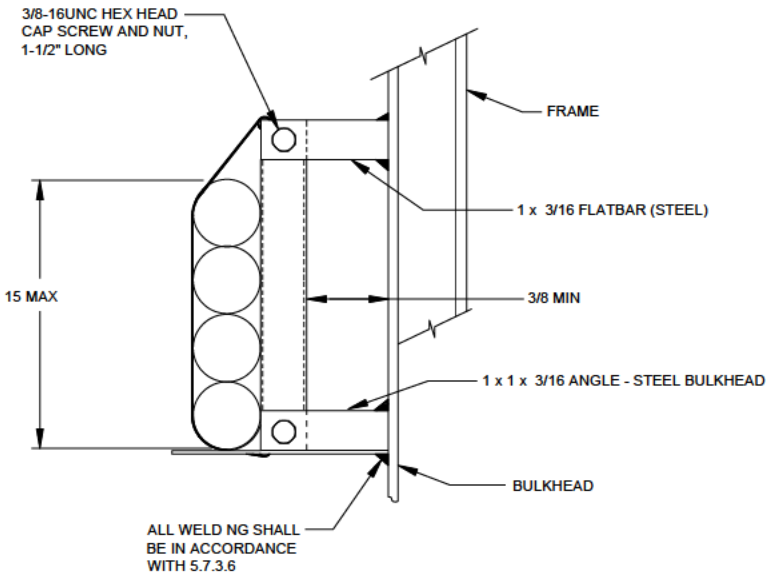
METHOD 4D-11-1
HORIZONTAL RUN
SINGLE CABLES



METHOD 4D-11-2
CABLE HANGER DETAIL
FOR SINGLE TIER
ATTACHMENT TO FRAME OR BULKHEAD



ALL DIMENSIONS ARE N NCHES

NOTES:

1. See 5.7.3.7 for fastener and fastener material requirements.
2. Welding shall be in accordance with 5.7.3.6.

FIGURE 4D11. Protection of degaussing cables from mechanical injury.

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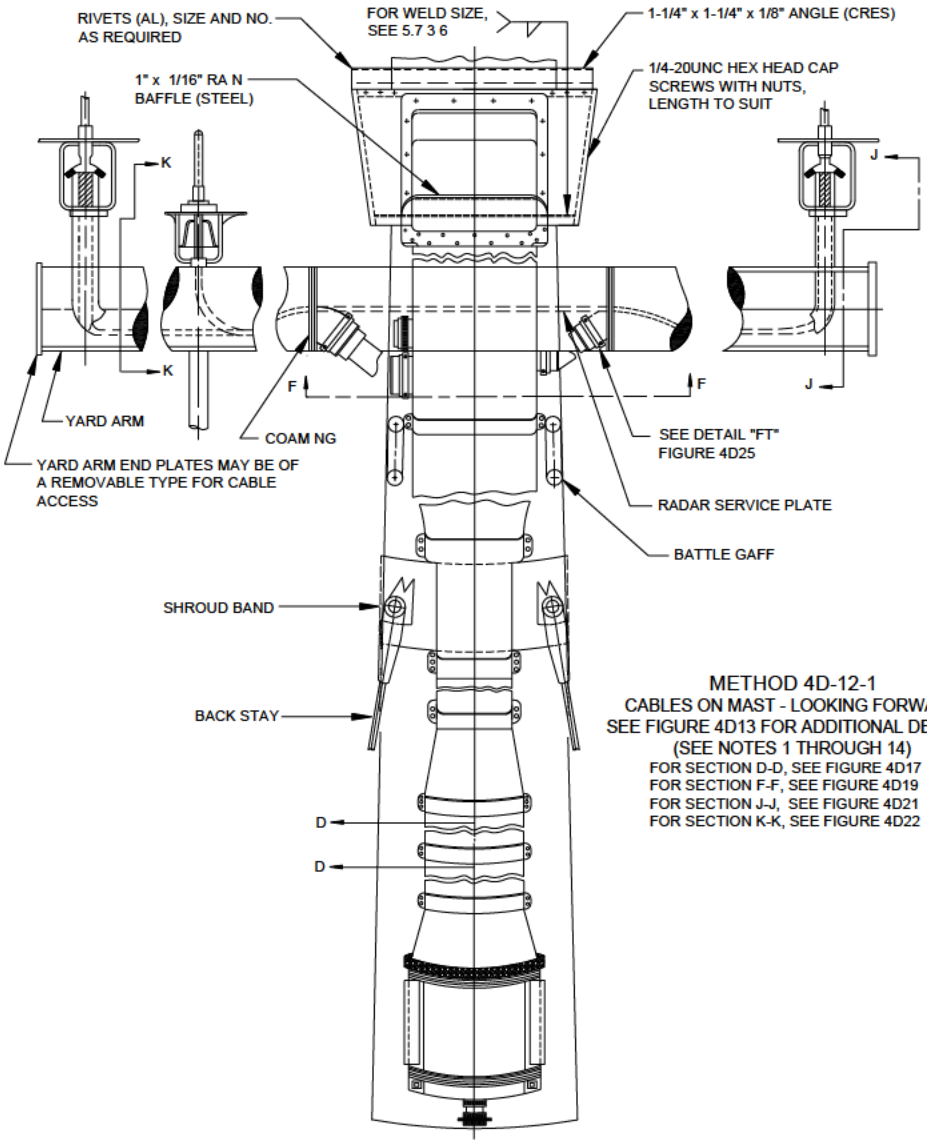

NOTES:

1. For cables on a surface ship mast, refer to figures 4D12 through 4D26.
2. The area of the ventilation duct shall be calculated to give a minimum free flow area of 30 square inches with the closest approach of duct wall to the cable of 1 inch.
3. The minimum distance of hanger support from the insulation to the hanger channel shall be 1½ inches to reduce conduction along hanger.
4. All seams, rivets, and openings in duct wall and insulating material shall be made weathertight.

FIGURE 4D12. Protection of cables on mast (surface ships) – forward view.

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NOTES (continued):

5. Provide doubler plates, as necessary, where brackets, coaming, yardarm, etc. are weakened by entrance of the ventilation duct.
6. Faying surfaces of steel and aluminum parts shall receive one coat of primer in accordance with MIL-PRF-23236.
7. After installation, all surfaces of duct shall receive necessary coats of heat-resisting paint to match the surrounding surfaces.
8. In determining the size of duct for new construction, allowance shall be made for several additional cables to accommodate future radar and electrical requirements.
9. For vessels on which the screened speed light is located on the mainmast, the service cable shall be branched from the ventilation duct through flexible tubing.
10. Free flow areas within rain caps and air deflectors shall have 1½ to 2 times the area of the feeding pipe.
11. Flexible tubing shall be installed without twist, shall have sufficient slack to prevent the tubing from being strained upon working of mast and yardarms, and with the run pitched to avoid water pockets.
12. Flexible tubing shall be supported at 16-inch intervals where practicable; otherwise at such spacing and location that tubing shall take easy bends. Supports shall not be so placed that the flexing of the tubing will be restrained.
13. To reduce the number of sizes required for star supports, cable grouping may be used with a maximum clearance of ½ inch, only as necessary, between star supports and corrosion resisting steel pipe.
14. Star supports shall be prevented from chafing the opposite cable by means of a spreader or steel barrier. The barrier may start longitudinally and twist 90 degrees as it progresses to a point beyond the cable outlet for inboard antenna.
15. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D12. Protection of cables on mast (surface ships) – forward view – Continued.

