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24 June 1987

DEPARTMENT OF DEFENSE STANDARD PRACTICE

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

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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 submarine and surface ship electrical distribution systems.

3. These criteria apply to work on a specific ship or ships only when invoked by the Ship Specifications or similar contractual documents.

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

5. Considering the magnitude of this standard, along with the changing requirements imposed on the Electric Plant, it is inevitable that changes will be required to update these criteria. Therefore, as comments arise, they should be forwarded to Naval Sea Systems Command (NAVSEA) 05Z3 to keep this standard as current as possible through subsequent revisions. Revisions will be accomplished by the issuance of additional or revised figures to be inserted in the basic standard parts. Superseded pages may be retained for reference if so desired.

6. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05M2, 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 http://assist.daps.dla.mil.

CONTENTS

1. SCOPE

1.1 Scope. This standard covers standard installation methods for casualty power, shore power, electrical equipment, and switchboards.

1.1.1 Application. These installation methods are to be used by all installing activities. These methods do not identify ship or type, but do establish minimum standards of acceptance for Naval ships. It is the responsibility of the user activity to determine which method satisfies their requirements. It does not authorize relaxation of any requirement specifically invoked by new construction, conversion, overhaul, or refurbishment contracts. In instances where deviated design requirements (for example, ship type, ship class, and so forth) conflict with the requirements of this standard, the requirements of this standard govern. Any deviation for electric plant installation identified in this standard is to be submitted to NAVSEA 05Z3 for resolution.

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.

FEDERAL STANDARDS

FED-STD-H28	-	Screw-Thread Standards for Federal Services

COMMERCIAL ITEM DESCRIPTIONS

A-A-50609	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 12 Volt, 15 Ampere-Hour, Type 12V-S-15 AH
A-A-50610	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 2 Volt, 20 Ampere-Hour, Type 2V-S-20 AH
A-A-50611	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 6 Volt, 50 Ampere-Hour, Type 6V-S-50 AH
A-A-50612	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 12 Volt, 50 Ampere-Hour, Type 12V-S-50 AH
A-A-50613	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 6 Volt, 100 Ampere-Hour, Type 6V-S-100 AH
A-A-50614	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 12 Volt, 100 Ampere-Hour, Type 12V-S-100 AH
A-A-50615	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 6 Volt, 130 Ampere-Hour, Type 6V-S-130 AH
A-A-50616	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 12 Volt, 130 Ampere-Hour, Type 12V-S-130 AH
A-A-50617	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 6 Volt, 200 Ampere-Hour, Type 6V-S-200 AH

A-A-50618	-	Battery, Storage (Portable, Sealed, Maintenance-Free, Lead-Acid), 6 Volt, 300 Ampere-Hour, Type 6V-S-300 AH

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1310	-	Standard Practice for Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety
DOD-STD-2134	-	Storage Battery Arrangement for Minimum Stray Magnetic Field (Metric)
MIL-STD-3007	-	Unified Facility Criteria and Unified Facility Guide Specifications

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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

803-6983506	-	Electrical Enclosures, Composite, Installation and Details

(Copies of this document are available from Commander, Portsmouth Naval Shipyard, ATTN: Code 280.1, Kittery, ME 03904.)

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

(Copies of this document are available from the Naval Logistics Library, 5450 Carlisle Pike, Mechanicsburg, PA 17055 or online at http://nll.ahf.nmci.navy.mil.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

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

This section is not applicable to this standard.

4. GENERAL REQUIREMENTS

4.1 Electrical equipment mounting. The installation of electrical equipment shall be in accordance with figures 2A1 through 2A22. Electrical equipment shall be secured in a manner that it does not come into direct contact with the outer shell plating or ballistic surfaces of the ship. A minimum clearance of 2 inches shall be maintained for inspection and painting. The mounting of electrical equipment on bulkheads subject to condensation, such as the outer surface of refrigerated space boundary bulkheads, shall be avoided. If no other location is feasible, the equipment shall be mounted at least 2 inches clear of such surfaces. Also, cable shall not be mounted in direct contact with such bulkheads, but shall use one of the wet location methods. When such surfaces are insulated, appropriate insulation methods shall be used for both equipment and cable. Where necessary to attach electrical equipment to decks or bulkheads within gun and missile blast areas, such equipment shall be mounted to provide a 2-inch minimum clearance between the structure and equipment, and, moreover, such equipment shall be located clear of areas of maximum expected deflection or whip of bulkhead and deck plating in order to prevent breakage or pulling loose of mounting feet. Composite electrical enclosures shall be mounted in accordance with NAVSEA Standard Drawing 803-6983506.

4.1.1 Installation welding requirements. Unless otherwise specified on the individual figure, the welding of studs, step hangers, tapped pads, mounting pads, extension hangers, and top bracing supports for switchboards shall be in accordance with S9074-AR-GIB-010/278. Pads, studs, and so forth shall be tapped or threaded before being welded to the ship's structure.

4.1.2 Installation fasteners. Bolts, nuts, machine screws, and flat and lock washers shall be of commercial grade (5 or better) and material specified. One to five (1-5) threads shall project past locking nuts. Threads shall be American-National firm, coarse series Class 2, unless otherwise specified in a ship contract or ship specification. Thread fastenings shall be as specified in FED-STD-H28. Locking devices shall be used for bolts mounting electrical equipment. Through bolts and self-locking nuts shall be used to mount equipment in gun mounts and in battery compartments. When required by local QA, torque seal shall be installed on all bus connections in power panels, load centers, switchboards, and power converters upon verification of torque using a calibrated torque wrench. Switchboards and load centers shall have torque seal on bus to bus connections as well as cable connections (vendor or contractor) to bus work upon verification of torque using a calibrated torque wrench.

4.1.3 Holes drilled in beams. Location of holes drilled in beams for passing cables or securing of supports or equipment shall be on or above the neutral axis.

4.1.4 Malleable iron castings. Malleable iron castings are not approved for any install except as may be noted on the individual figure.

4.2 Switchboard mounting. Switchboard mounting and bracing shall be in accordance with figures 2B1 through 2B6. The base of each unit shall be adequately secured to the foundation and shall be in a level plane (with reference to ship's baseline) when secure. In order to ensure there is no warping of the switchboard framework or misalignment of component parts of the switchboard, the base of each section shall not be out-of-plane by more than ⅛ inch after installation, with all securing bolts tightened. Switchboards shall be located so that the base of the units can be bolted directly to the deck stiffeners or foundation and not bolted to a thin deck plate. Foundation bolts of the switchboard units shall be fastened to metal whose thickness in the immediate vicinity of the bolts is at least equivalent to the bolt diameter. The addition of pads may be necessary to obtain the required thickness or to compensate for the lack of flanges on the deck stiffeners. The requirements regarding rigidity of the switchboard structure, the requirements for securing the units to the foundation, and for the foundation in the ship for mounting the switchboard are intended to ensure that the switchboard units after installation in the ship will not display unsatisfactory resonant vibrations. If the horizontal vibration of deck-mounted switchboard sections or switchboards exceeds 0.040-inch double amplitude, measured on the framework near the top of the structure, top bracing shall be provided. Rigidity of the braces and their attachments shall be adequate to prevent vibration of the top of the section. Shear bolts may be employed in the braces if provision is made to prevent the brace from striking the section or bulkhead after shearing of the bolt. Horizontal braces are preferred. The angle of inclination of braces shall not exceed 45 degrees from the horizontal. The braces shall possess inherent flexibility in the vertical direction. Top bracing and installation features shall conform to the methods shown in this section. Bolts, nuts, and washers used to fasten the braces to the switchboard frame shall be held captive by suitable means. Unless other means of bracing are provided, sway bracing shall be provided front-to-back on all switchboards and side-to-side on one-section and two-section switchboards.

4.3 Storage batteries and servicing facilities. Storage batteries and service facilities shall be in accordance with figures 2C1 through 2C10, and all batteries shall be valve regulate lead acid (VRLA), unless otherwise approved by NAVSEA 05Z3. The required number of trays or cells shall be connected in series to produce the required voltage. The necessary ampere-hour capacity shall be obtained by the use of the proper size of battery. Batteries may be connected in parallel in order to obtain greater capacities than those available from the largest sized battery. In general, batteries and their applications shall be as shown in table I. Alternative VRLA batteries shall be proposed if technical and economic factors justify their use. All contractor-furnished and Government-furnished batteries shall be maintained by the contractor in accordance with the manufacturer's instructions during construction of the ship. The contractor shall charge all batteries in accordance with manufacturer's instructions not more than 30 days before Acceptance Trials (AT). Battery records shall be kept which indicate the battery function, the Navy type designation, the specification type, the initial charging date, and the dates of subsequent charges, and date and type of any other maintenance actions.

TABLE I. Classes and applications of portable lead storage batteries.

Navy type designation	Reference	Typical uses 1/
2V-20AH-L/D-A	A-A-50610	Portable floodlights
12V-15AH-L/D-A or B	A-A-50609	Gyros and emergency communications on submarines
6V-50AH-L/D-A or B	A-A-50611 A-A-50612	Dial telephone systems having a capacity of 50 lines or less, interior communications, gyrocompass emergency power
12V-50AH-L/D-A or B	A-A-50611 A-A-50612	
6V-100AH-L/D-A or B	A-A-50613 A-A-50614	All purposes mentioned for 50-AH Type and for gun firing and sight lighting circuits, director instrument illumination, fire control instrument illumination, radio power, and 100 or 150 line telephone systems
8V-100AH-L/D-A or B	A-A-50613 A-A-50614	
12V-100AH-L/D-A or B	A-A-50613 A-A-50614	
6V-130AH-H/S-A or B	A-A-50615 A-A-50616	Engine starting services
8V-130AH-H/S-A or B	A-A-50615 A-A-50616	
12V-130AH-H/S-A or B	A-A-50615 A-A-50616	
6V-205AH-H/S-A or B	A-A-50617	Engine starting services requiring greater capacity than 130-AH.
8V-205AH-H/S-A or B	A-A-50617	
6V-300AH-L/D-A or B	A-A-50618	General services emergency batteries, electronic, and dial telephone systems having a capacity of more than 150 lines
8V-300AH-L/D-A or B	A-A-50618	

LEGEND:

V = Battery nominal voltage

AH = Ampere-hour capacity

L/D = Low rate/deep discharge cycling

H/S = High rate/shallow discharge cycling

NOTE:

1/ Typical uses of batteries shall include UPS systems in support of shipboard applications such as navigation systems, control systems, etc.

4.3.1 Storage batteries – tray and rack installation. Trays for separately mounted batteries shall be installed to be readily accessible for testing and cleaning. Spacing of trays shall ensure effective ventilation. Clearance above trays shall be not less than 12 inches. Battery trays and racks (open and enclosed) shall be in accordance with figures 2C1 through 2C11. Where racks cannot be adequately secured to the deck and bulkhead, they shall be additionally secured by diagonal braces to the deck above, but in no case shall the vertical support extend from deck to deck. Spaces assigned for storage and service of spare batteries shall have sufficient shelf space or racks for storage of all spare batteries. On minesweepers, mine tenders, mine hunters, and similar type ships designed for low magnetic signature, where it is required to reduce to a minimum the stray magnetic field produced by the current through batteries and connections to them, arrangement and connections shall be as shown in DOD-STD-2134.

4.4 Casualty power. The casualty power distribution system installation shall be in accordance with figures 2D1 through 2D7. These figures depict the installation requirements for horizontal bulkhead terminals, vertical risers, portable jumper cable, cable stowage racks, terminals mounted in equipment enclosures, terminal wiring, installation, and end preparation of casualty power cable. The following equipment and cable types shall be used for casualty power installments:

Bulkhead terminals	Symbol 1046 and 1048
Riser terminals	Symbol 1047
Plugs	Symbol 1049
Cable storage racks	Symbol 1040 and 1040.1
Permanent riser cable	TSGU-75 (LSTSGU-75)
Portable cable	THOF-42 (LSTHOF-42)

4.5 Shore power. Receptacles and cables associated with shore power facilities for surface ships shall be in accordance with the installation methods shown in figures 2E1 through 2E23. These figures depict the configuration of shore power stations inside and outside bulkheads, mounting of connection boxes, incline mounted shore power receptacles in protected areas, free standing shore power stations, details of in-line connectors on alongside power cables, portable cable jumper assemblies, termination and potting of plugs, termination and heat shrink boot requirements for in-line connectors, installation details for receptacles, typical shore power cable supports, repair and mounting of terminal boxes, and the repair and preparation of shore power cables.

4.6 Grounding of electrical equipment. The methods for grounding electrical equipment, enclosures, and supports shall be in accordance with MIL-STD-1310. Removable and hinged enclosure access panels with mounted energized components shall be grounded to the enclosure using a flexible ground strap when any voltage on the access panel exceeds 30 volts.

4.7 Tangle boxes. Tangle boxes shall be used when necessary. For instance, a tangle box shall be used if it becomes necessary to remove cable jackets from electrical cables prior to entering electrical equipment such as switchboards and load centers. Removal of cable jackets may be required to meet cable bend radius requirements or for convenience of handling due to the large number of cables involved. Conductors and cables shall be supported within the first 16 inches of coming out of the collar or transit upon entering the tangle box and every 16-32 inches thereafter. Support shall be provided using a fire resistant, non-magnetic material, such as aluminum or phenolic. Clearance of conductors and cables must maintain 1.5 inches from sides, bottom, top, and beams inside the tangle box. There shall be no duct work, piping, or any other foreign objects in the tangle boxes. Tangle boxes shall be constructed by welding and shall be painted for corrosion protection.

5. DETAILED REQUIREMENTS

(See figures.)

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 section specifies the requirements for equipment mounting, switchboard mounting, battery equipment, casualty power, and shore power 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.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Fastener threads if other than specified in 4.1.2.

6.3 Designation of electric plant installation standard methods figures. The electric plant installation standard method MIL-STD-2003-2 contains drawings that depict standard methods that are applicable for general electric plant installation on both surface ships and submarines. The methods shown on the figures are grouped together providing similar functions. These groups are:

MIL-STD-2003-2 (Equipment)

Group A. Standard Methods for Mounting Equipment

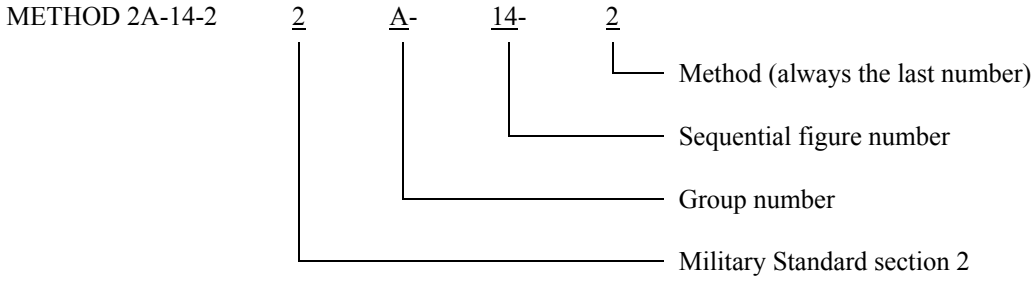
B. Switchboard Mounting

C. Battery Rack Mounting

D. Casualty Power

E. Shore Power

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



Thus, Method 2A-14-2 identifies Method 2, figure number 14, Group A of MIL-STD-2003-2.

6.4 Subject term (key word) listing.

Battery equipment

Casualty power

Shore power

Switchboard mounting

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.

GROUP A - STANDARD METHODS FOR MOUNTING EQUIPMENT

A.1 SCOPE

A.1.1 Scope. This appendix describes standard methods and procedures for the installation and mounting of equipment.

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.

COMMERCIAL ITEM DESCRIPTIONS

A-A-59125	-	Terminal Boards, Molded, Barrier Screw and Stud Types and Associated Accessories

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-E-917	-	Electric Power Equipment, Basic Requirements
MIL-DTL-16036	-	Switchgear, Power, Low Voltage, Naval Shipboard
MIL-PRF-23236	-	Coating Systems for Ship Structures
MIL-S-24149	-	Studs, Welding, and Arc Shields (Ferrules), General Specification for
MIL-C-24231/1	-	Connector, Plug, Type I, Molded, Three-, Four-, and Five-Conductor
MIL-C-24231/10	-	Connectors, Single Cable, Type III, 14-, 24-, 30-, or 40-Conductor
MIL-C-24231/25	-	Connector, Hull Inserts, Type VII
MIL-DTL-24441/20	-	Paint, Epoxy-Polyamide, Green Primer, Formula 150, Type III
MIL-PRF-32273	-	Battery Cells and Modules, Valve Regulated Lead-Acid, Main Storage, Submarine; General Specification for
MIL-PRF-32273/1	-	Battery Cell, Valve Regulated Lead-Acid, Main Storage, Submarine, Classification Type B
MIL-PRF-32273/2	-	Battery Cell, Valve Regulated Lead-Acid, Main Storage, Submarine, Classification Type C

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-2003-3	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Penetrations)

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-2036	-	Preparation of Electronic Equipment Specifications

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

A.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

815-1853069 - Bearing Circle, Compass Holder for Portable Gyro Repeater

(Copies of this document are available from Commander, Portsmouth Naval Shipyard, ATTN: Code 280.1, Kittery, ME 03904.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9086-KC-STM-010 - NSTM Chapter 300, Electric Plant-General

(Copies of this document are available from the Naval Logistics Library, 5450 Carlisle Pike, Mechanicsburg, PA 17055 or online at http://nll.ahf.nmci.navy.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.