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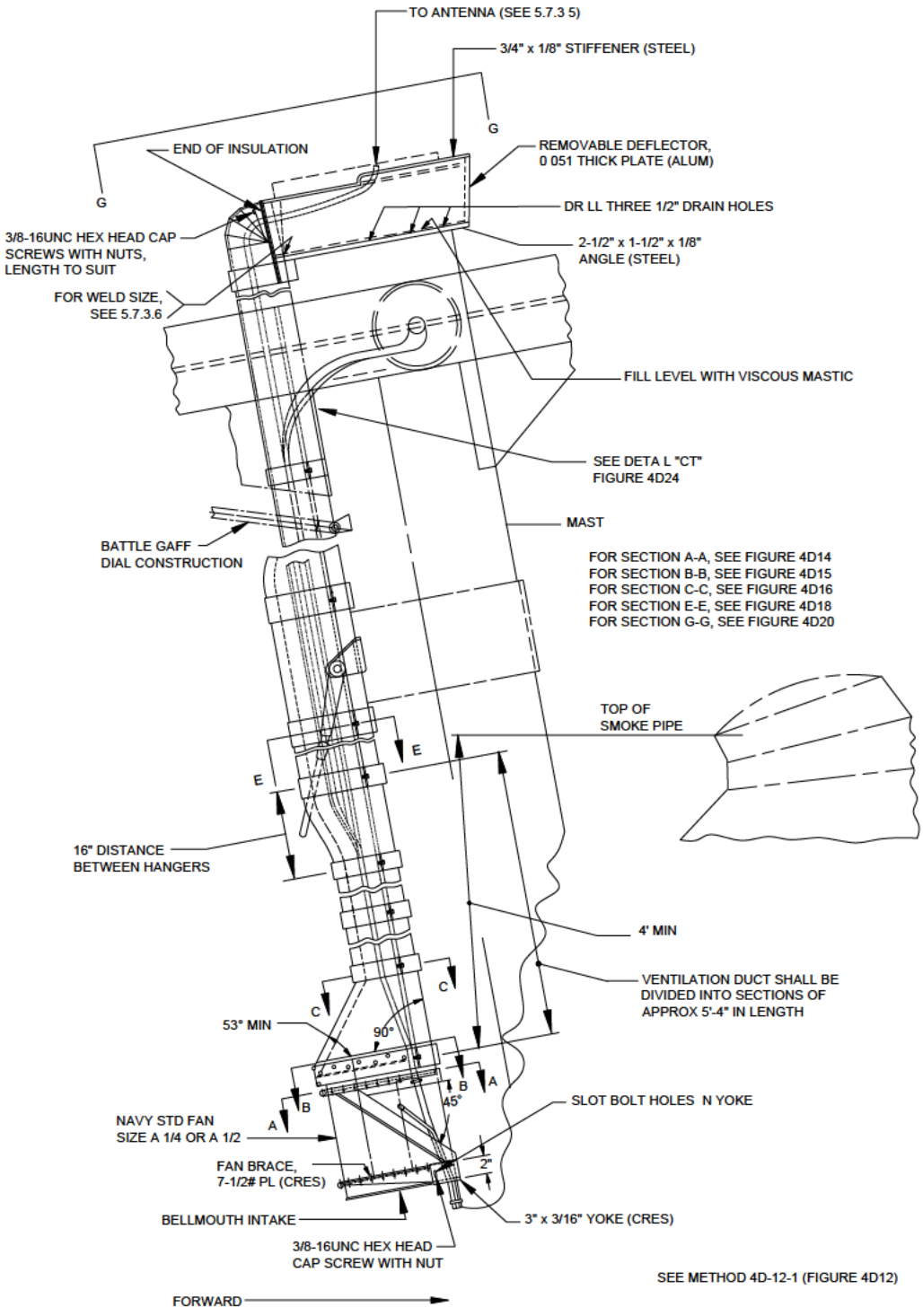

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D13. Protection of cables on mast (surface ships) – port view.

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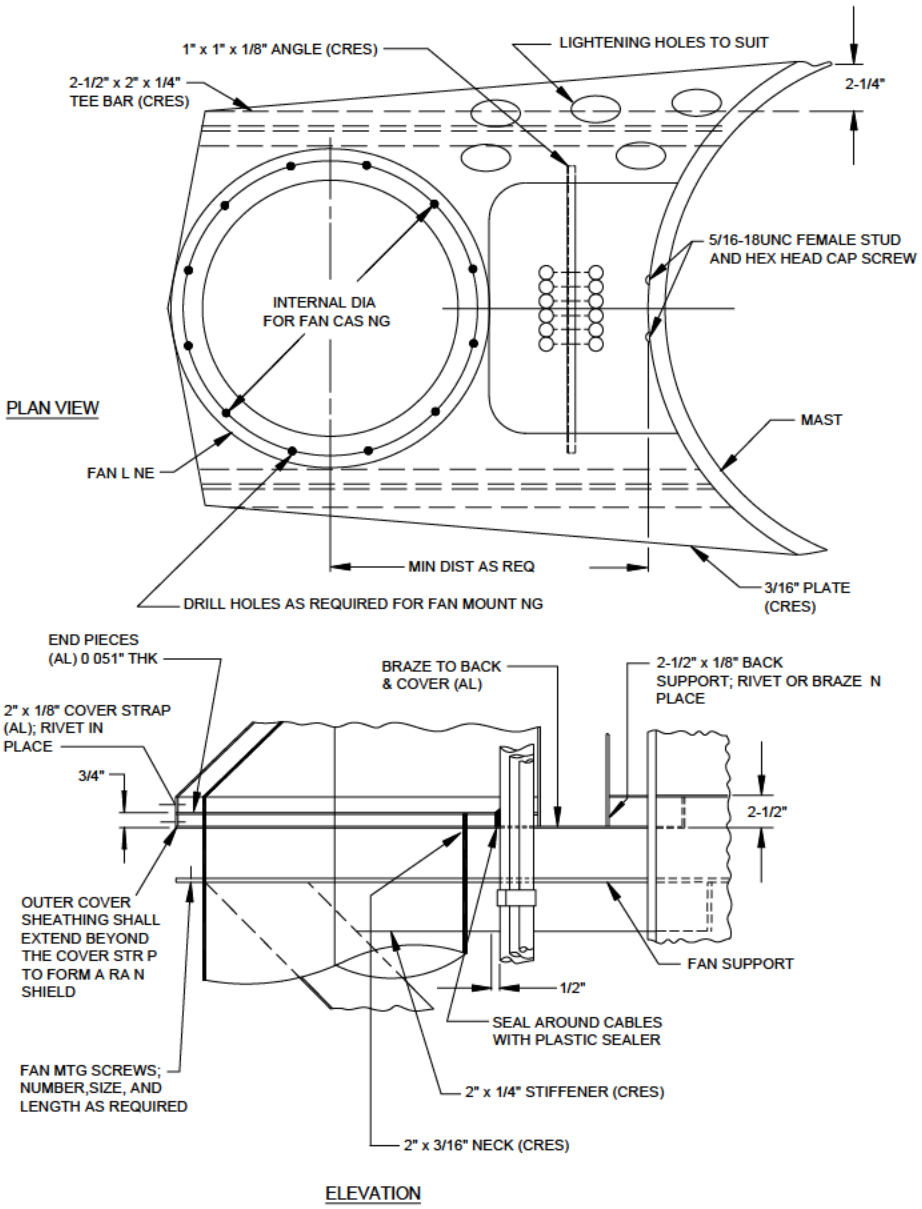
SECTION "A-A"
FAN SUPPORT (SEE FIGURE 4D13)



NOTES:

1. See 5.7.3.8 for weld stud and collar stud requirements.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D14. Protection of cables on mast (surface ships) – section "A-A".