ASTM INTERNATIONAL

ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes

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

(Copies of these documents are available from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2959 or online at www.astm.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. Equipment and materials for the installation and mounting of equipment shall be as specified in figures 2A1 through 2A25.

A.4 NOTES AND PROCEDURES

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

A.4.2 Figures. Table 2AI provides information for the figures in this group.

TABLE 2AI. Figures for equipment mounting.

Figure number	Equipment mounting	Page
2A1	Equipment secured to watertight and non-watertight steel decks or bulkheads	11
2A2	Equipment mounted on insulated watertight steel deck or bulkhead	13
2A3	Bracket fans supported on steel bulkheads	15
2A4	Equipment secured to non-watertight steel decks or bulkheads	17
2A5	Equipment secured to steel stanchions	19
2A6	Equipment mounted on aluminum watertight and non-watertight decks and bulkheads	20

TABLE 2AI. Figures for equipment mounting - Continued.

Figure number	Equipment mounting	Page
2A7	Equipment mounted on insulated aluminum decks or bulkheads	22
2A8	Equipment mounted on non-watertight aluminum bulkheads	24
2A9	Equipment mounted on aluminum stanchions	25
2A10	Equipment mounted on aluminum or steel pilaster bulkheads	26
2A11	Equipment mounted on metal joiner bulkheads	28
2A12	Equipment mounted on expanded metal or wire mesh bulkheads	29
2A13	Equipment mounted on expanded metal or wire mesh bulkhead	30
2A14	Equipment mounted on cabling racks	31
2A15	Ceiling fan support in refrigerated spaces	32
2A16	Equipment mounted in refrigerated spaces	33
2A17	Connecting adjacent cast aluminum equipment with pipe nipples	34
2A18	Connecting adjacent equipment with pipe nipples	35
2A19	Mast position indicator switches for submarines	37
2A20	Locking devices on electrical connections and installations on submarines	39
2A21	Portable ship control unit submarine bridge type	42
2A22	Electrical equipment mounting to GRP bulkheads/panels	44
2A23	Electrical equipment mounting to GRP bulkheads/panels	45
2A24	Electrical equipment mounting to GRP bulkheads/panels	45

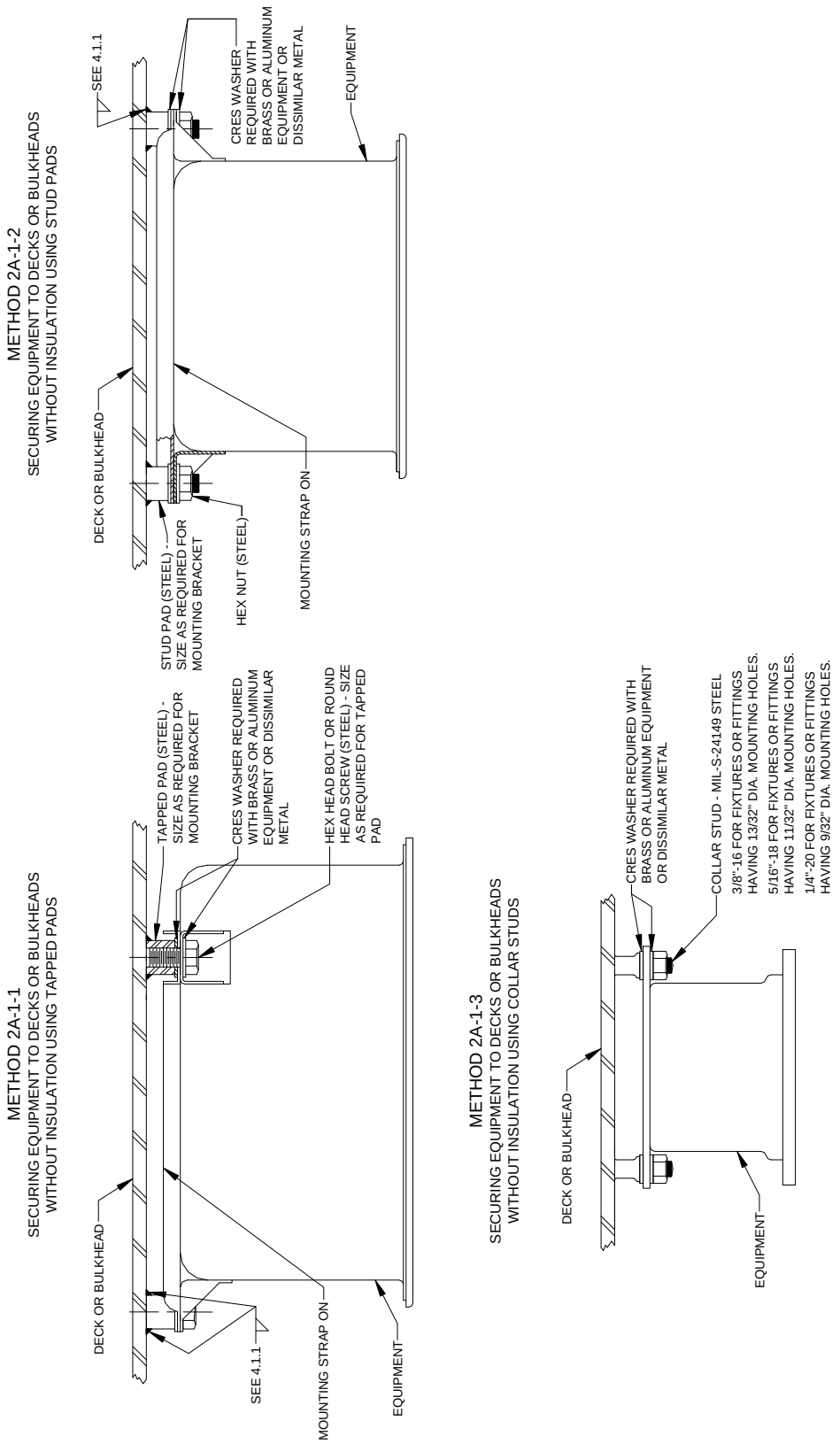


FIGURE 2A1. Equipment secured to watertight and non-watertight steel decks or bulkheads.

NOTES:

1. Suitable corrosion protection shall be used for dissimilar metals.
2. Methods shown are for use on interior decks or bulkheads when not subjected to moisture or high temperature [125 °F (51.6 °C)]. Not to be used for decks or bulkheads insulated or exposed to weather.
3. CRES hardware required where equipment is brass or dissimilar metal.

FIGURE 2A1. Equipment secured to watertight and non-watertight steel decks or bulkheads - Continued.

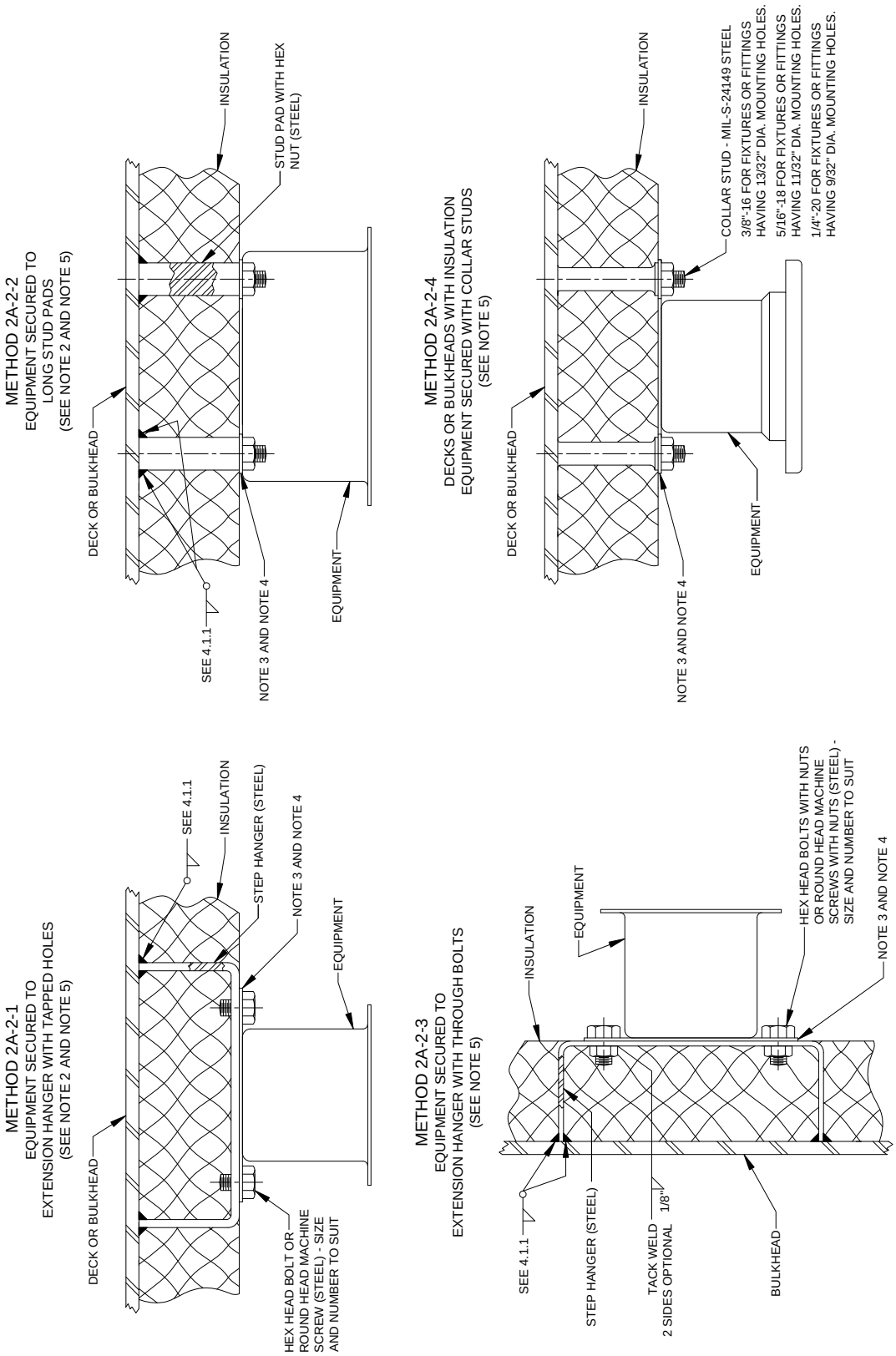


FIGURE 2A2. Equipment mounted on insulated watertight steel deck or bulkhead.

NOTES:

1. CRES hardware required when equipment is aluminum or brass or dissimilar metal.
2. Methods 2A-2-1 and 2A-2-2 may be used when bulkheads or decks are special treatment steel (S.T.S.).
3. CRES washers are required for aluminum or brass equipment.
4. Step hangers shall be flush with surface of insulation and threads shall extend ½" above insulation or equipment to properly mount equipment.
5. Methods 2A2-1, 2A2-2, 2A2-3, and 2A2-4 are for use on interior decks or bulkheads not subjected to moisture or high temperature [125 °F (51.6 °C)].

FIGURE 2A2. Equipment mounted on insulated watertight steel deck or bulkhead - Continued.

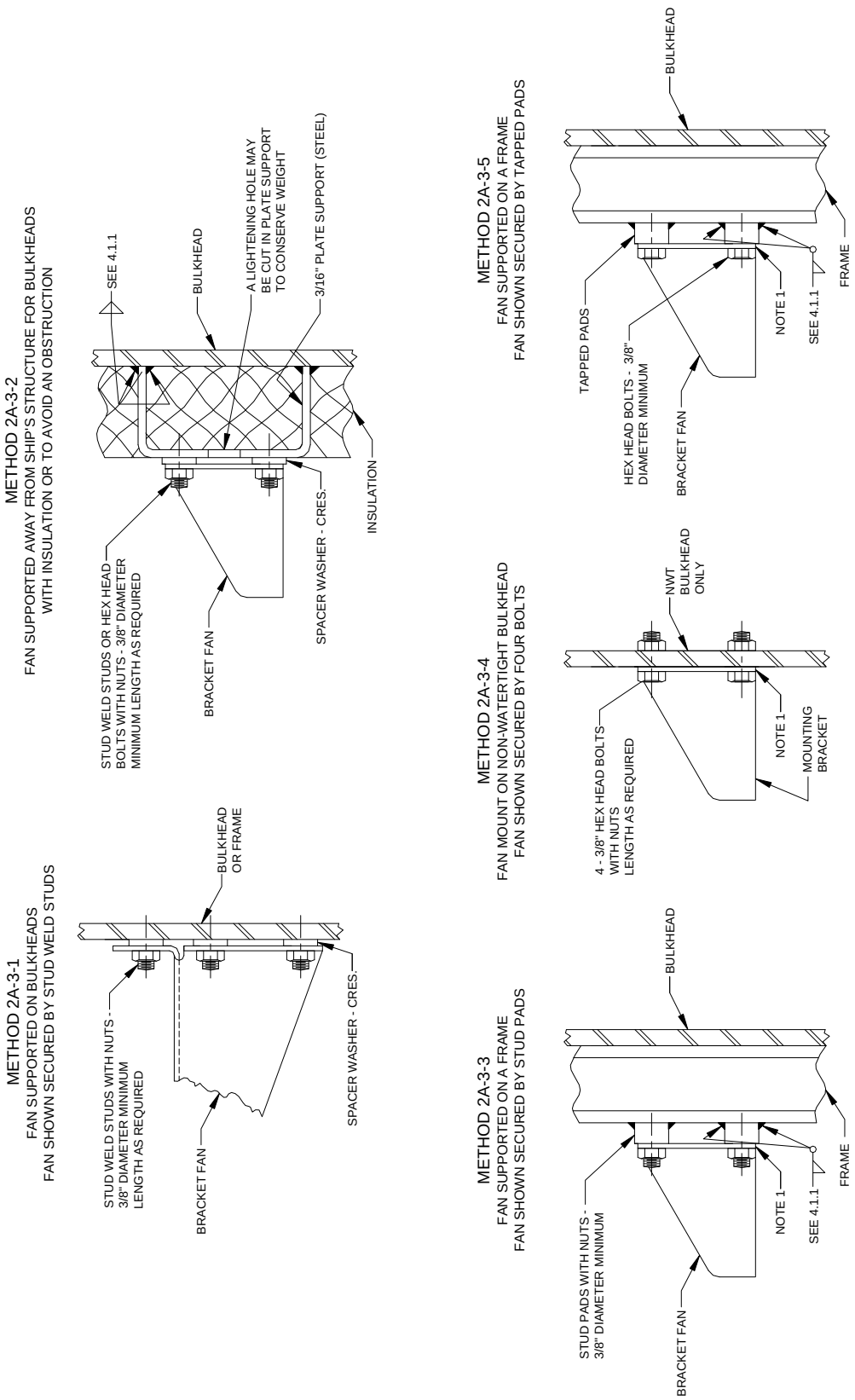


FIGURE 2A3. Bracket fans supported on steel bulkheads.

NOTES:

1. CRES hardware required when material of fan brackets is aluminum or brass or dissimilar metal.
2. Methods shown are for use on interior bulkheads not subjected to moisture or high temperature [125 °F (51.6 °C)].

FIGURE 2A3. Bracket fans supported on steel bulkheads - Continued.

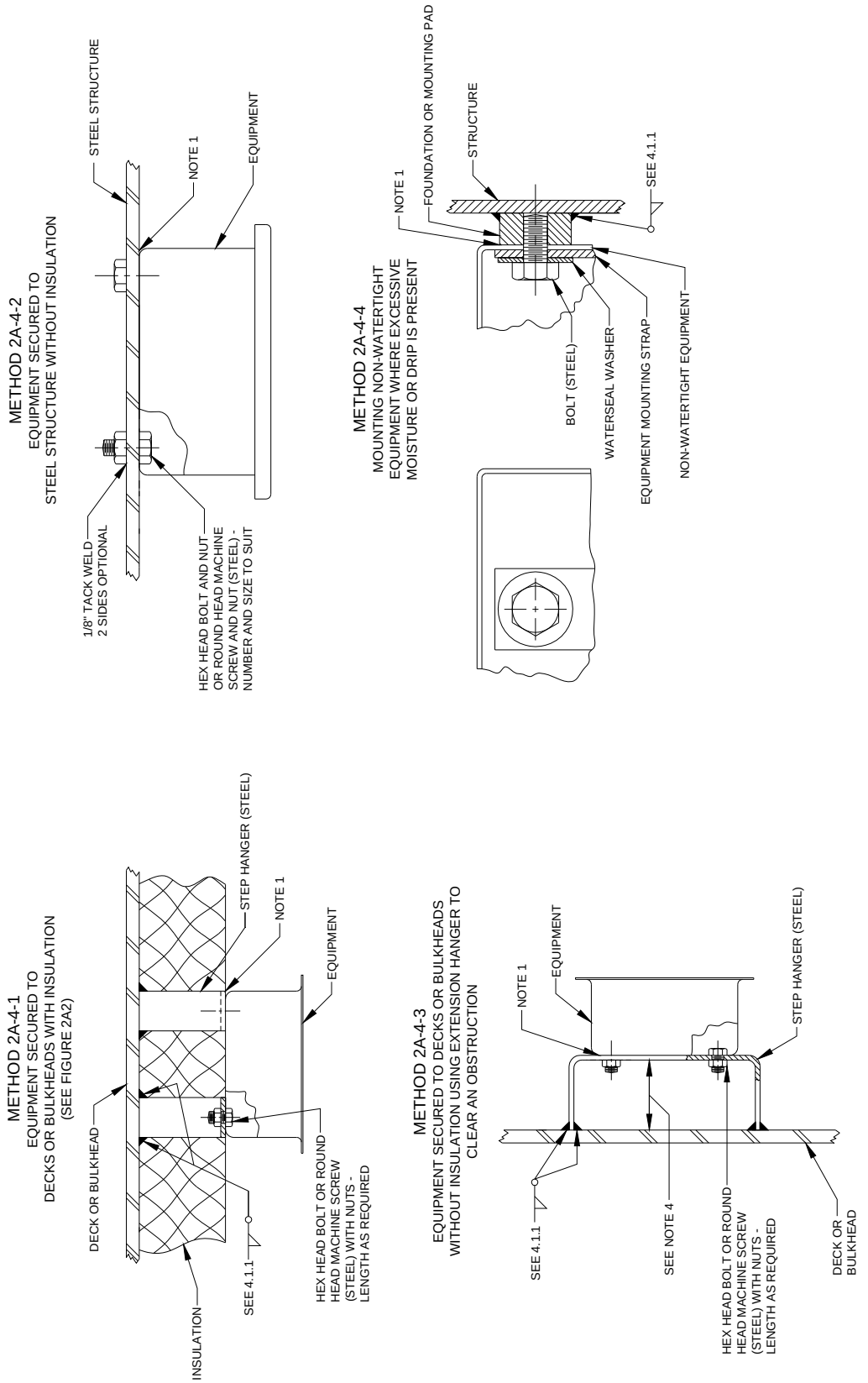


FIGURE 2A4. Equipment secured to non-watertight steel decks or bulkheads.

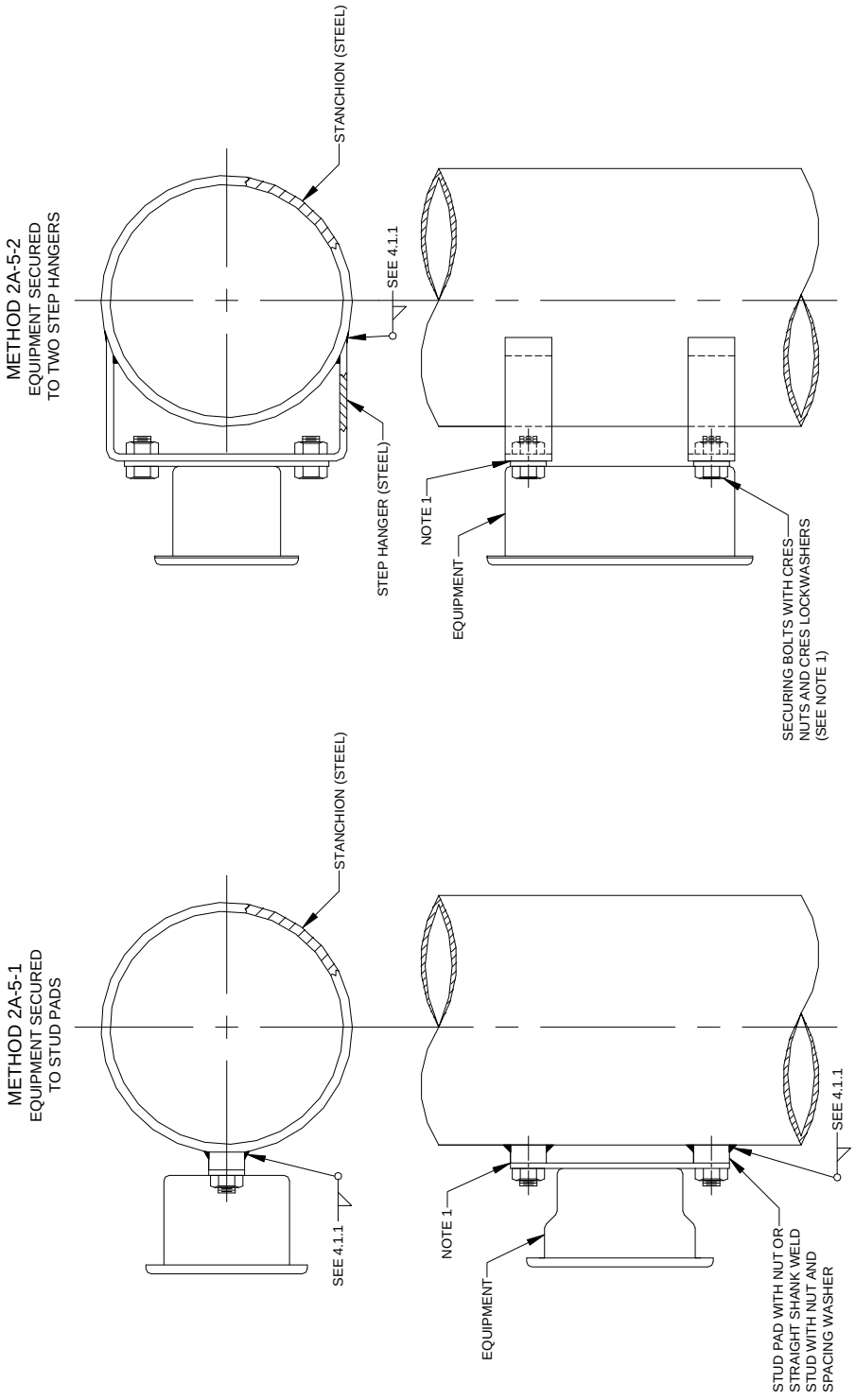
TABLE 2A4-I. Waterseal washer table.

Mounting	Metal portion – stainless steel			Rubber portion - neoprene		
Bolt	**O.D.**	**I.D.**	**Thickness**	**O.D.**	**I.D.**	**Thickness**
¼	0.729	0.3593	0.0299	0.8125	0.1875	0.0625 to 0.0937
⅜	0.875	0.50	0.0299	0.9375	0.2812	0.0625 to 0.0937
½	1.1875	0.5468	0.0299	1.250	0.4062	0.0625 to 0.0937
⅝	1.5625	0.750	0.0359	1.625	0.50	0.0625 to 0.0937
¾	1.090625	0.962	0.0359	2.0312	0.625	0.0625 to 0.0937

NOTES:

1. CRES hardware required when equipment material is aluminum, brass, or dissimilar metal.
2. Suitable corrosion protection shall be used for dissimilar metals.
3. Methods 2A-4-1, 2A-4-2, and 2A-4-3 are for use on interior decks and bulkheads not exposed to weather, moisture, or high temperature [125 °F+ (51.6 °C+)].
4. This dimension shall be sufficient to clear the obstruction.

FIGURE 2A4. Equipment secured to non-watertight steel decks or bulkheads - Continued.



NOTES:

1. CRES hardware required when equipment material is aluminum, brass, or dissimilar metal.
2. For use in interior of ships where not exposed to weather, moisture, or high temperature [125 °F+ (51.6 °C+)].

FIGURE 2A5. Equipment secured to steel stanchions.

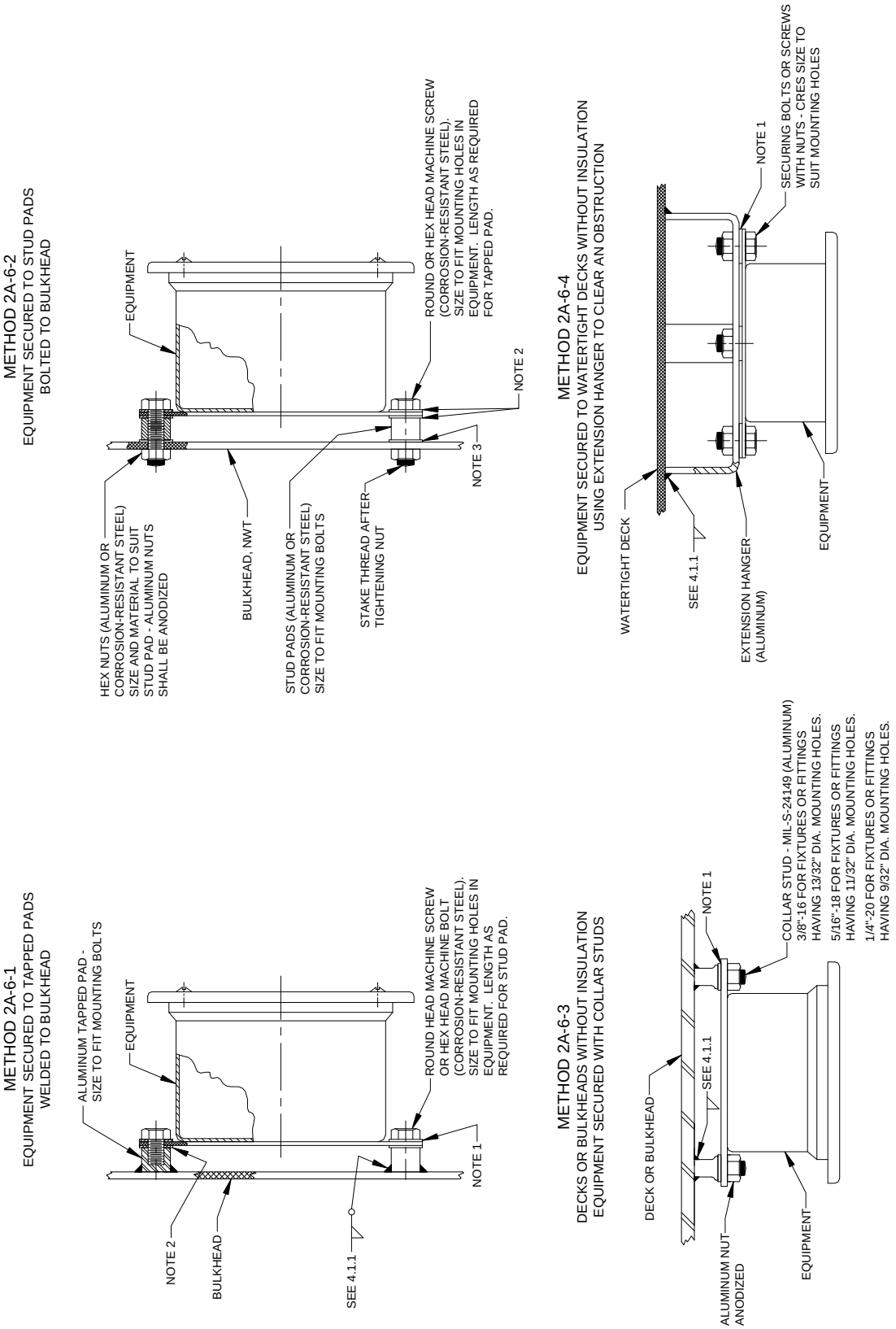


FIGURE 2A6. Equipment mounted on aluminum watertight and non-watertight decks and bulkheads.

NOTES:

1. CRES washers shall be used when equipment material is steel or brass or dissimilar metal.
2. CRES washers shall be used when stud pad is aluminum and equipment is steel or brass.
3. Apply gasket joint sealing packing material on watertight bulkheads.

FIGURE 2A6. Equipment mounted on aluminum watertight and non-watertight decks and bulkheads - Continued.

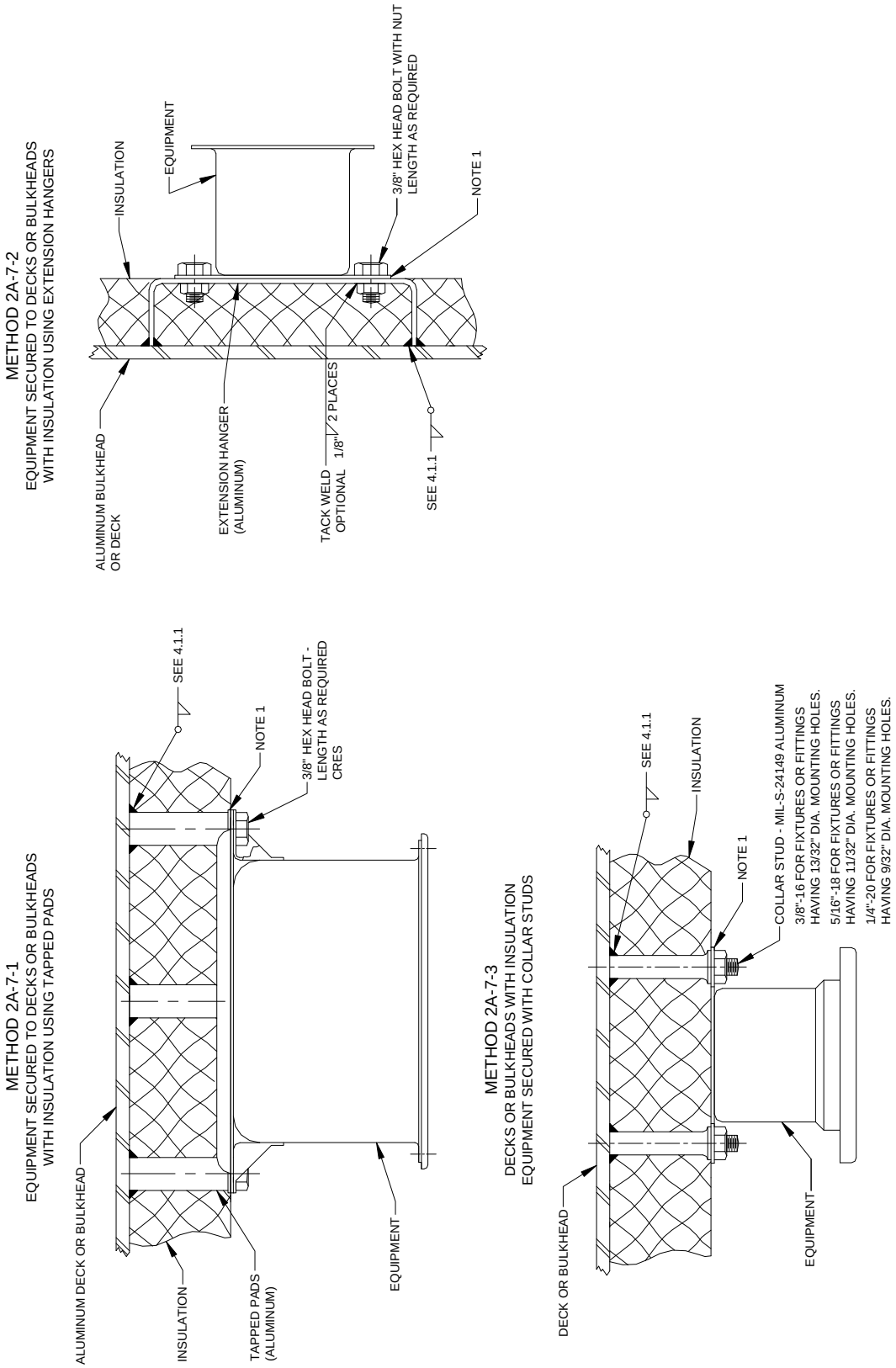


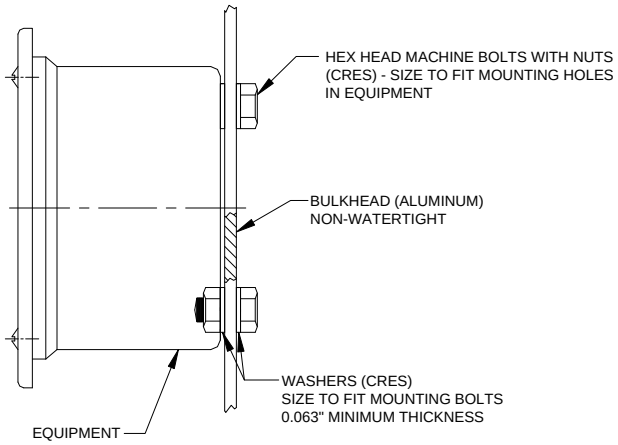
FIGURE 2A7. Equipment mounted on insulated aluminum decks or bulkheads.

NOTES:

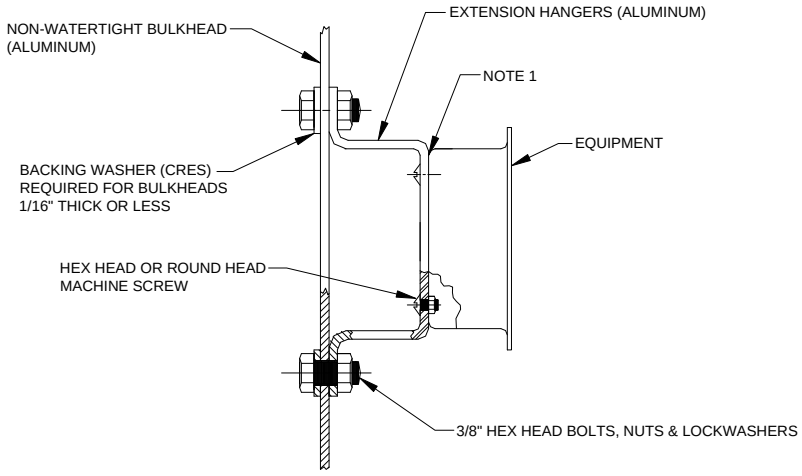
1. CRES hardware shall be used when equipment material is steel, brass, or dissimilar metal.
2. For use in interior of ships where not exposed to weather, moisture, or high temperature [125 °F+ (51.6 °C+)].