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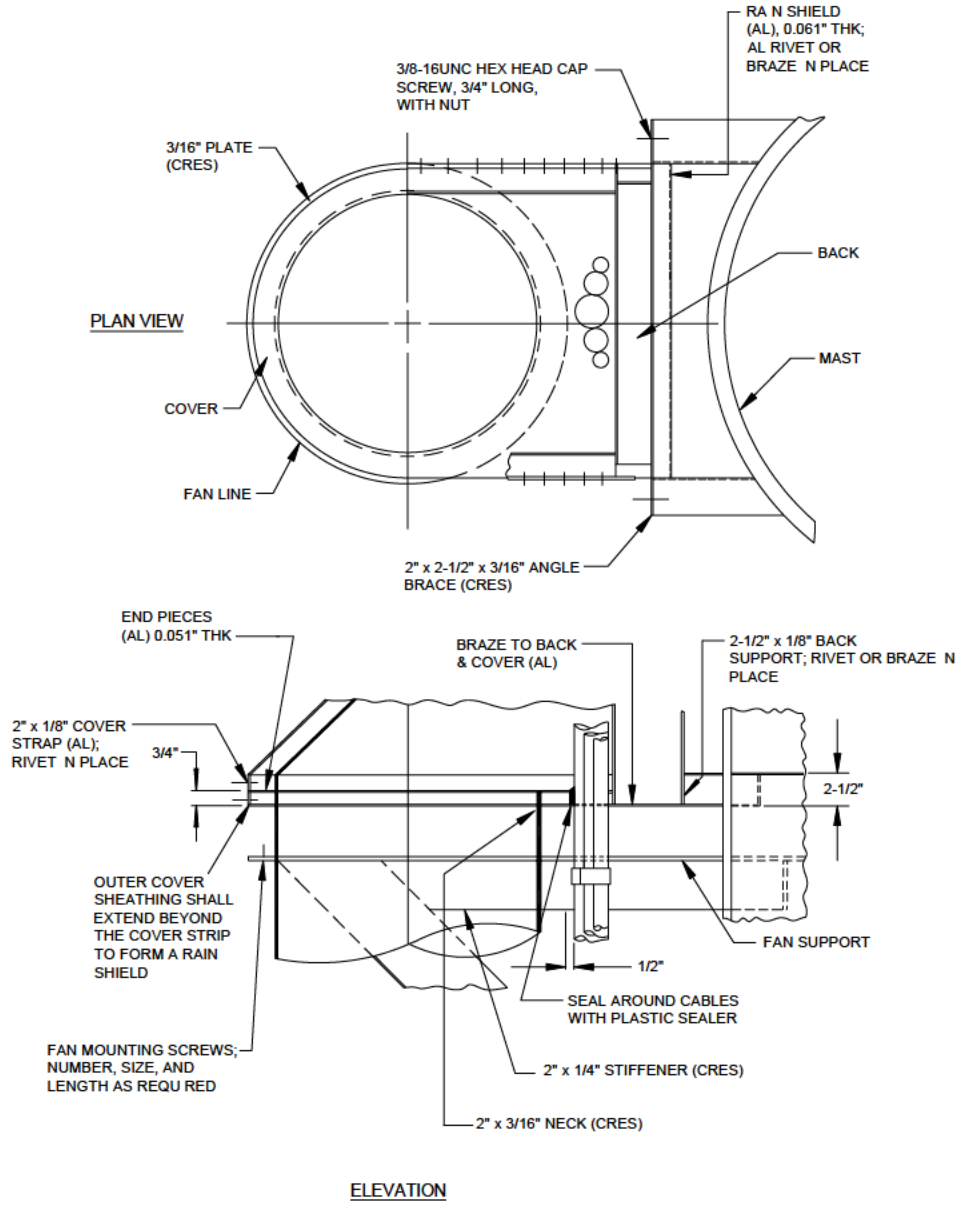
SECTION "B-B"
DUCT FOUNDATION
(SEE FIGURE 4D13)



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D15. Protection of cables on mast (surface ships) – section "B-B".

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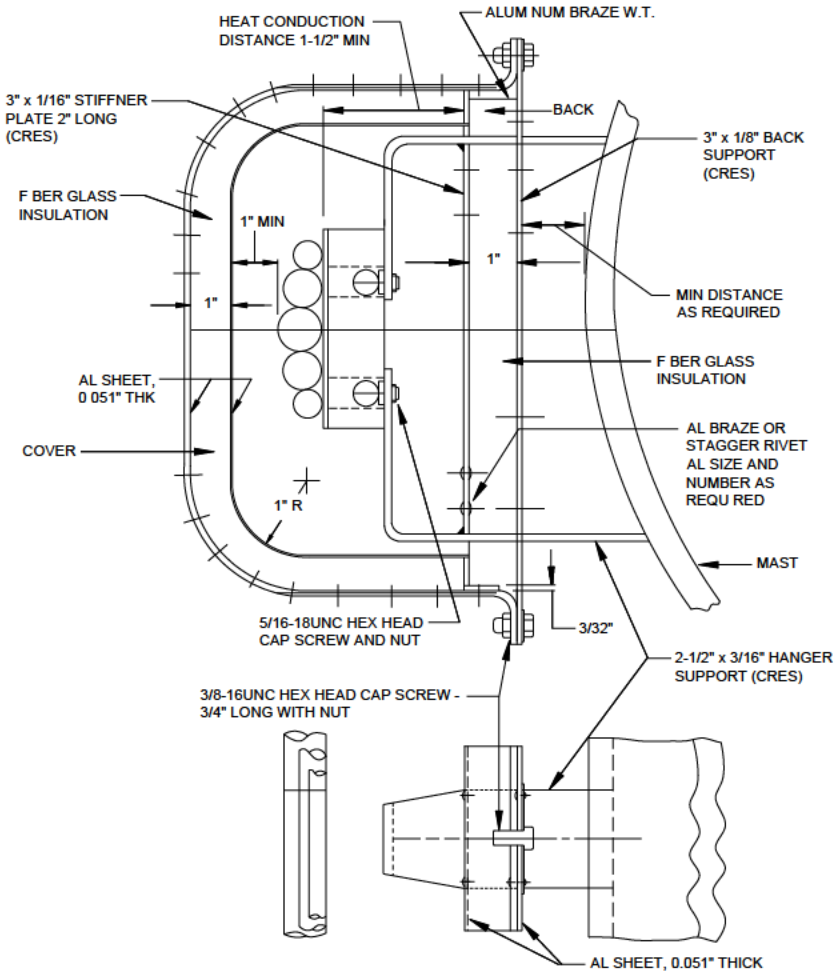
SECTION "C-C"
METHOD SHOW NG ARRANGEMENT OF DUCT
AND A S NGLE T ER OF CABLES ON MAST WITH
ROOM FOR ADDITIONAL CABLES
(SEE FIGURE 4D13)



SIDE V EW OF DUCT, COVER REMOVED

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D16. Protection of cables on mast (surface ships) – section "C-C".

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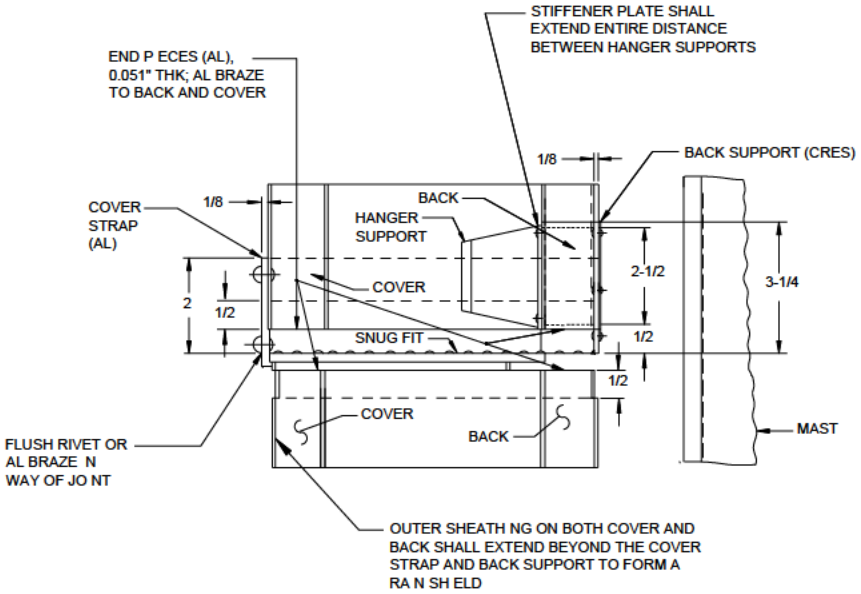
SECTION "D-D"
VIEW SHOWING ARRANGEMENT
OF DUCT AT SECTION JOINTS
(SEE FIGURE 4D12)



ALL DIMENSIONS ARE N NCHES

FIGURE 4D17. Protection of cables on mast (surface ships) – section "D-D".