FIGURE 2A7. Equipment mounted on insulated aluminum decks or bulkheads - Continued.

METHOD 2A-8-1
EQUIPMENT SECURED TO
BULKHEADS 3/16" THICK AND OVER



METHOD 2A-8-2
EQUIPMENT SECURED TO NON-WATERTIGHT BULKHEAD
USING EXTENSION HANGER TO CLEAR AN OBSTRUCTION

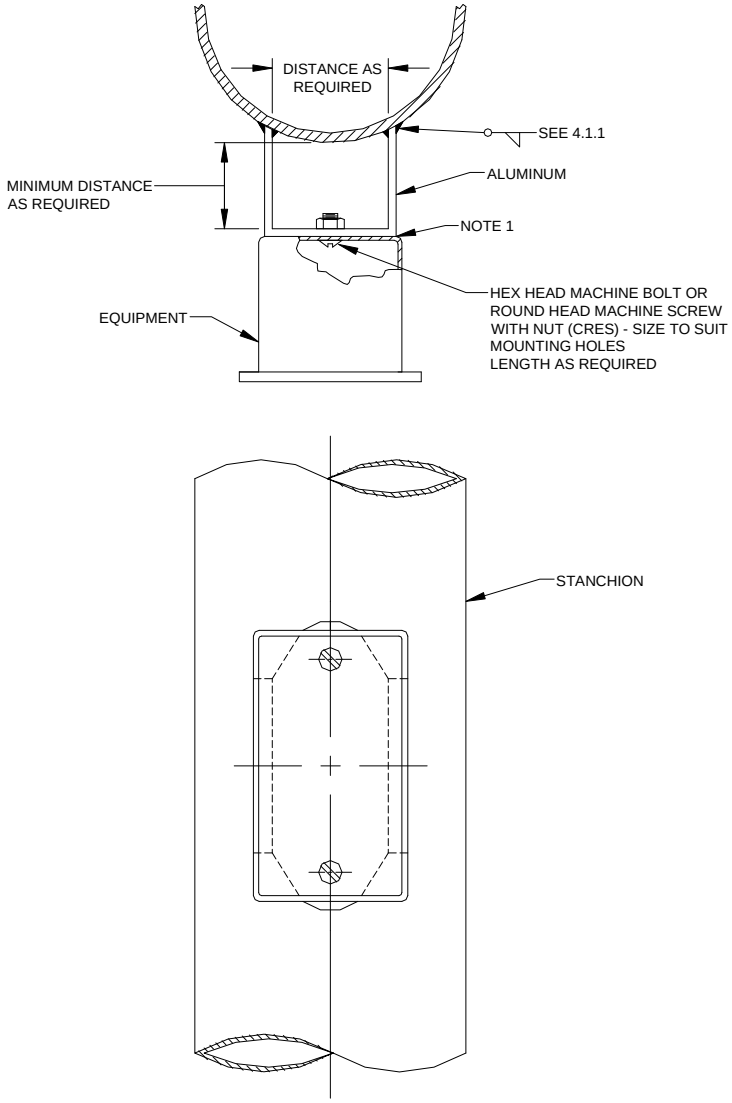


NOTE:

1. CRES washers shall be used as spacers when equipment material is steel, brass, or dissimilar metal.

FIGURE 2A8. Equipment mounted on non-watertight aluminum bulkheads.

METHOD 2A-9-1
EQUIPMENT SECURED TO ALUMINUM STANCHIONS
AND BULKHEADS LESS THAN 3/16" THICK



NOTE:

1. CRES washers shall be used as spacers when equipment material is steel or brass.

FIGURE 2A9. Equipment mounted on aluminum stanchions.

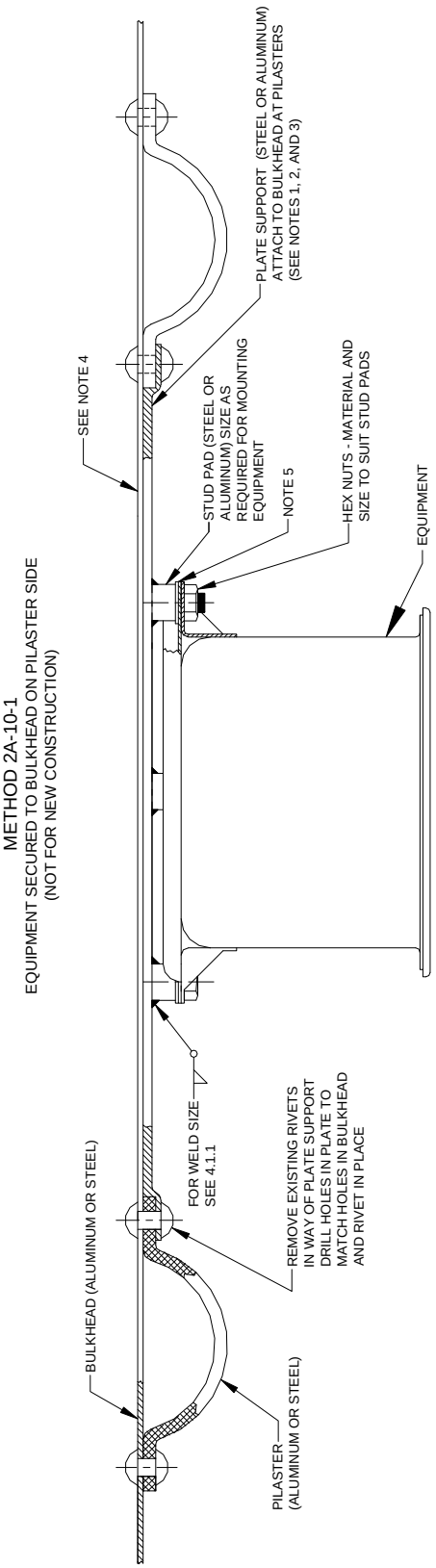
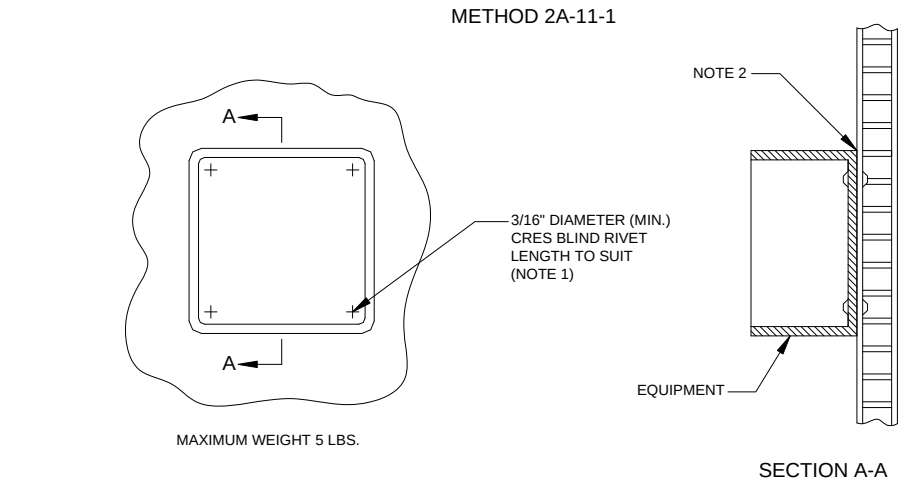


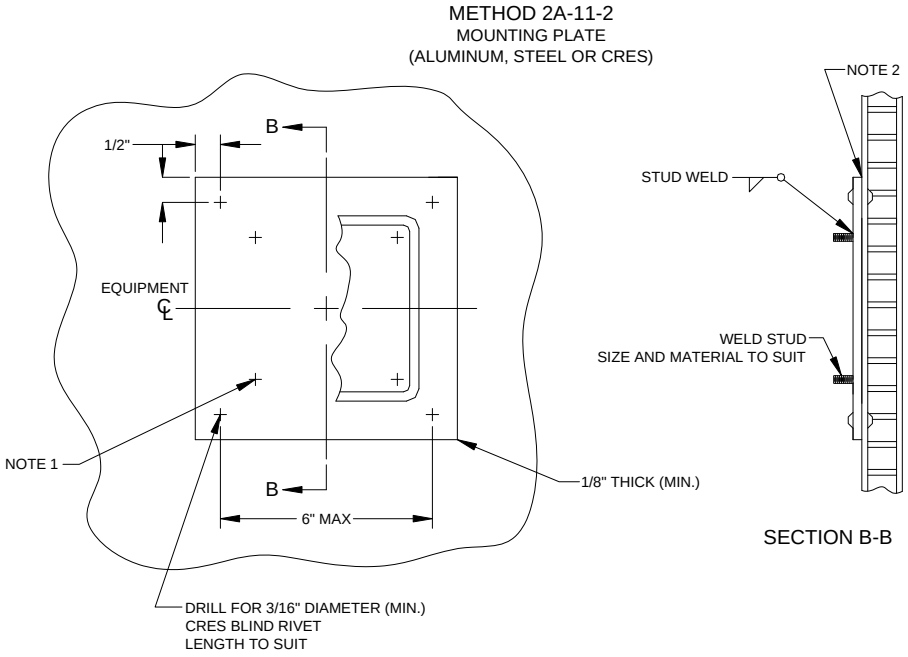
FIGURE 2A10. Equipment mounted on aluminum or steel pilaster bulkheads.

NOTES:

1. Plate support is not required except when equipment to be mounted is greater than 6" by 9" or weighs 15 pounds or more.
2. Steel plate supports shall be used when attaching brass equipment.
3. Aluminum plate supports may be used when attaching aluminum or steel equipment.
4. Apply two coats of primer in accordance with MIL-PRF-23236 or MIL-DTL-24441/20, F150 between faying surface of bulkhead and plate support.
5. CRES washers shall be used as spacers when stud pad and equipment are of dissimilar metal.

FIGURE 2A10. Equipment mounted on aluminum or steel pilaster bulkheads - Continued.



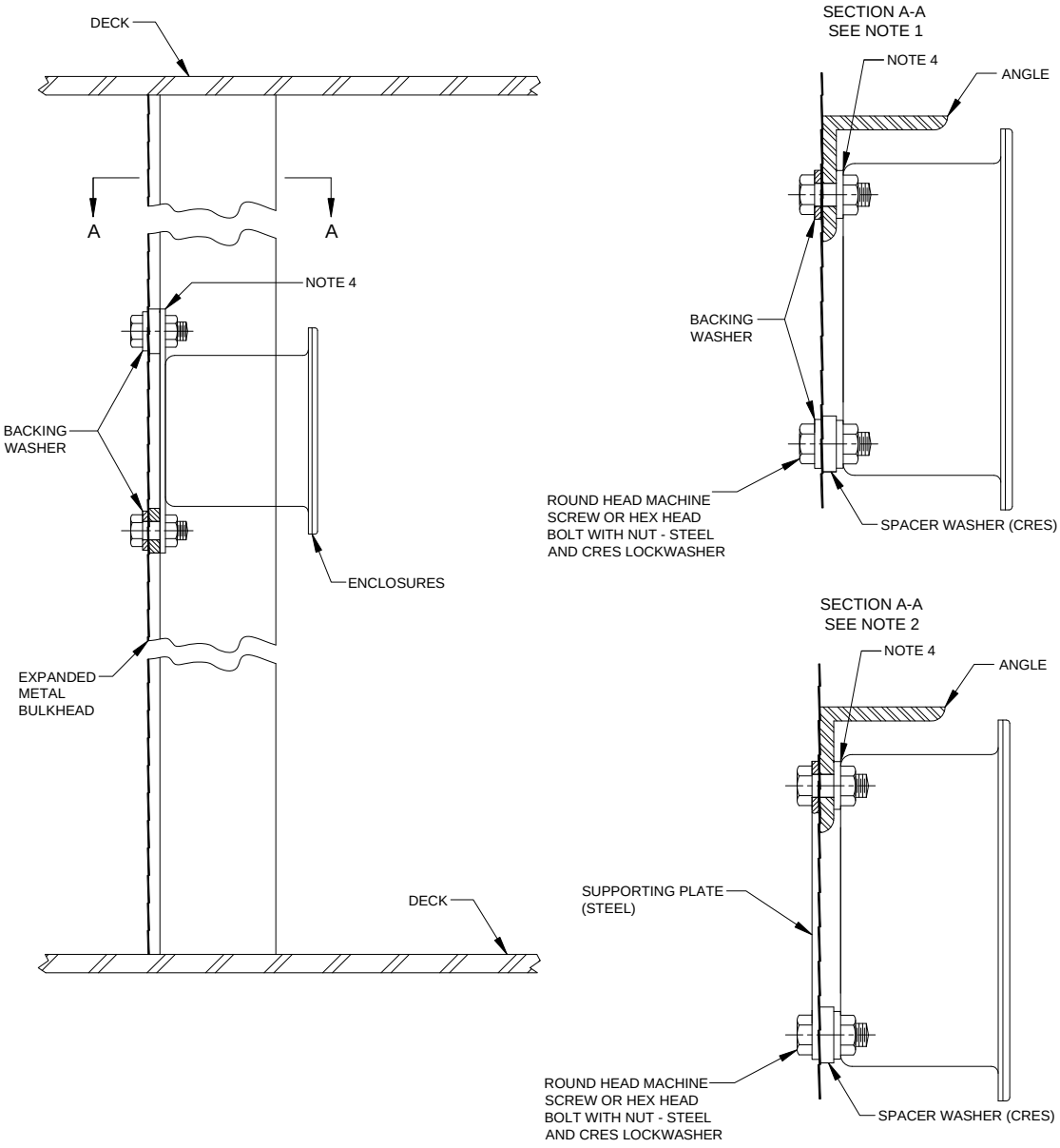


NOTES:

1. Location of mounting holes to be templated from unit being installed.
2. All faying surfaces of aluminum to dissimilar metal to be protected with one layer of scotch wrapped no. 22 tape, Minnesota Mining and Mfg. Co. or equal.

FIGURE 2A11. Equipment mounted on metal joiner bulkheads.

METHOD 2A-12-1
EQUIPMENT SECURED TO EXPANDED METAL OR
WIRE MESH BULKHEADS USING ANGLE SUPPORTS



NOTES:

1. Method shown is for components up to 10 pounds.
2. Method for appliances over 10 pounds and up to 30 pounds use backing plates extended to angle support for mesh. Backing plates to be ⅛" steel.
3. No appliances are to be mounted on portable sections of expanded metal bulkheads except small fixtures which may easily be moved and which must be attached thereto for efficient operation.
4. CRES washers shall be used as a spacer when enclosure material is aluminum and angles are steel.

FIGURE 2A12. Equipment mounted on expanded metal or wire mesh bulkheads.