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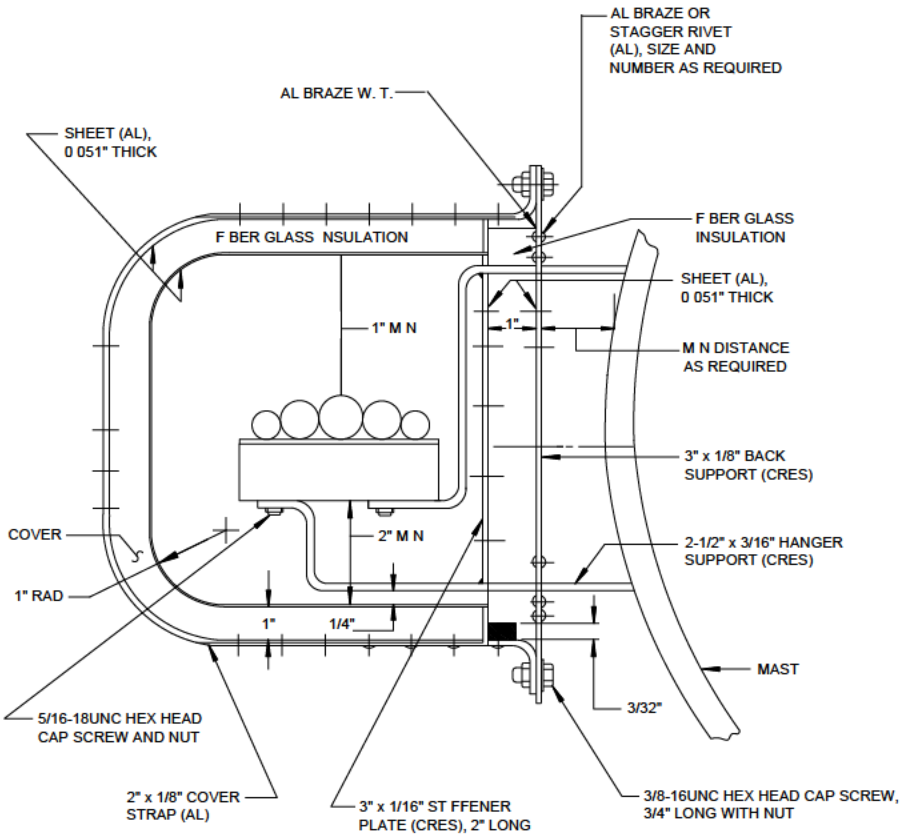
SECTION "E-E"

METHOD SHOW NG ARRANGEMENT OF DUCT
AND CABLES TO CLEAR AN OBSTRUCTION
(SEE FIGURE 4D13)



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D18. Protection of cables on mast (surface ships) – section "E-E".

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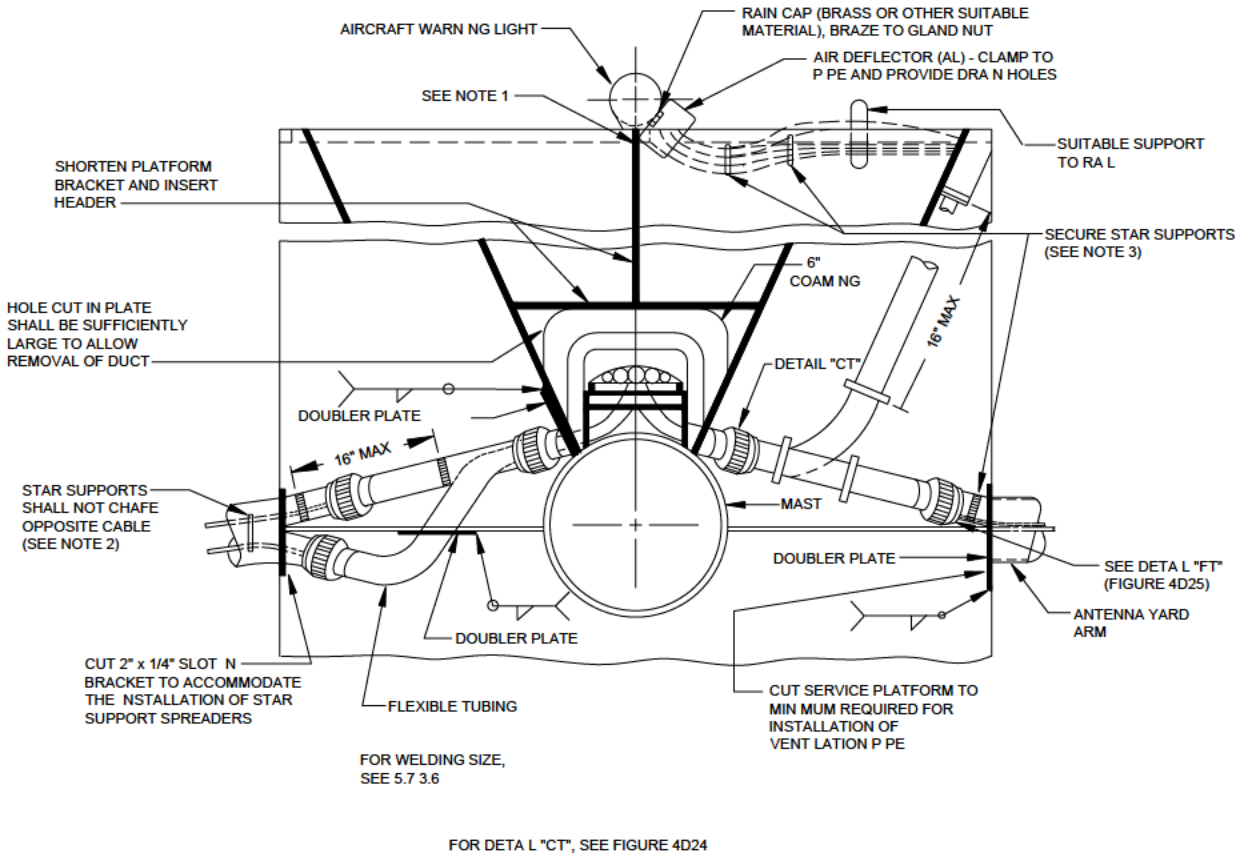
SECTION "F-F"
V EW OF RADAR SERVICE PLATFORM
(SEE FIGURE 4D12)



NOTES:

1. The area of the ventilation duct shall be calculated to give a minimum free flow area of 30 square inches with the closest approach of duct wall to the cable of 1 inch.
2. Star supports shall be prevented from chafing the opposite cable by means of a spreader or steel barrier. The barrier may start longitudinally and twist 90 degrees as it progresses to a point beyond the cable outlet for inboard antenna.
3. Secure star supports to cable at 16 inches (maximum) intervals continuing through the flexible tubing and yard arm runs and terminating 2 inches (minimum) from the open end of the tubing or pipe.
4. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D19. Protection of cables on mast (surface ships) – section "F-F".