METHOD 2A-13-1
EQUIPMENT SECURED TO EXPANDED
METAL OR WIRE MESH BULKHEADS

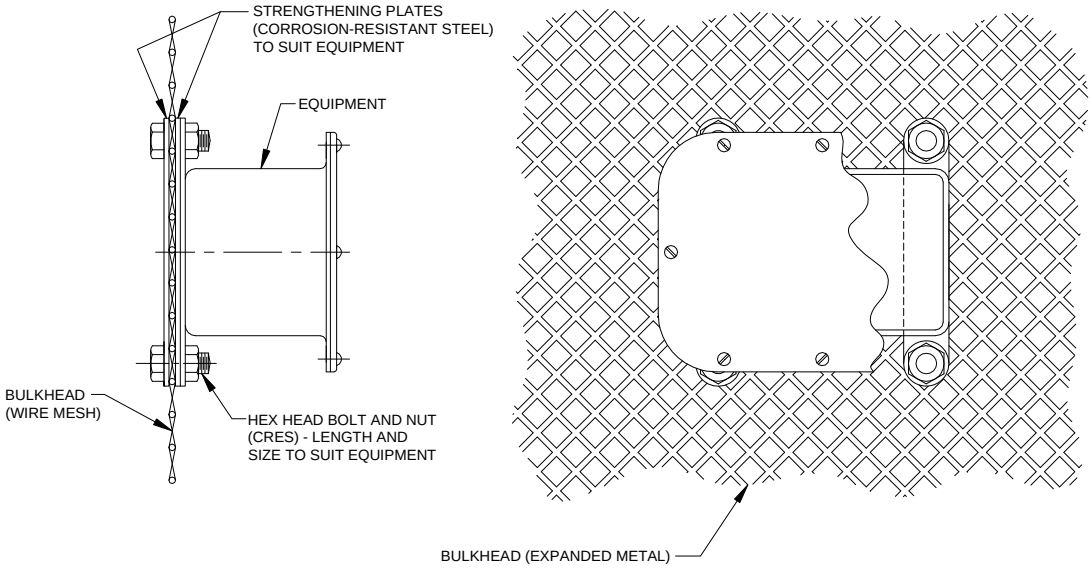
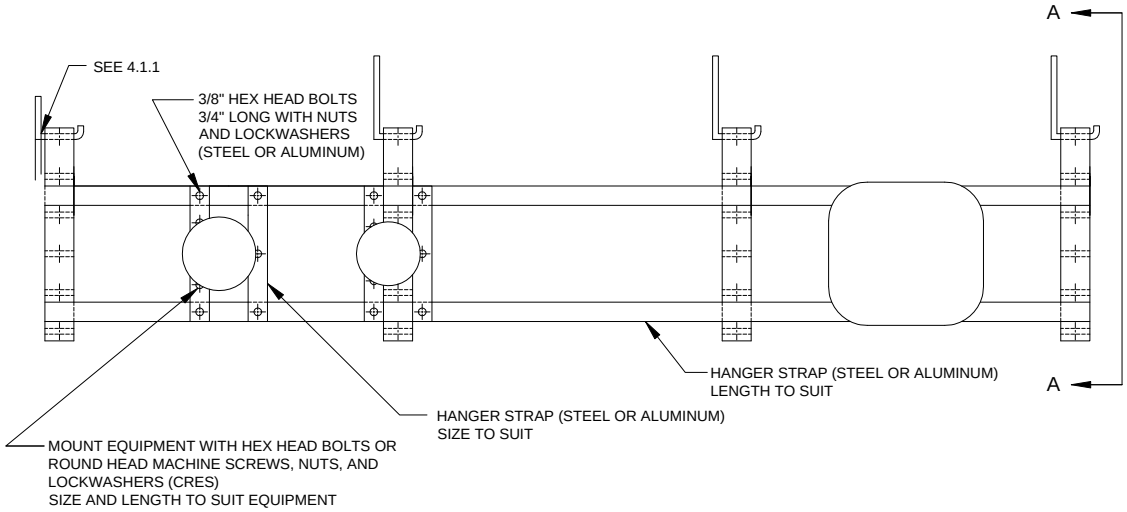
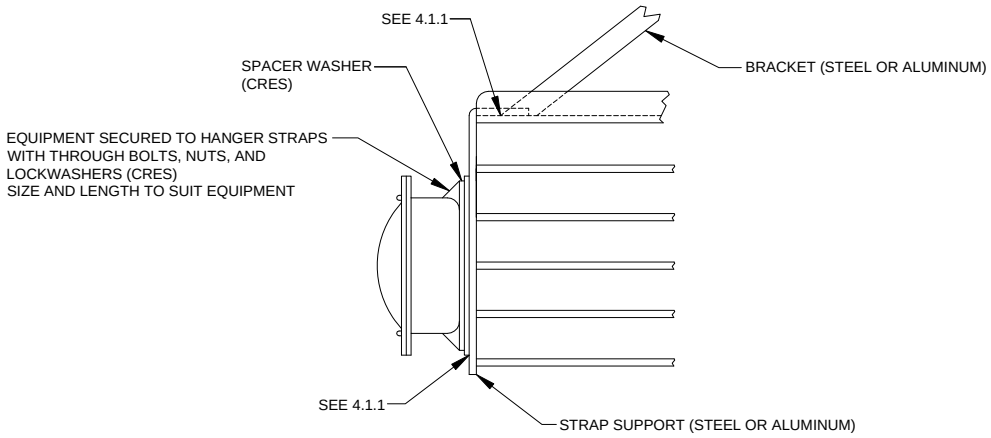


FIGURE 2A13. Equipment mounted on expanded metal or wire mesh bulkhead.

METHOD 2A-14-1
EQUIPMENT MOUNTED ON CABLE RACKS
APPLICABLE TO BULKHEAD RUNS IN MAIN CABLEWAYS, IN
MACHINERY SPACES, AND PASSAGES



ELEVATION
SECTION "A-A"



NOTES:

1. The weight of any particular piece or group of electrical equipment secured to cable rack will be limited to 25 pounds maximum on steel and 10 pounds maximum on aluminum racks.
2. Location of equipment to be so arranged that it will not interfere with inspection and painting.
3. This method is intended for use in isolated cases only.

FIGURE 2A14. Equipment mounted on cabling racks.

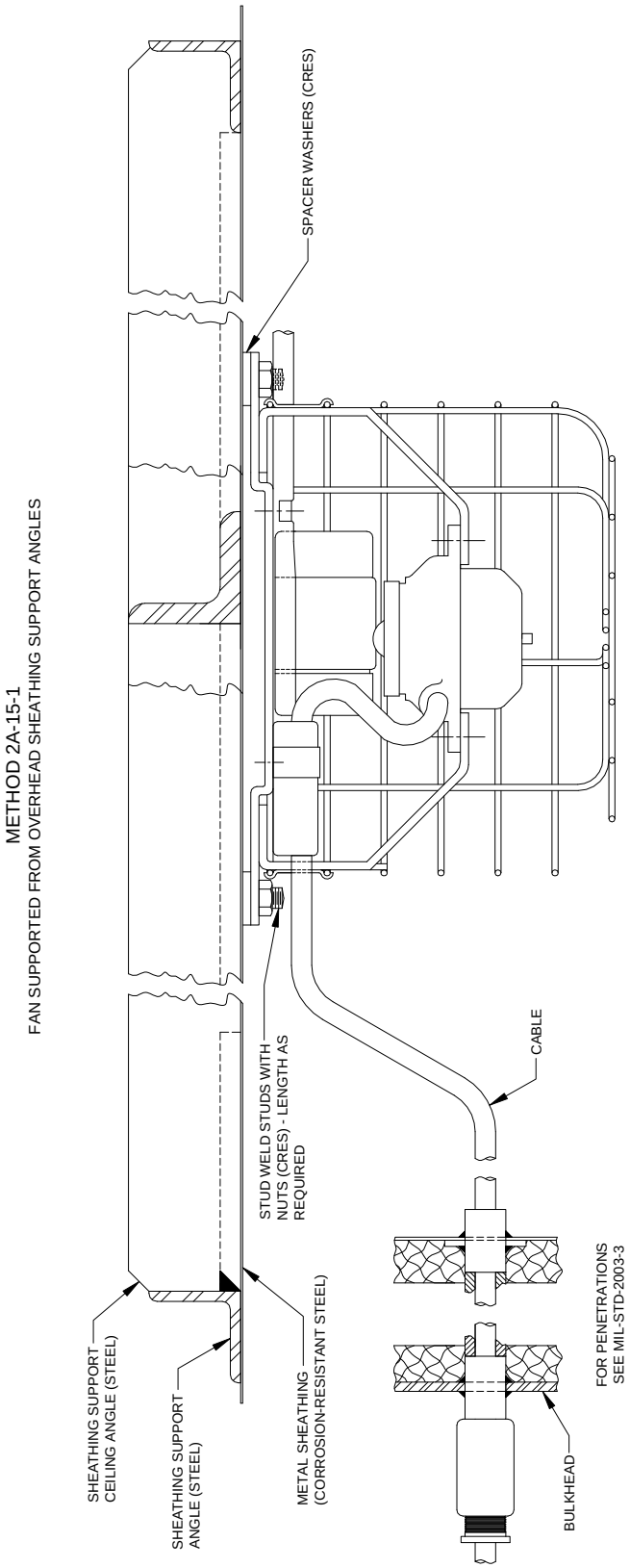


FIGURE 2A15. Ceiling fan support in refrigerated spaces.

METHOD 2A-16-1
EQUIPMENT SECURED TO SHEATHING SUPPORTS

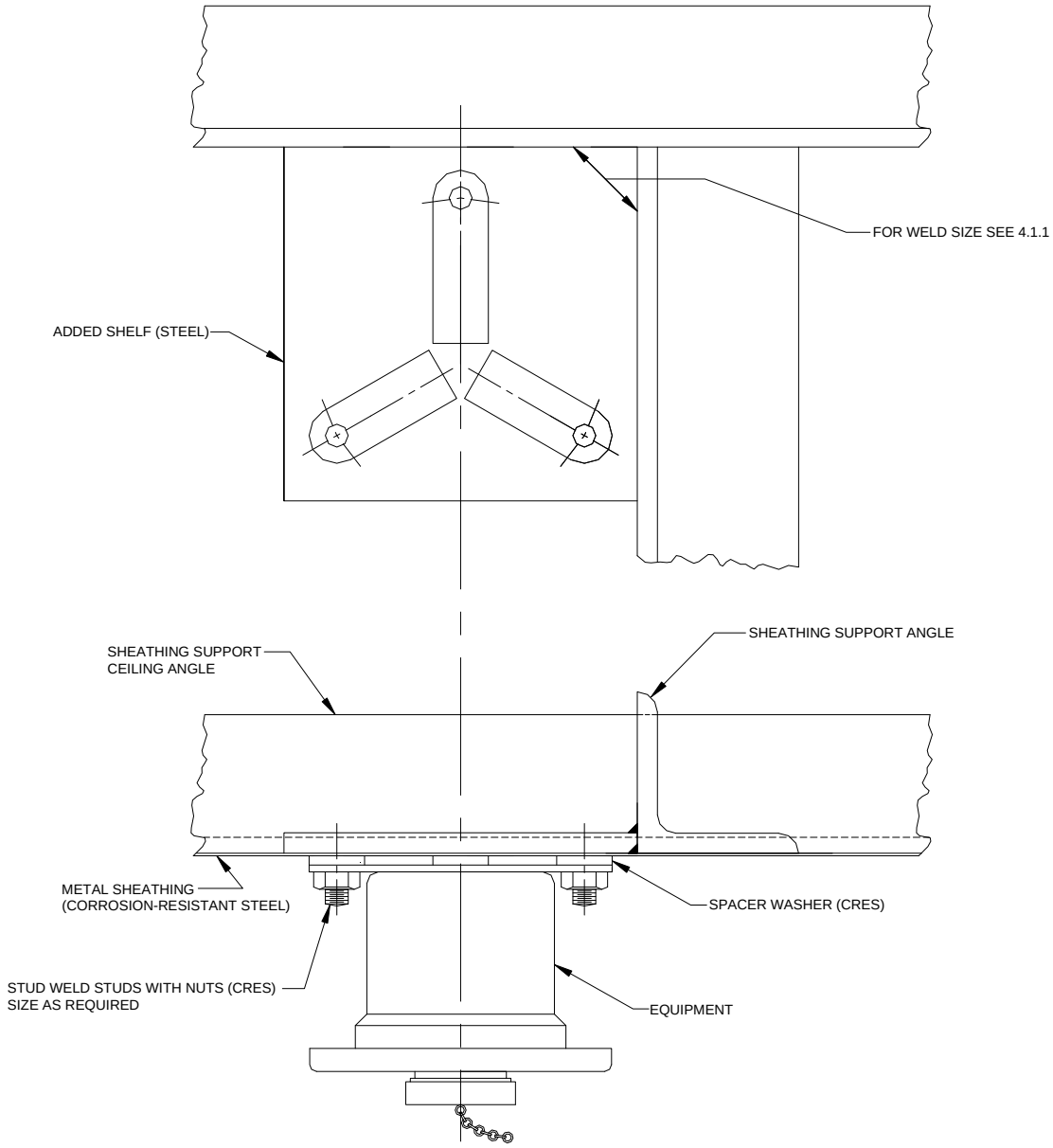


FIGURE 2A16. Equipment mounted in refrigerated spaces.

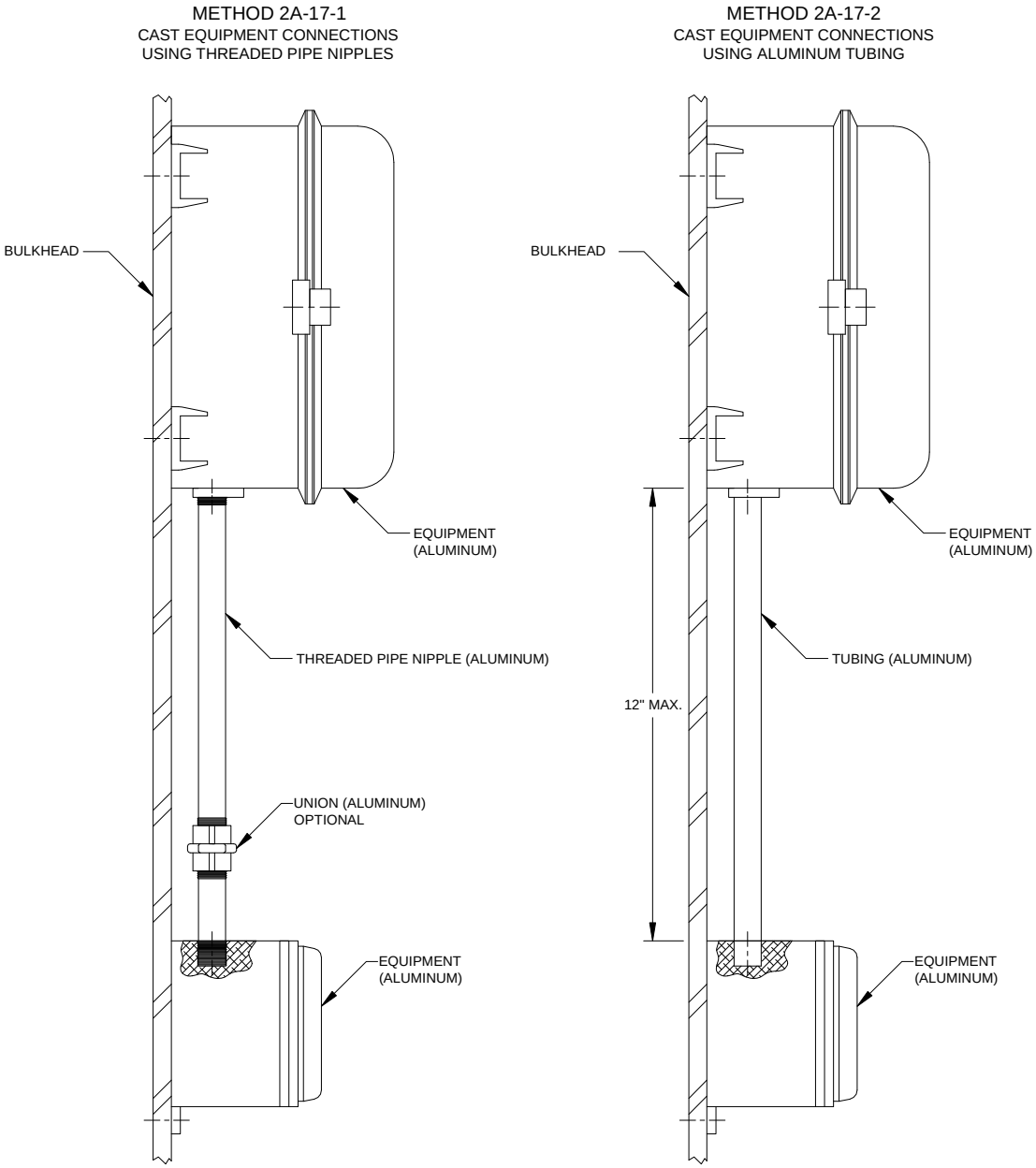


FIGURE 2A17. Connecting adjacent cast aluminum equipment with pipe nipples.