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SECTION "G-G"
VIEW OF DUCT AT RADAR PEDESTAL
(SEE FIGURE 4D13)

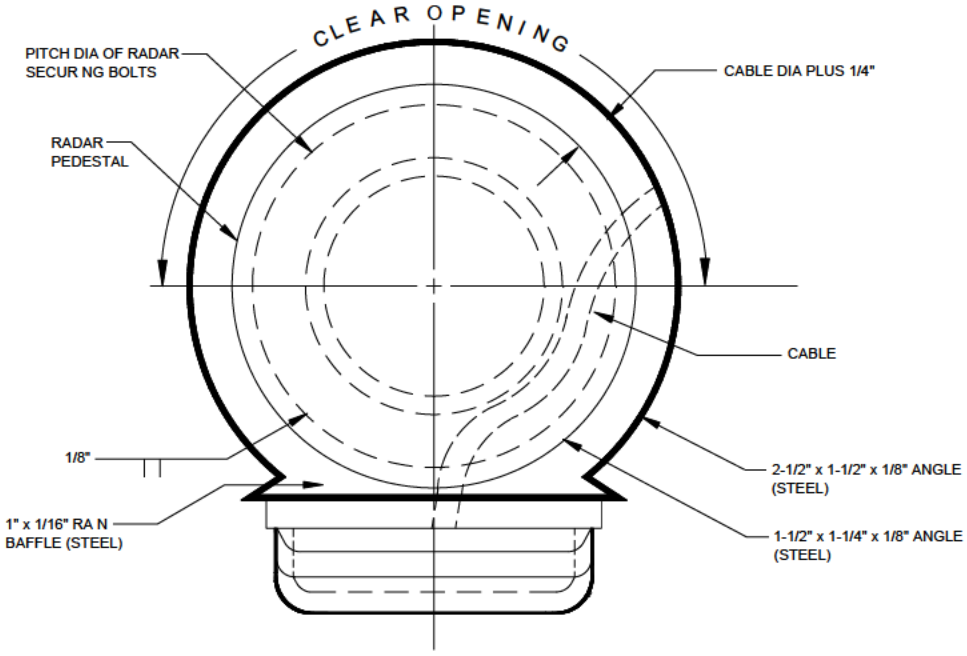

FIGURE 4D20. Protection of cables on mast (surface ships) – section "G-G".

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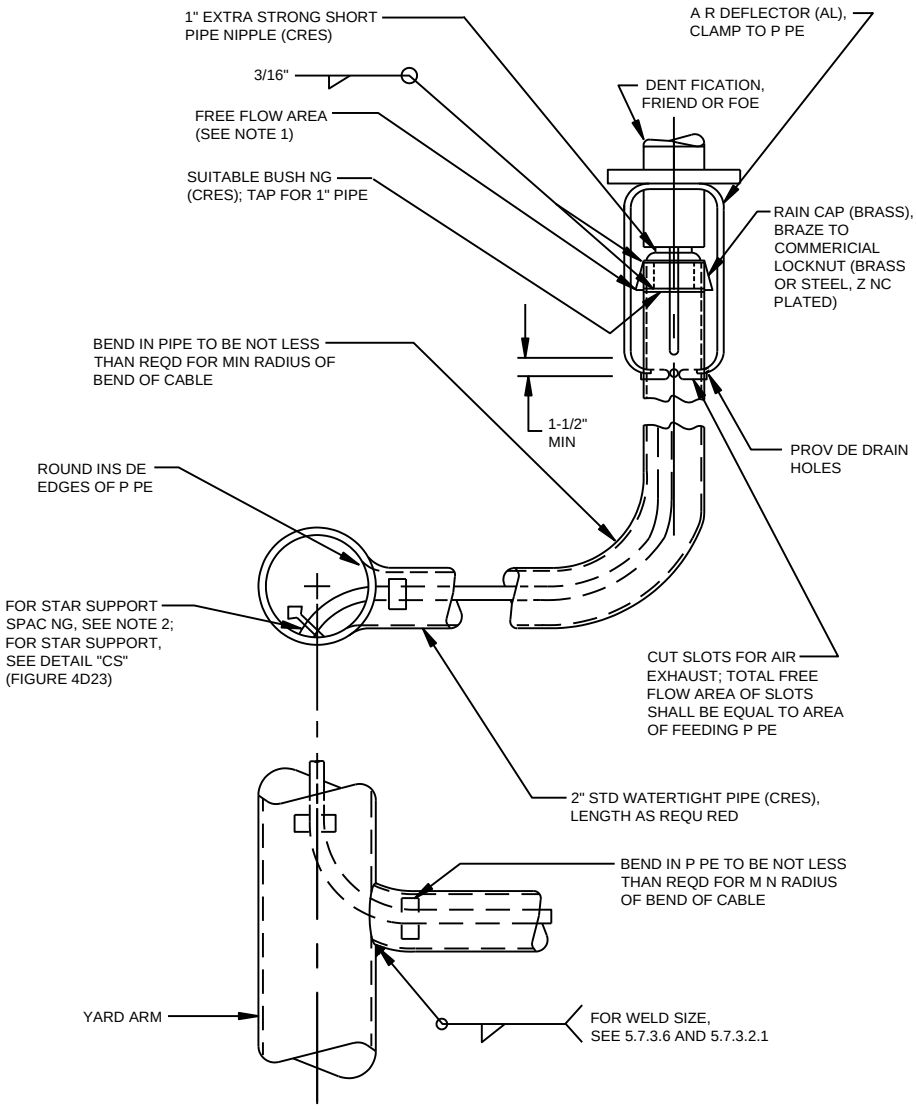
SECTION "J-J"
VIEW SHOWING ARRANGEMENT
OF STRUCTURAL SUPPORT
FOR IDENTIFICATION, FRIEND OR FOE EQUIPMENT
(SEE FIGURE 4D12)



NOTES:

1. Free flow areas within rain caps and air deflectors shall have 1½ to 2 times the area of the feeding pipe.
2. Star supports shall be spaced a maximum of 18 inches on center in straight runs. Near pipe bends and in bends, they shall be provided in sufficient quantity to prevent chafing of cables and to ensure that the cable is surrounded by ventilating air.
3. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D21. Protection of cables on mast (surface ships) – section "J-J".

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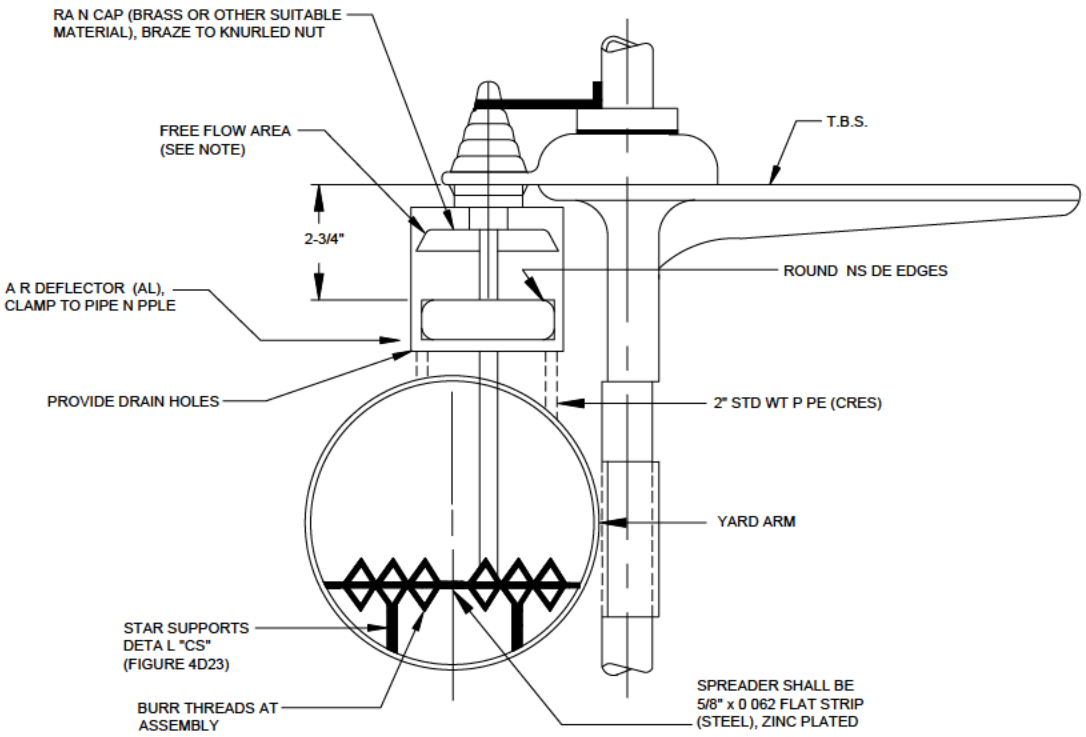
SECTION "K-K"
VIEW SHOWING MOUNTING ARRANGEMENT FOR T.B.S EQUIPMENT
(SEE FIGURE 4D12)



NOTE:

1. Free flow areas within rain caps and air deflectors shall have 1½ to 2 times the area of the feeding pipe.

FIGURE 4D22. Protection of cables on mast (surface ships) – section "K-K".

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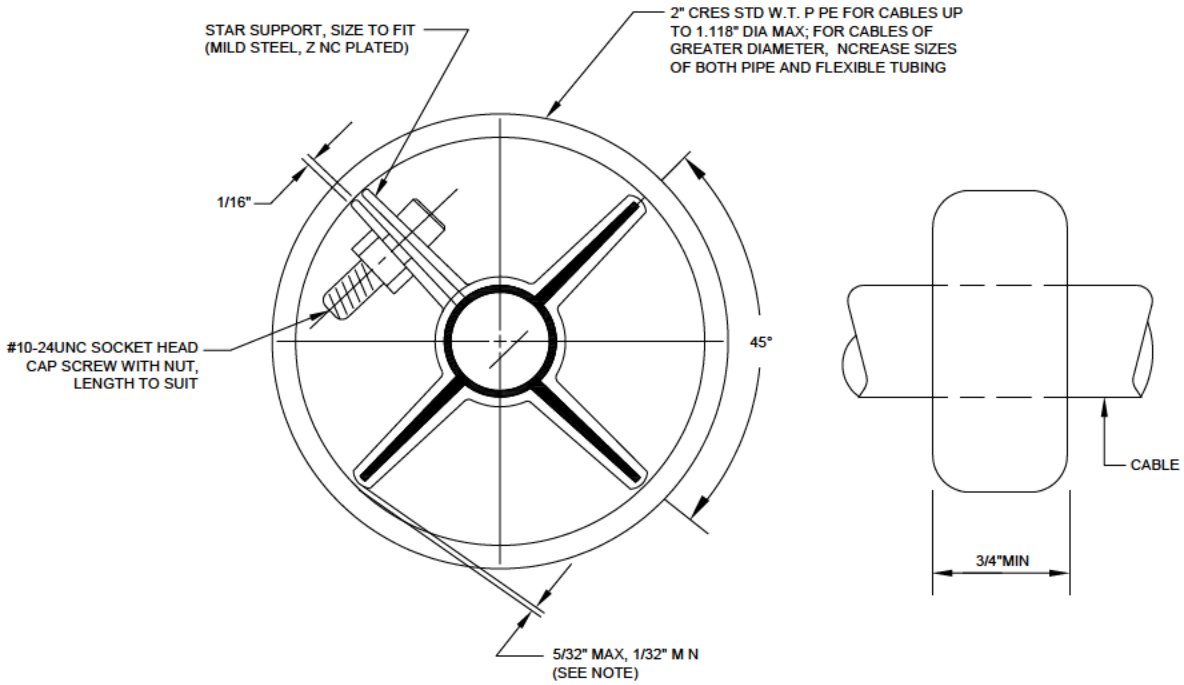
DETAIL "CS"

METHOD OF SUPPORTING CABLES IN PIPE AND FLEXIBLE TUB NG
SEE FIGURES 4D21 AND 4D22



NOTES:

1. To reduce the number of sizes required for star supports, cable grouping may be used with a maximum clearance of 5/32 inch, only as necessary, between star supports and corrosion resisting steel pipe.
2. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D23. Protection of cables on mast (surface ships) – detail "CS".

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DETAIL "CT"
METHOD OF SECUR NG FLEX BLE TUBING TO VENTILATION DUCT
(SEE FIGURE 4D19)

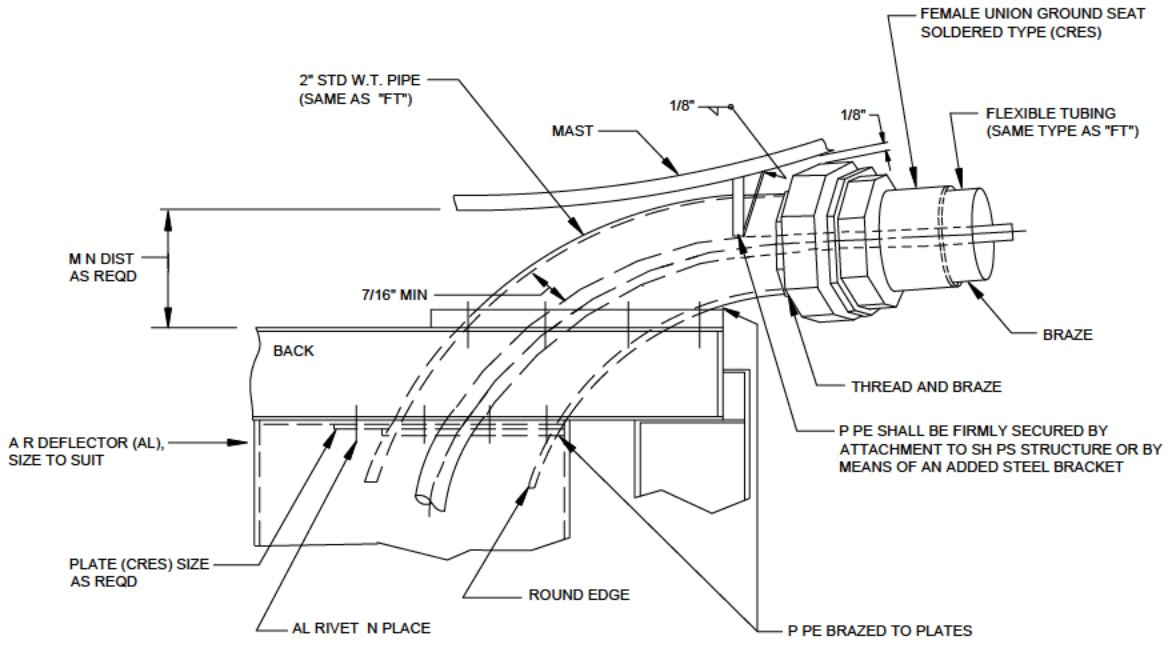

FIGURE 4D24. Protection of cables on mast (surface ships) – detail "CT".