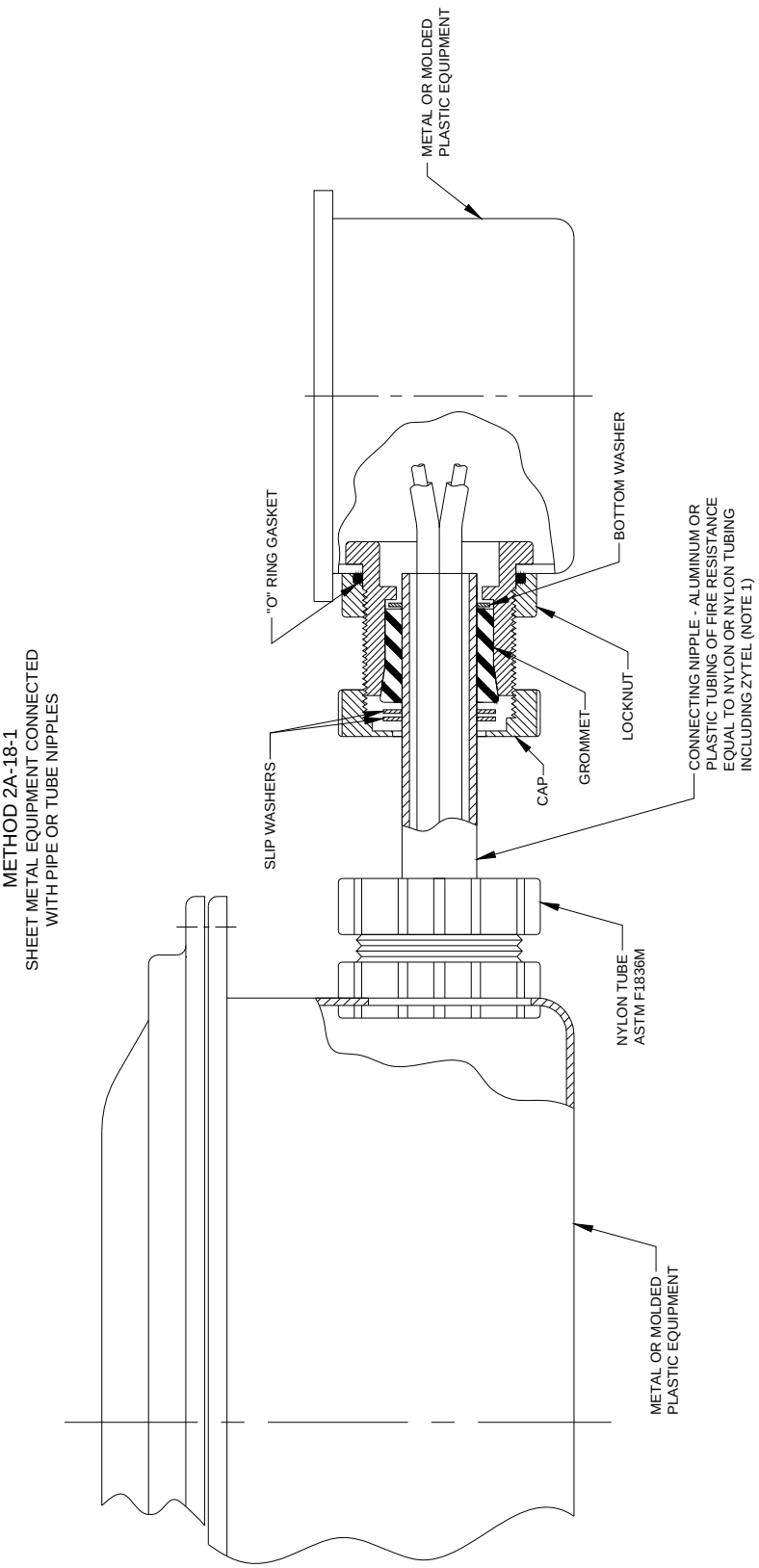


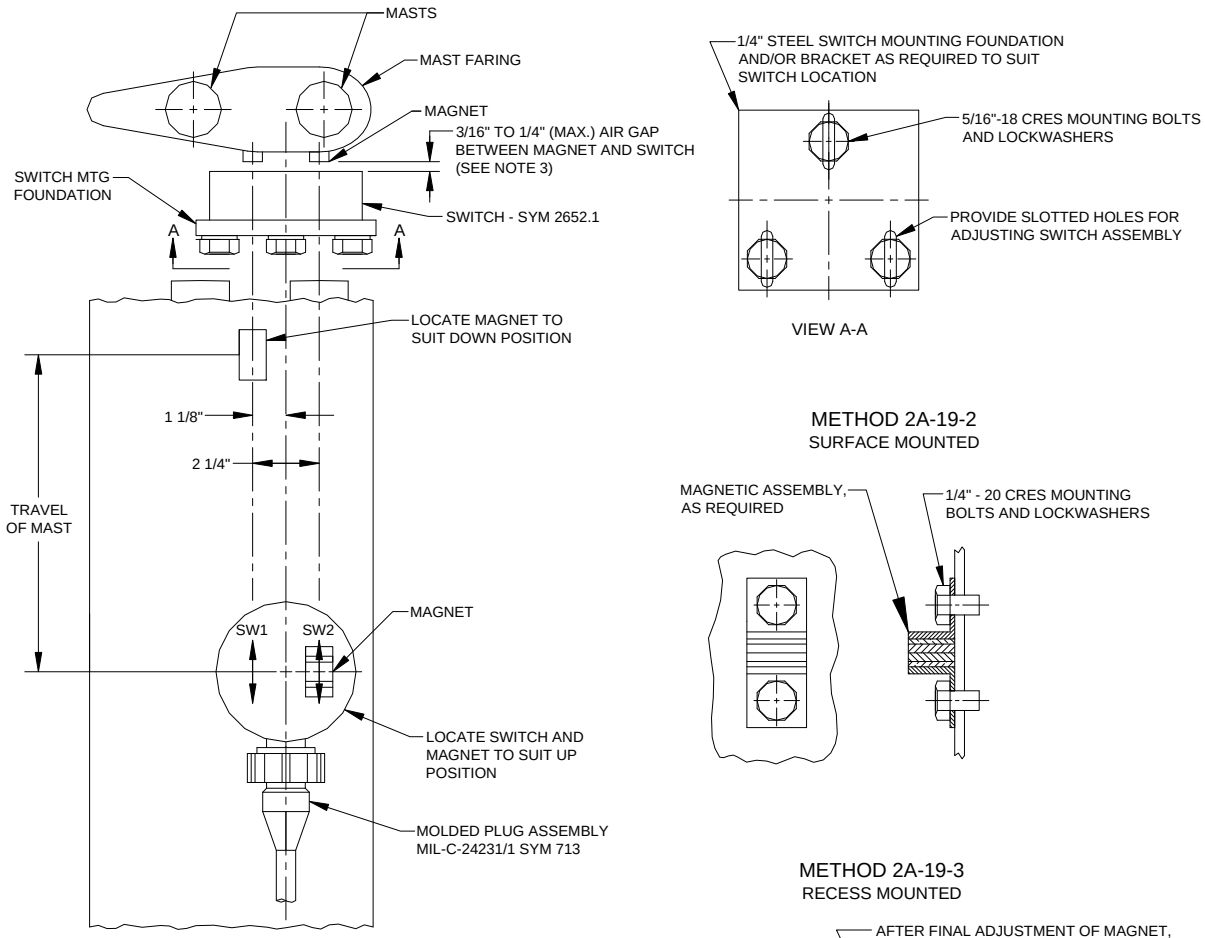
FIGURE 2A18. Connecting adjacent equipment with pipe nipples.

NOTE:

1. Plastic and composite equipment enclosures shall be connected with plastic or composite tubing only.

FIGURE 2A18. Connecting adjacent equipment with pipe nipples - Continued.

METHOD 2A-19-1



NOTES:

1. Typical methods shown here are for information and guidance to installing activities for mounting indicator switches and associated magnets.
2. Switches and magnets shall be mounted in such a manner as to facilitate their adjustment in the direction of mast travel.

FIGURE 2A19. Mast position indicator switches for submarines.

NOTES (continued):

3. If magnets other than those furnished with switch assembly are required, the following precautions shall be taken:
   a. Air gap between switch and magnet must be set to ensure that the coercive force of the magnet is sufficient to operate the switch at an ambient of -40 °F (-40 °C).
   b. The coercive force must be limited to operate only the switch for which it is intended.
4. All welding shall be in accordance with approved methods.
5. Magnet assemblies other than those furnished with switch shall have a thin coating of epoxy resin compound PR-610-TCF (chockfast orange) of ITW Philadelphia Resins Corp. or equal.

FIGURE 2A19. Mast position indicator switches for submarines.

Locking devices

Method 2A-20-1
A – Electrical connections

1. Motors and generators
   a. Use lock nuts, lock washers, or other means to lock connections which tend to become loose because of vibration (see Method 1B-10-1). Refer to Naval Ships' Technical Manual S9086-KC-STM-010, Chapter 300.
2. Control and instrument circuits
   a. Unless otherwise specified in the individual equipment specification, locking devices shall be provided on the following basis for electrical connections in all equipment: all nuts, bolts, studs, and screws used for electrical connections shall be secured by means of a locking device in accordance with acceptable locking devices such as nut and locknut, self-locking nut, external tooth lock washers, internal tooth lock washers except that a locking device need not be provided where lug terminals are used for conductors below 4000 circular mils (CM) (14AWG). Terminal boards shall be in accordance with A-A-59125, except that lock washers are not required under terminal nuts. Refer to MIL-E-917.
3. Propulsion control cubicle (other than bus bar joints)
   a. Locking devices shall be provided on the following basis for electrical assemblies in all switchgear units and in all equipment unless otherwise specified in the individual equipment specifications. All nuts, bolts, studs, and screws used for electrical connections shall be secured by means of an acceptable locking device except that a locking device need not be provided where solderless type connectors are used for conductors below 4000 circular mils (CM) (14AWG). Terminal boards shall be in accordance with A-A-59125 or equivalent, except that lock washers are not required under terminal nuts. Refer to MIL-E-917 and MIL-DTL-16036.
4. Bus bar joints (main and auxiliary power)
   a. In securing bus joints, bolts shall be fitted with a securing nut and a lock nut, or may be fitted with nuts of special design which have been specifically approved by NAVSEA. Flat washers shall be used under all bolt heads and nuts adjacent to the conductor.
   b. Intercell connectors in battery compartments shall be secured with stainless steel bolts, flat washers, and nuts conforming to ASTM A276, Type 316. Refer to MIL-PRF-32273, MIL-PRF-32273/1, and MIL-PRF-32273/2.
5. Interior communication (I.C.) and fire control (F.C.) equipment
   a. Lock washers shall be employed with bolts or machine screws and nuts in all cables used to secure electrical connections. Refer to MIL-HDBK-2036.
6. Switchboards and control equipment
   a. Use locking devices such as check nuts or lock washers where necessary to keep connections tight. Refer to S9086-KC-STM-010, NSTM Chapter 300.

FIGURE 2A20. Locking devices on electrical connections and installations on submarines.

Locking devices

Method 2A-20-2
B – Electrical installations

1. In general, locking devices should be employed under the following conditions:
   a. For mounting rotating equipment and/or mounting equipment in steering gear compartments.
   b. For securing electrical equipment in the battery compartment and in and about the propulsion controls. Refer to S9086-KC-STM-010, NSTM Chapter 300.
2. Parts subject to vibration
   a. Nuts used on moving parts or subject to vibration during operation shall be secured by star washers, cotter pins, or other approved form of locking device.
   b. Equipment attached directly to hull foundations, and which is subject to severe self-generated vibration, shall be attached with through bolts and self-locking nuts or castellated nuts and cotter pins or wire.
3. Interior parts of machinery
   a. Nuts or bolts used on interior parts of machinery must be wired, cottered, or otherwise locked.
4. Switchboard and control equipment
   a. Use locking devices such as lock nuts and lock washers to keep mechanical connections tight. Refer to S9086-KC-STM-010, NSTM Chapter 300.
   b. Equipment mounted in the battery compartment above the levels of the lowest cell tops shall be attached with through bolts and self-locking nuts of castellated nuts with cotter pins or wire.
5. Enclosures (fitting and fixtures)
   a. Locking devices are not required for mounting non-rotating electrical equipment unless subject to excessive vibration (see 2.a above).
6. Open equipment (exposed wiring, bus bars, switches, etc.)
   a. Nuts, bolts, and screws used for structural purposes above exposed electrical equipment shall be secured with acceptable locking devices where holding nut, screw, bolt, or component part could fall into the equipment. Refer to MIL-DTL-16036.

NOTES:

1. This figure is for guidance only and does not take precedence over any specification mentioned herein nor any individual equipment specification.
2. Referenced documents contained herein are those in effect on issue date of this standard. Amendments and/or revisions to referenced documents bearing a later date than the issue date of this standard take precedence.
3. Self-locking nuts of the elastic stop nut type, with nylon (or equivalent) insert locking rings shall not be used at temperatures in excess of 250 °F (121.1 °C).
4. For #10 screws and below, use of tooth lock washers in lieu of split type lock washers is preferred.
5. Internal tooth lock washers shall not be used for new construction.

FIGURE 2A20. Locking devices on electrical connections and installations on submarines - Continued.

TABLE 2A20-I. Locking devices on electrical connections and installations on submarines.

Application	Paragraph number	Locking device required (numbers indicate order of preference)				Remarks
		Jam or lock nut	Tooth lock washer	Split ring lock washer	Approved self-locking nut 1/	
Main motor & generator						
Mounting	B-1-A, B-3-A, B-6-A				1	
Terminal	A-1-A	3 3/		2	1	
Auxiliary motor & generator						This includes all MG sets and all AC and DC motors used in aux power ckts
Mounting	B-1-A, B-3-A, B-6-A	3 3/			1	
Terminal	A-1-A		2 3/	4	1	
Distribution switchboards						Approved self-locking nut preferred for bus bar joints, tooth lock washers preferred for terminal studs
Mounting	B-2-A, B-2-B, B-6-A				1	
Mech connection	B-4-A				3	
Elec connection	A-6-A	3 3/	2 3/, 4/	4	1	
A.C. switchboards						Approved self-locking nut preferred for bus bar joints, tooth lock washers preferred for terminal studs
Mounting	B-2-A, B-2-B, B-6-A				1	
Mech connection	B-4-A				3	
Electrical connectino	A-6-A	3 3/	2 3/, 4/	4	1	
Prop cont cubicle						
Mounting	B-1-B, B-6-A				1	
Electrical connection	A-1-A	3 2/	2 3/, 4/	4	1	
Control panel						Locking devices not generally used for cont pnl mtg except for condition B-2-A & B-2-B. This includes small motor controllers.
Mounting	B-2-A, B-2-B, B-6-A				1	
Wiring	A-2-A	2 3/	1 3/, 4/	4	3	
Bus bar joints	A-4-A			2	1	
I.C. & F.C. equipment						
Installation	B-4-A, B-5-A			3	4	
Wiring	B-5-A	2 2/, 3/	1 3/, 4/	3	4	
General wiring connections	B-2-A	2 2/, 3/	1 3/, 4/	3	4	
Bus bar joints in battery tanks	A-4-A			2	1	
Battery cell connectors	A-4-B					None required

NOTES:

1/ Elastic stop nuts are generally procured for this application.

2/ This includes the wiring of connection boxes, distribution boxes, rotary snap switches, push-button switches, receptacles, terminal connection of fractional HP motors, LTG fixtures, etc.

3/ Where spring lock-washers and tooth lock-washers are used on electrical connections, they shall be employed in connection with flat washers for bolts and screws larger than ¼ diameter.

4/ Tooth lock-washers shall be used under the bearing surface of screw heads or nuts whichever (if both, place under nut) comes in contact with plastic material.

FIGURE 2A20. Locking devices on electrical connections and installations on submarines - Continued.

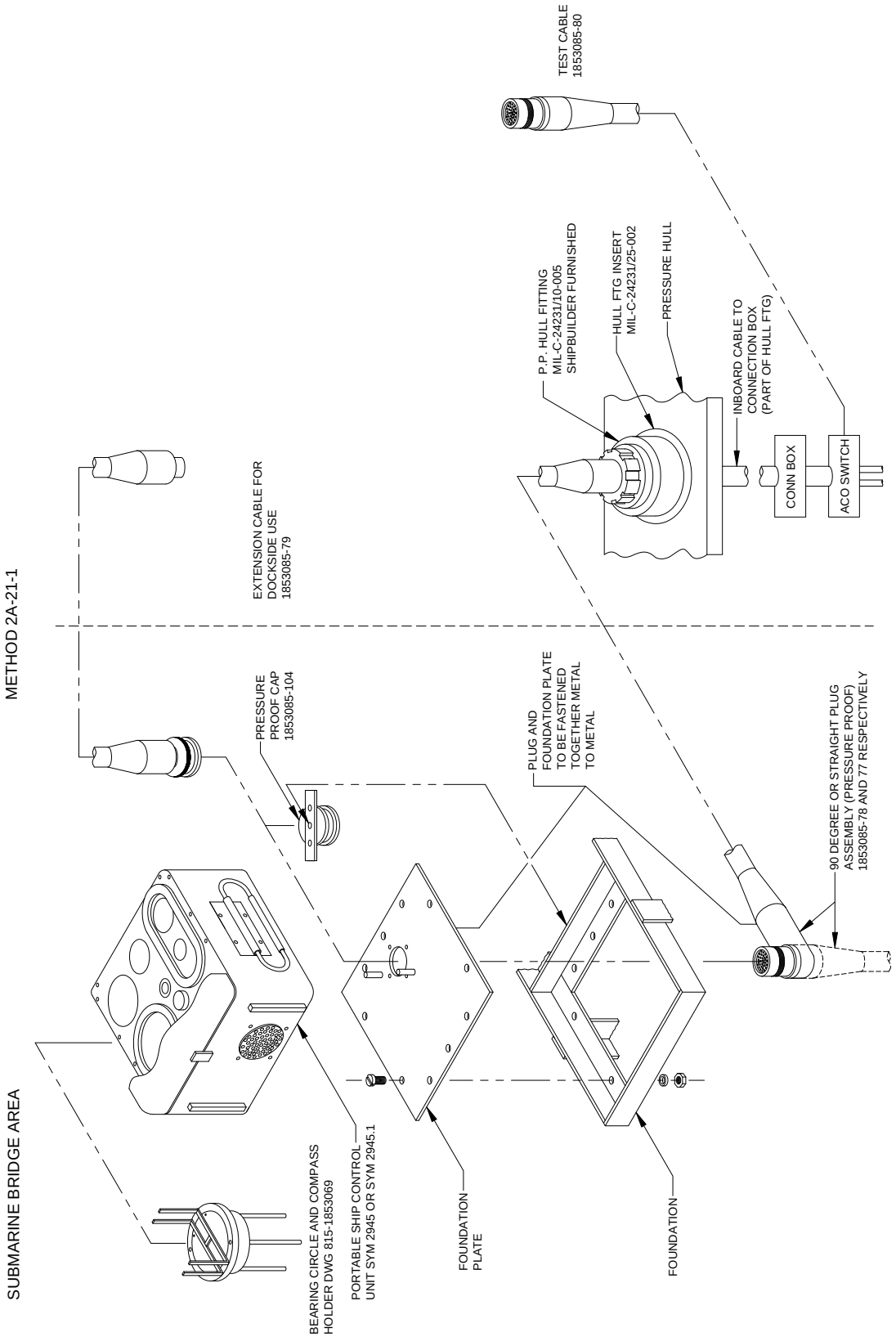
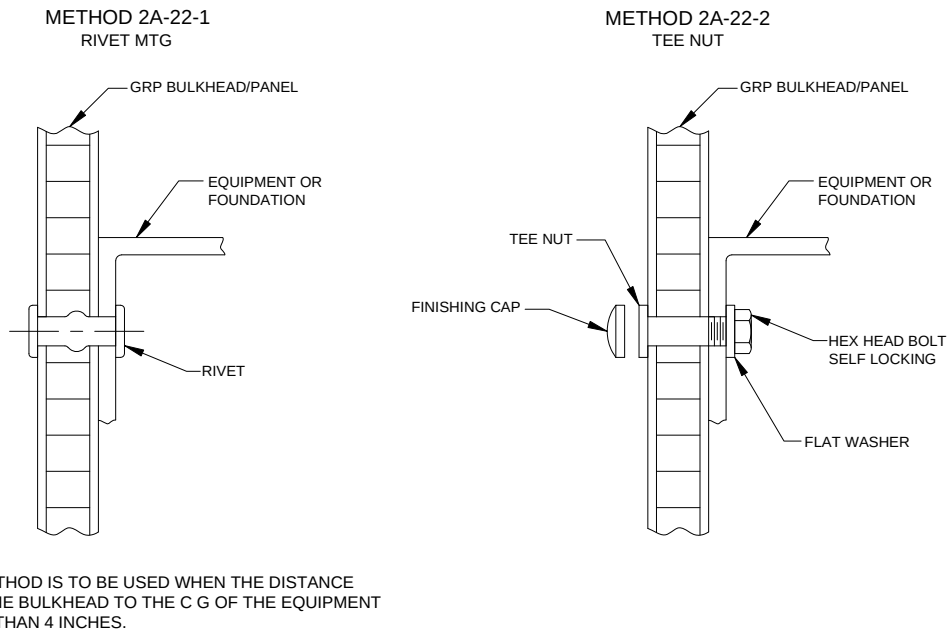


FIGURE 2A21. Portable ship control unit submarine bridge type.