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DETAIL "FT"
METHOD OF SECURING FLEXIBLE TUBING TO A FLAT SURFACE
(SEE FIGURES 4D12 AND 4D19)

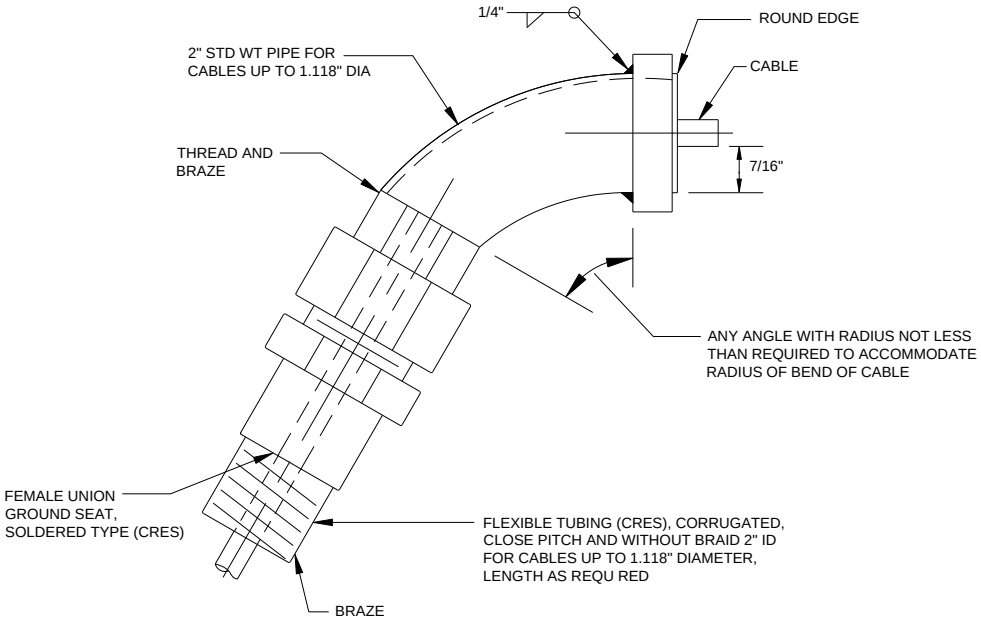

FIGURE 4D25. Protection of cables on mast (surface ships) – detail “FT”.

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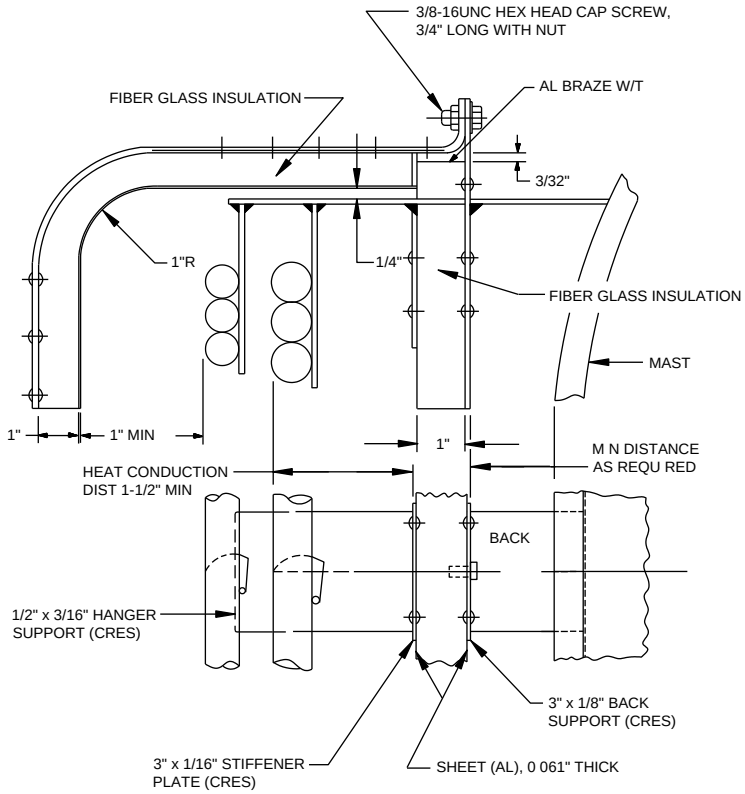
METHOD 4D-26-1
ARRANGEMENT OF DUCT AND A DOUBLE TIER OF CABLES ON MAST



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D26. Arrangement of duct and double tier of cables on mast (surface ships).

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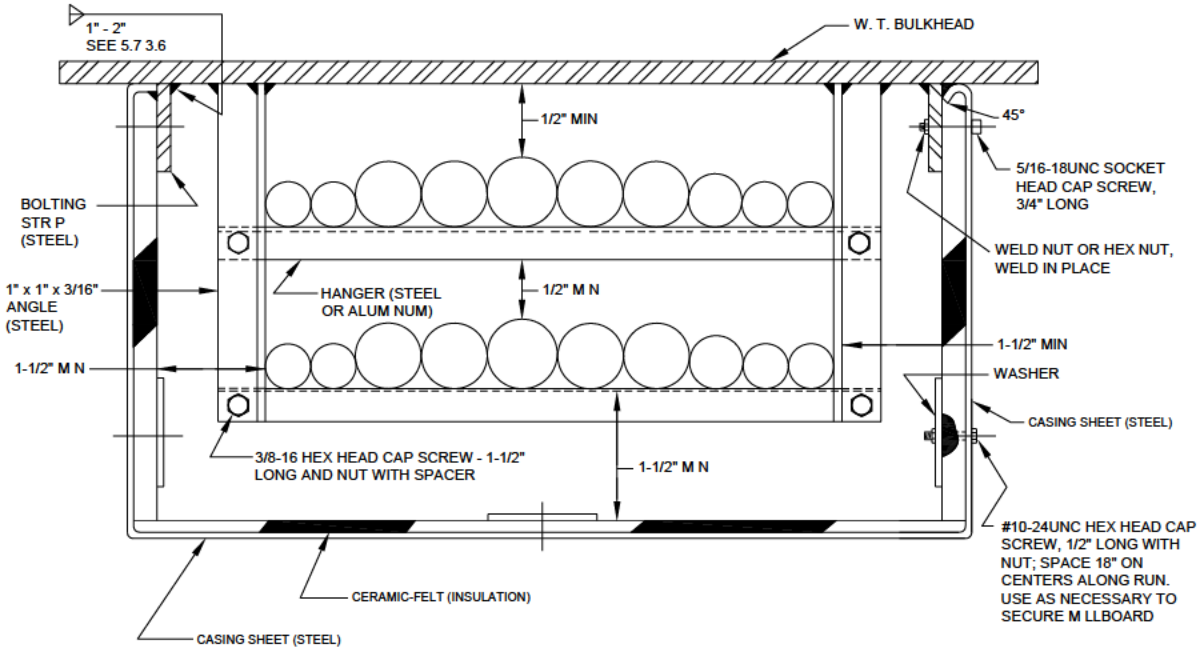
METHOD 4D-27-1
TWO TIERS OF CABLES (HANGAR SPACES)



NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements. For welding of fasteners, ensure that the fastener material requirements referenced in 5.7.3.7 are met.

FIGURE 4D27. Protection of cables in hangar spaces (surface ships).