TABLE 2A21-I. Portable ship control unit submarine bridge type and NSN.

Name	Sym	PC no.	NSN
Cont unit	2945		
Cable assy	2945.1		
	2945.2	77	
		78	1H6150-00-590-0863
	2945.4	79	1H6150-00-590-3453
	2945.5	80	1H6150-00-590-3454

FIGURE 2A21. Portable ship control unit submarine bridge type - Continued.



THIS METHOD IS TO BE USED WHEN THE DISTANCE FROM THE BULKHEAD TO THE C G OF THE EQUIPMENT IS LESS THAN 4 INCHES.

NOTES:

1. Location of mounting holes to be templated from unit being installed.
2. Small holes can be drilled into GRP panels with a sharp, twist-type drill bit. Prick punch to center drill bit. Larger holes can be drilled with a hole cutter. When drilling holes for "blind fasteners", a drill stop should be utilized to prevent drilling through the entire panel. When using a hole cutter, first drill through one face sheet, and from the opposite side of the panel, use the pilot hole from the first cut to drill the second face sheet. This method will help avoid panel delamination and high pressure plastic laminate (HPPL) chipping.
3. When cutting and drilling GRP panels, care must be taken to provide adequate ventilation and dust collection. Eye and ear protection and the use of a dust mask is recommended. Caution: if any signs of allergic reaction appear when working with GRP panels, work should stop immediately.
4. Some chipping and cracking of the HPPL may occur when cutting or drilling GRP panels. This degradation of the panel, while unavoidable, must be kept to a minimum so as not to degrade the holding capacity of fasteners or take away from the finished appearance of the panel. In many cases, keeping the drill bits and blades sharp, and using masking tape over the area to be cut or drilled, will keep degradation of the panel at a minimum. If chips and cracks propagate out beyond where the mounting hardware ends, the damage will be noticeable and will require cosmetic repair. In some cases, through-type fasteners may dimple the panel. This condition is acceptable as long as there is no cracking of the panel face.
5. GRP panels are easily scratched, punctured, and scorched by hot work. Care should be taken when working on or close to these panels.
6. For weight limitation of equipment installed on GRP panels, see figure 2A24.

FIGURE 2A22. Electrical equipment mounting to GRP bulkheads/panels.

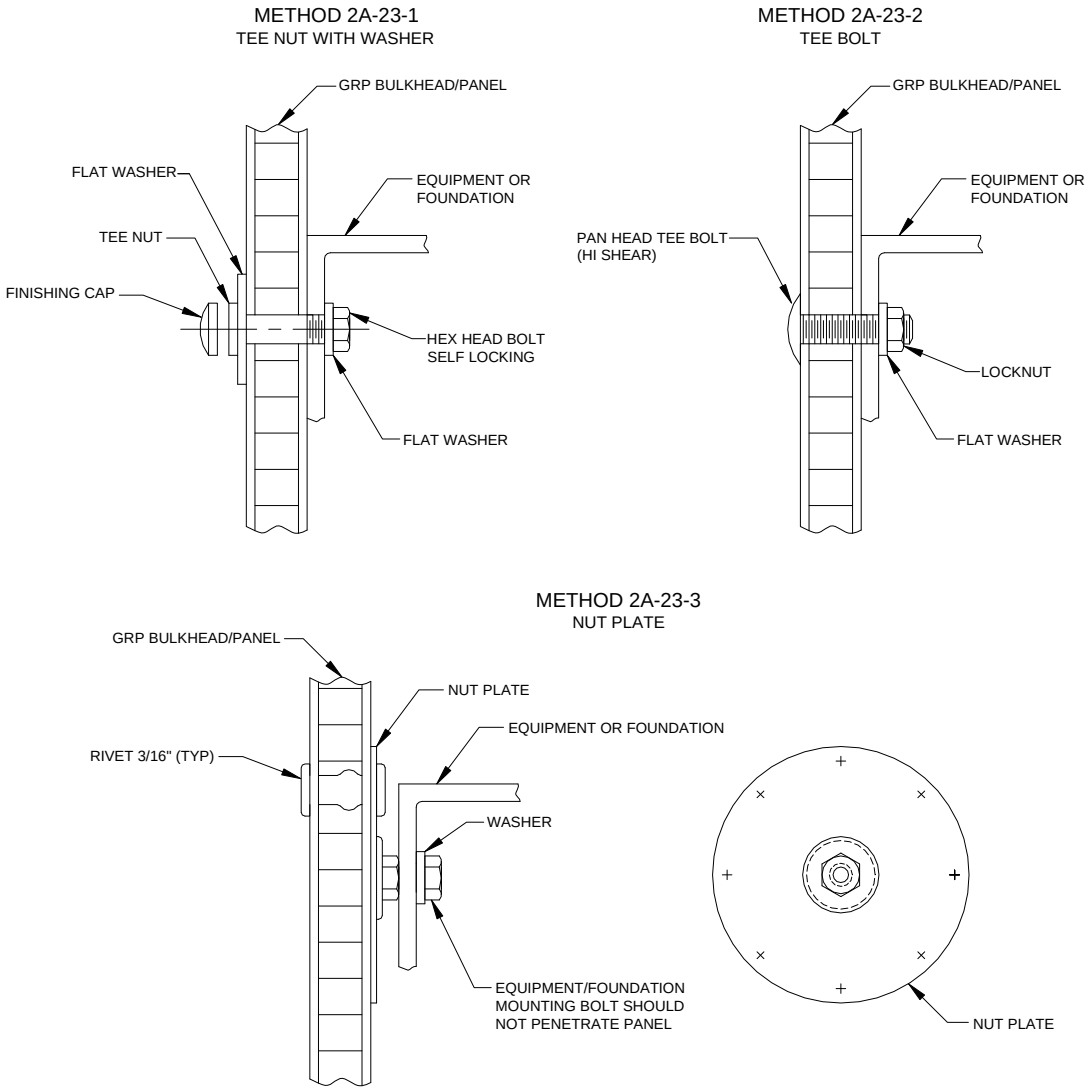
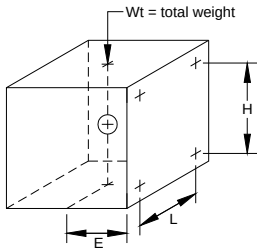


FIGURE 2A23. Electrical equipment mounting to GRP bulkheads/panels.

Fastener selection (size) for installation of electrical equipment/foundations to GRP bulkheads/panels

Procedure for selecting fastener size and type:

1. Establish correct E, H, L, and Wp per pair of bolts:
   E = Horizontal distance (inches) from BHD to equipment CG (taken from vendors drawings)
   H = Vertical distance (inches) between the pair of bolts
   Wp = Weight (pounds) of equipment acting through each pair of bolts (Wt ÷ number of bolt pairs)
   L = Horizontal distance between the extreme pair of fasteners



2. Locate correct “E” and “H” values on the “E” and “H” scales shown in table 2A25-I.
3. Make a straight line connecting these points.
4. Where the line made in step 3 crosses the “K” scale shown in table 2A25-I, make a horizontal line all the way to the right side of the chart.
5. The vertical lines located under each detail represent different ranges of weight that the vertical pair of fasteners can support.
   If the horizontal line made in step 4 crosses these vertical lines at values greater then the Wp found in step 1, the fastener detail can be used. In the event that the Wp required exceeds the Wp available on the chart, a pedestal foundation should be considered.
6. If more than one detail will work, the final choice will depend on such factors as available inventory, size of existing mounting holes on equipment, type of space where the equipment is located, and the required finish on the opposite face of the bulkhead.
7. “L” is a function of the number of pairs as shown:

No. of pairs	“L”
2	0.5H
3	0.75H
4	1.0H

Example

Equipment: Feeder distribution box weight Wt = 20 lbs., Height = 14", Width = 13", Depth = 8"

Mounting data: Four holes – 17/32" dia, 10" (vertical), 9" (horizontal)

1. E = 4 (vendor data), H = 10, Wp = Wt ÷ number of bolt pairs = 20 ÷ 2 = 10 lbs.
2. A straight line connection of E = 4 and H = 10 results in a “K” value of 0.4.
3. A horizontal line drawn from a 0.4 “K” value to the right end of the chart shows that Method 2A-24-1 meets the requirement.

FIGURE 2A24. Electrical equipment mounting to GRP bulkheads/panels.

TABLE 2A24-I. Fastener size and type selection.

	METHOD 2A231 CHERRY -MATE	METHOD 2A232 T-NUT	METHOD 2A241 T-NUT	METHOD 2A242 T-BOLT	METHOD 2A243 NUT PLATE
	1/4	1/4 5/16 3/8 1/2	3/8 1/2 (WITH WASHER)	3/8 1/2	3/16

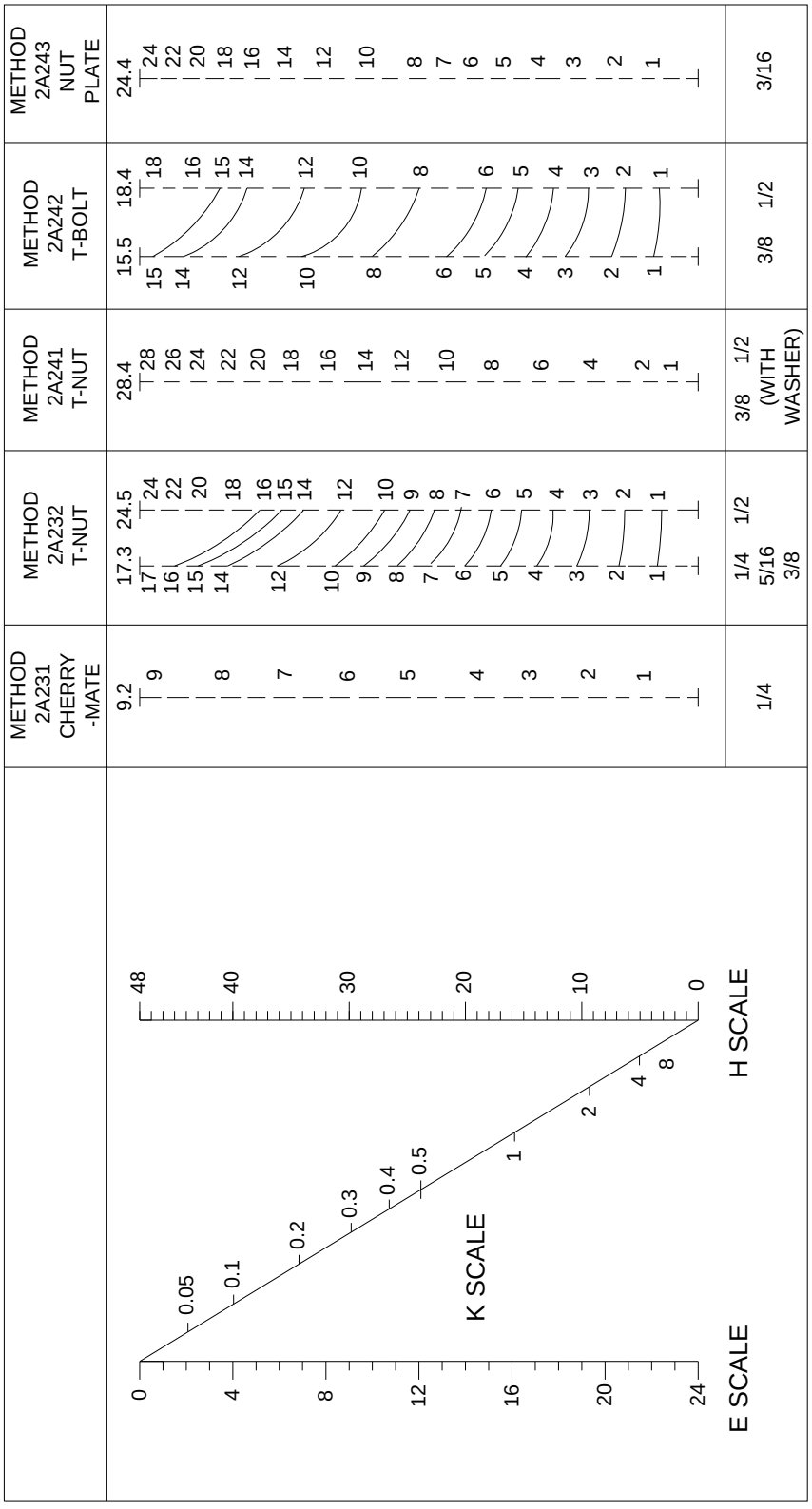


FIGURE 2A24. Electrical equipment mounting to GRP bulkheads/panels - Continued.

GROUP B – SWITCHBOARD MOUNTING

B.1 SCOPE

B.1.1 Scope. This section describes procedures for the proper installation and mounting of switchboards.

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-16036 - Switchgear, Power, Low Voltage, Naval Shipboard

(Copies of this document are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

B.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.

B.3 REQUIRED EQUIPMENT AND MATERIALS

B.3.1 Required equipment and materials. The equipment and materials required for the proper installation and mounting of switchboards are specified in figures 2B1 through 2B6.

B.4 NOTES AND PROCEDURES

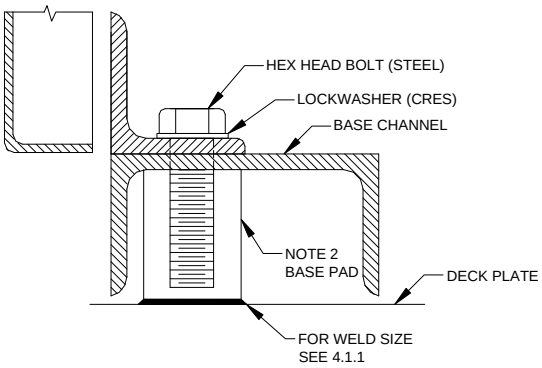
B.4.1 Dimensions. For figures and tables in this section, all dimensions are in inches unless otherwise noted.

B.4.2 Figures. Table 2BI provides information for the figures in this group.

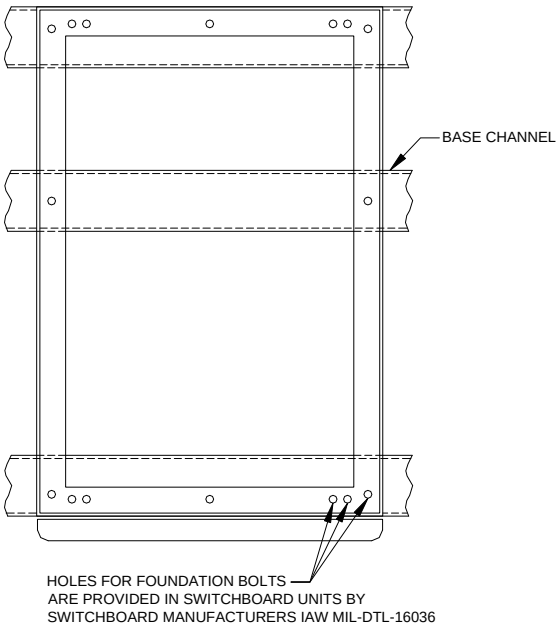
TABLE 2BI. Figures for the installation and mounting of switchboards.