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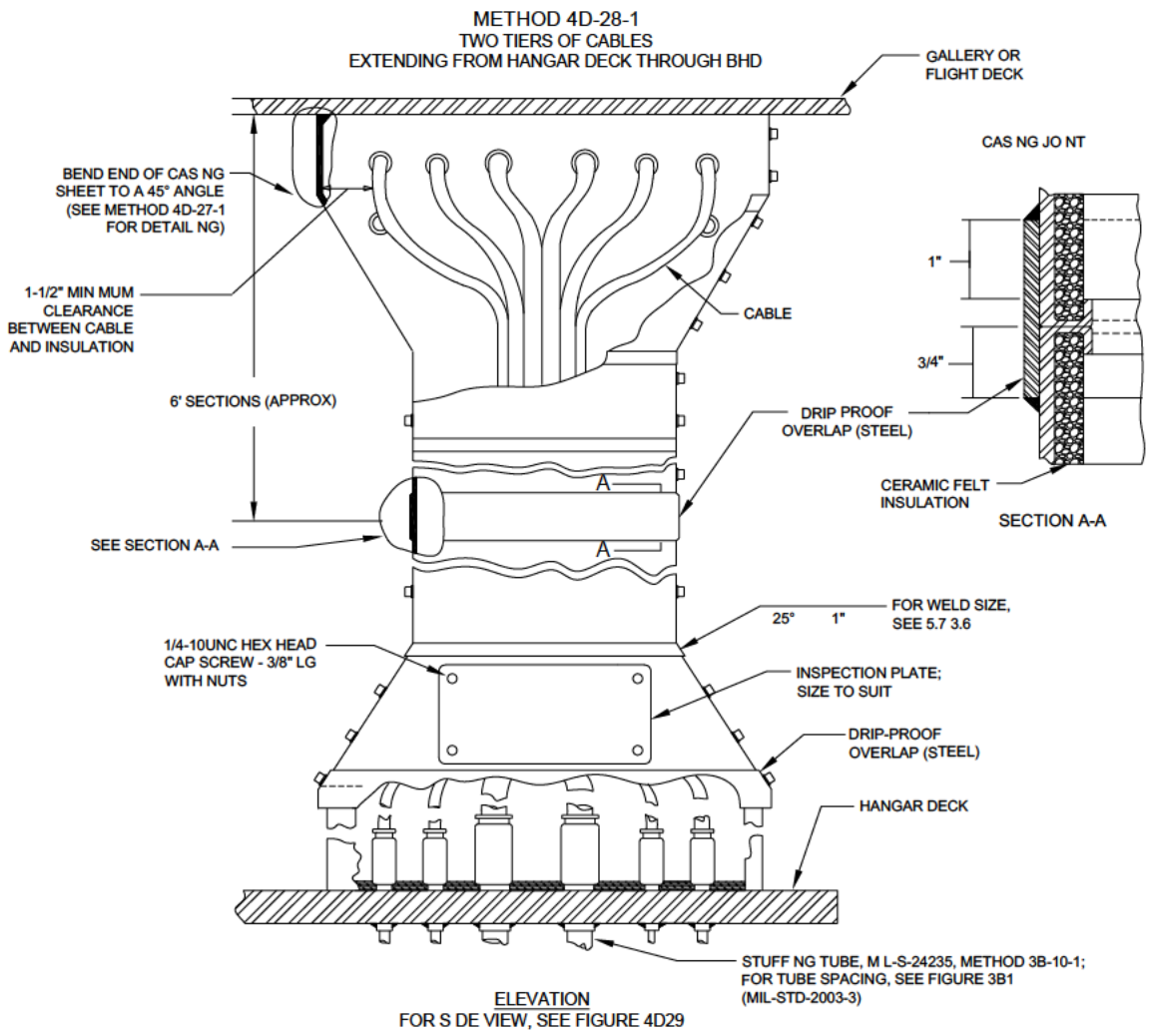

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements.

FIGURE 4D28. Protection of cables in hangar spaces (surface ships) – elevation.

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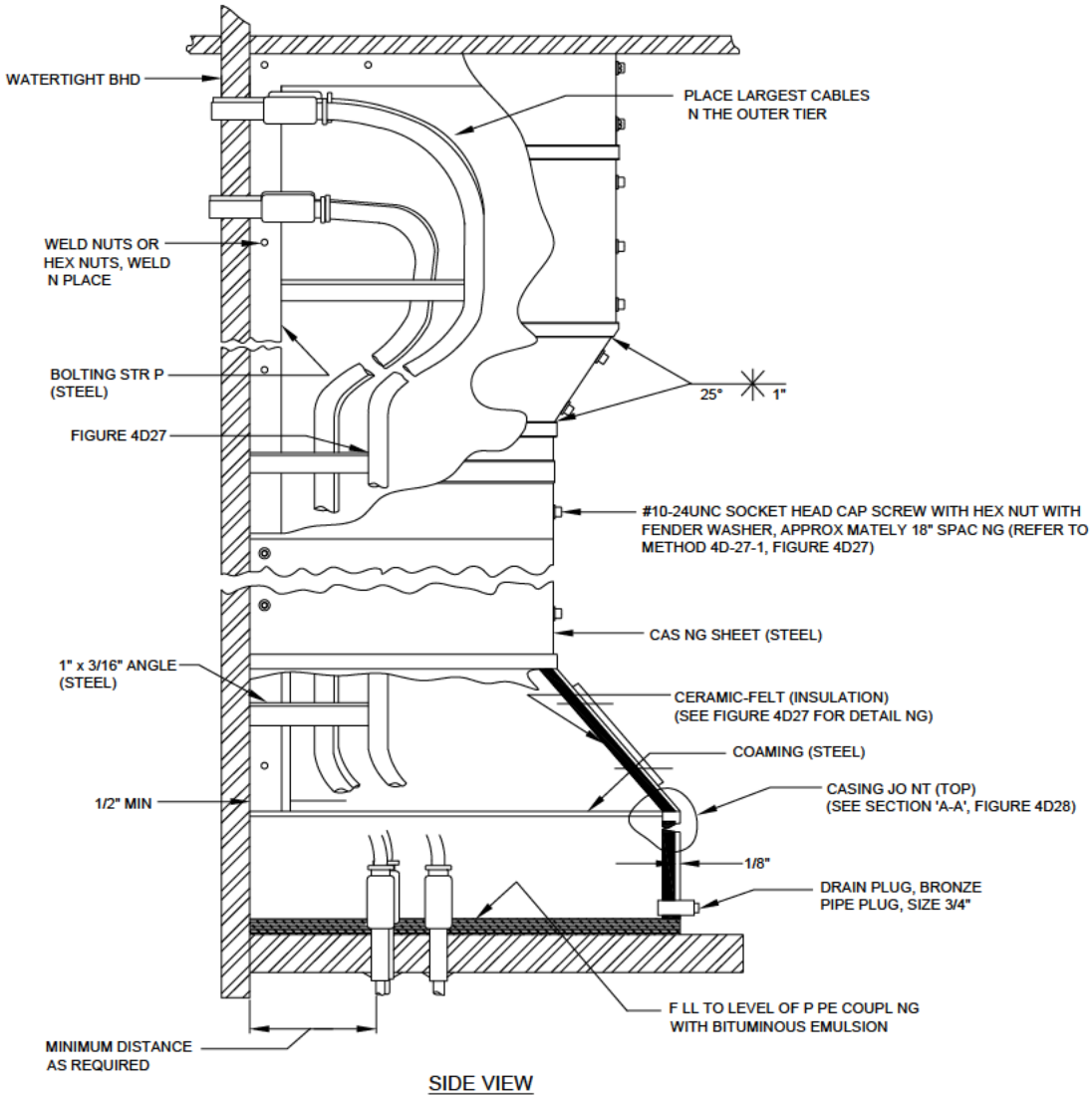
SIDE VIEW FOR METHOD 4D-28-1
TWO T ERS OF CABLES
EXTEND NG FROM HANGAR DECK THROUGH BHD



SIDE VIEW

NOTE:

1. See 5.7.3.7 for fastener and fastener material requirements. For welding of fasteners, ensure that the fastener material requirements referenced in 5.7.3.7 are met.

FIGURE 4D29. Protection of cables in hangar spaces (surface ships) – side view.

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CONCLUDING MATERIAL

Preparing activity:
Navy – SH
(Project SESS-2015-030)

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.