Figure number	Switchboard installation	Page
2B1	Switchboard foundation bolting	49
2B2	Switchboard bracing	50
2B3	Switchboard bracing	51
2B4	Switchboard bracing	52
2B5	Switchboard bracing	53
2B6	Switchboard bracing	55

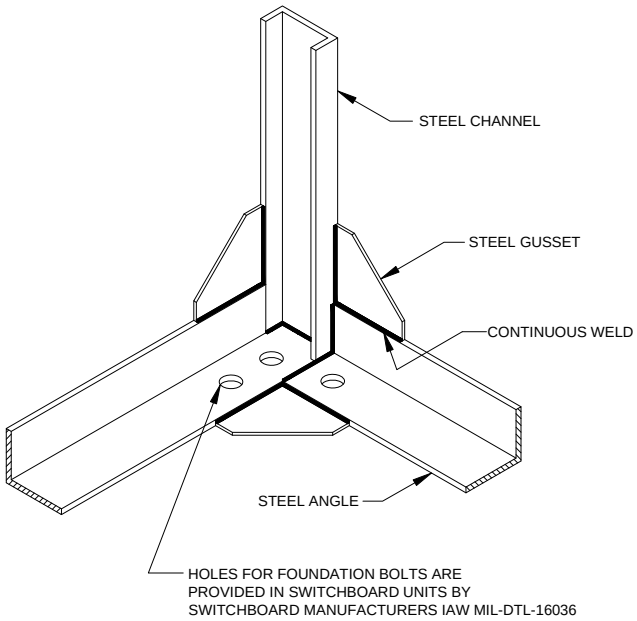
METHOD 2B-1-1
SECTION THROUGH BASE CHANNEL SHOWING BASE PAD
(SEE NOTE 1)



METHOD 2B-1-2
TYPICAL FLOOR PLAN FOR SWITCHBOARD UNIT



METHOD 2B-1-3
BOTTOM CORNER CONSTRUCTION

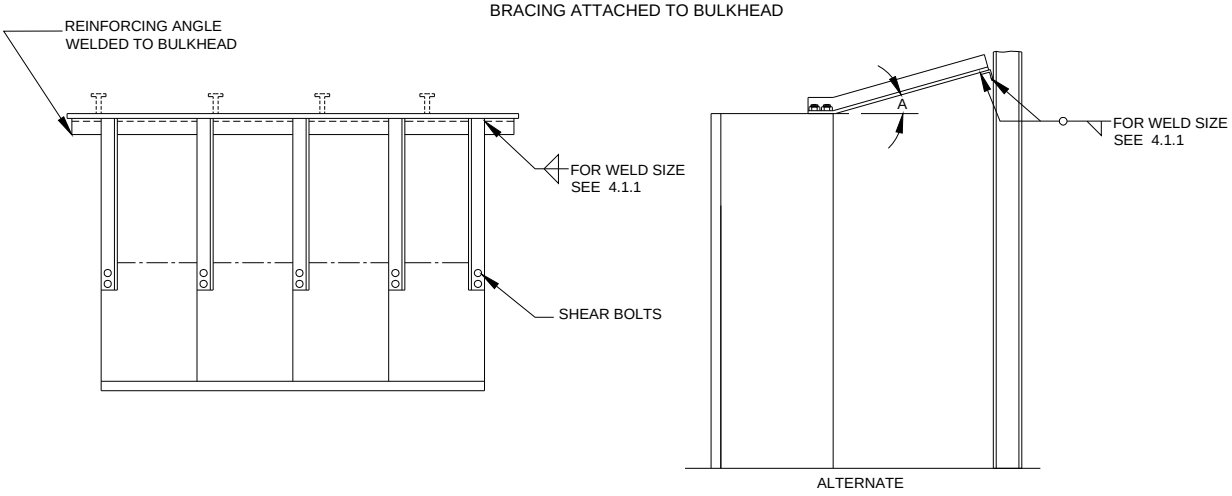


NOTES:

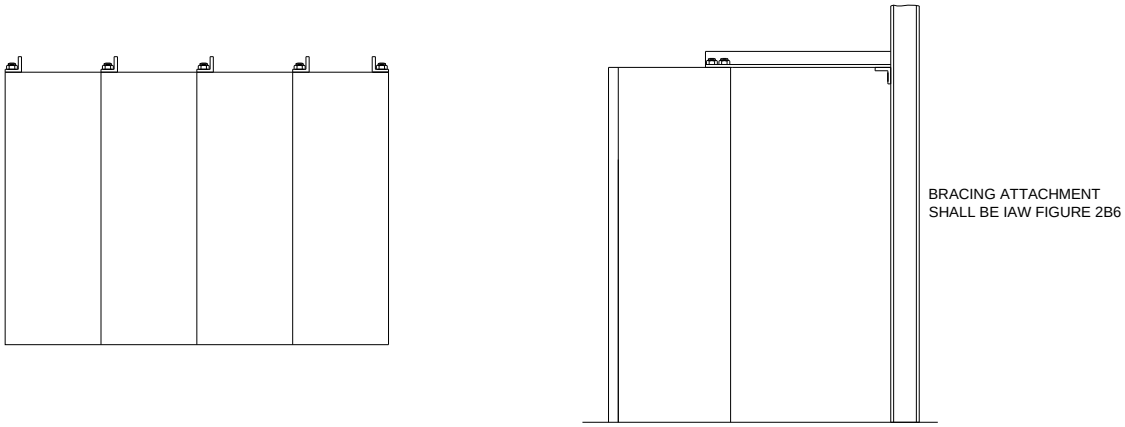
1. Base channel web strengthening pieces located on each side of foundation bolts shall be provided when base pads are not used. Weld webs in place on underside of base channel to form a square with foundation bolt in center.
2. CRES washers shall be used when switchboard framing is aluminum and base pad is steel.
3. Switchboard base channel shall be Class B bonded to foundation base pad in accordance with MIL-STD-1310.

FIGURE 2B1. Switchboard foundation bolting.

METHOD 2B-2-1
TYPICAL METHOD USING SHEAR BOLTS WITH TOP BRACING ATTACHED TO BULKHEAD



METHOD 2B-2-2



NOTE:

1. Dimensions marked “A” must be less than 45 degrees.

FIGURE 2B2. Switchboard bracing.

METHOD 2B-3-1
TYPICAL METHOD USING INITIAL DEFLECTING BRACE

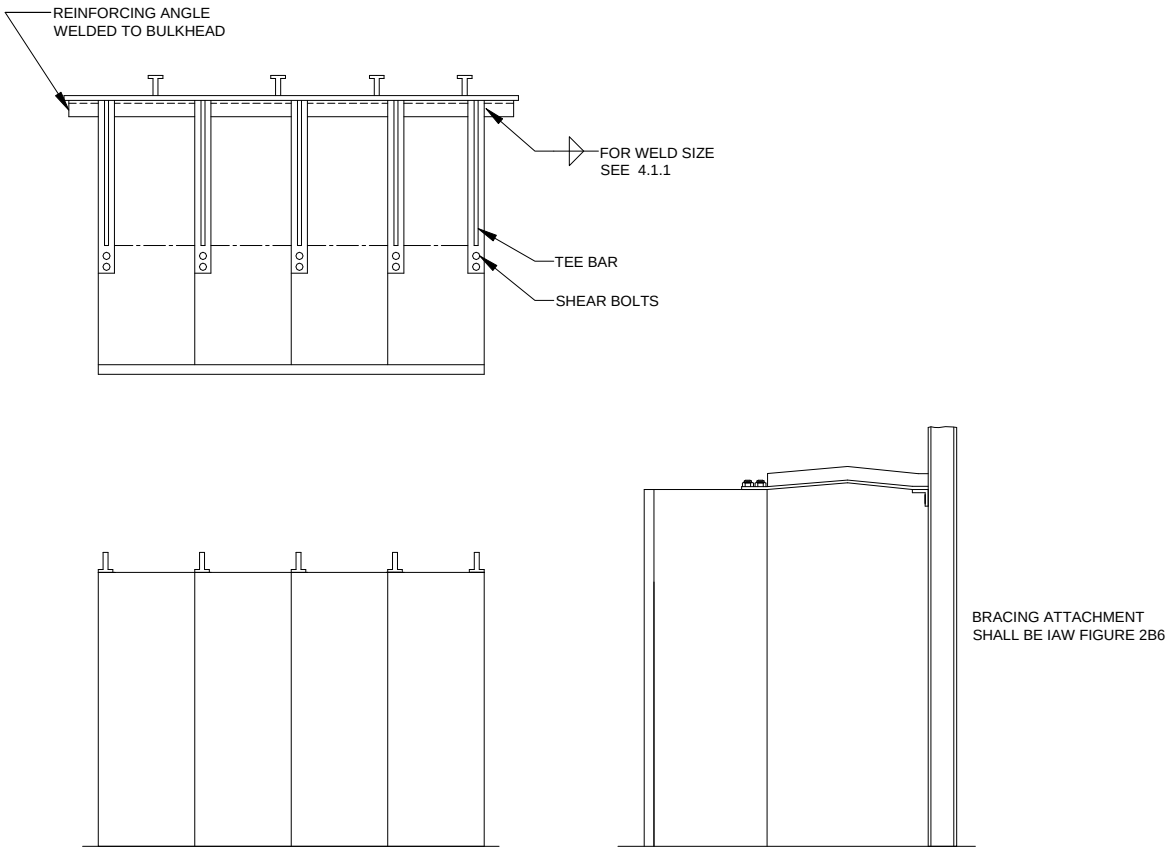
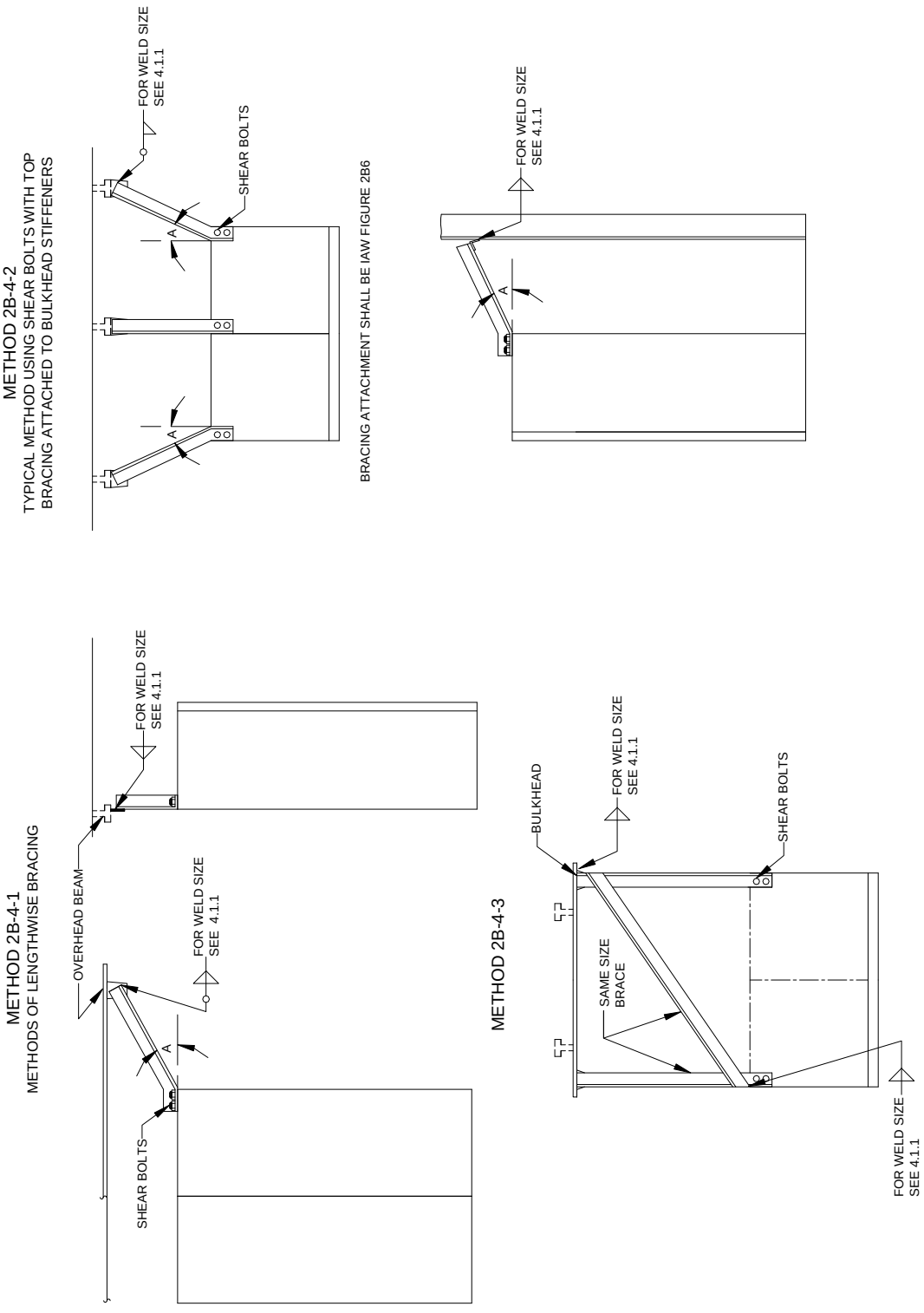


FIGURE 2B3. Switchboard bracing.



NOTES:

1. Where the length of switchboard section is less than the height, lengthwise bracing shall be provided.
2. Dimensions marked “A” must be less than 45 degrees.

FIGURE 2B4. Switchboard bracing.

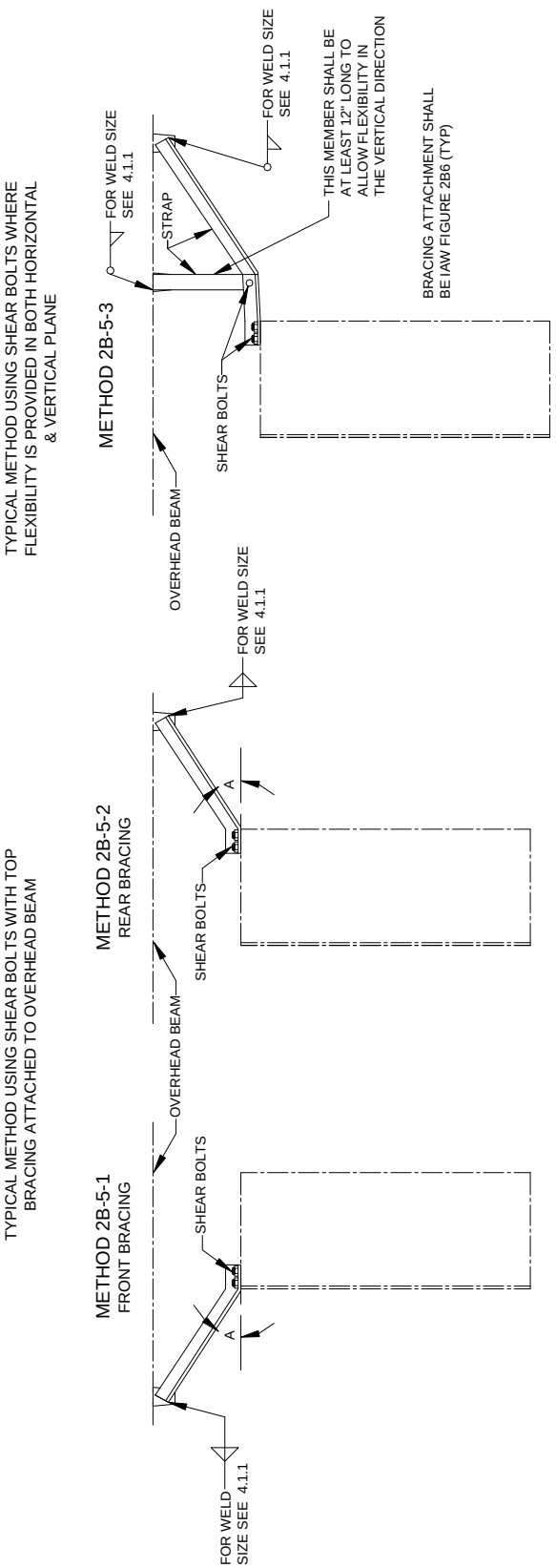


FIGURE 2B5. Switchboard bracing.

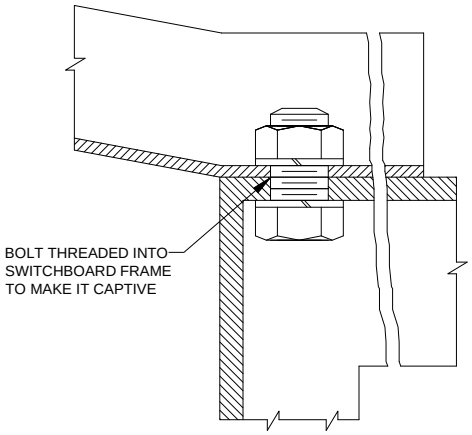
NOTE:

1. Dimensions marked “A” must be less than 45 degrees.

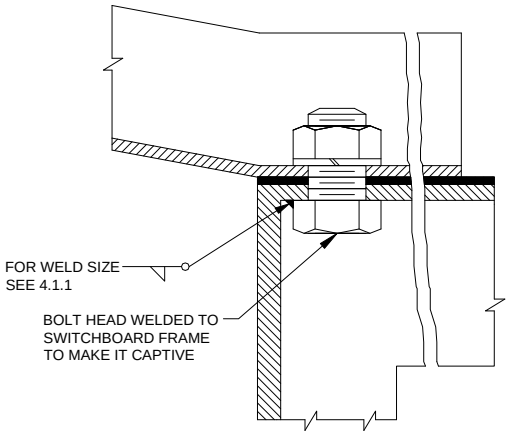
FIGURE 2B5. Switchboard bracing - Continued.

TYPICAL METHODS OF RETAINING SHEAR BOLTS,
NUTS, AND WASHERS

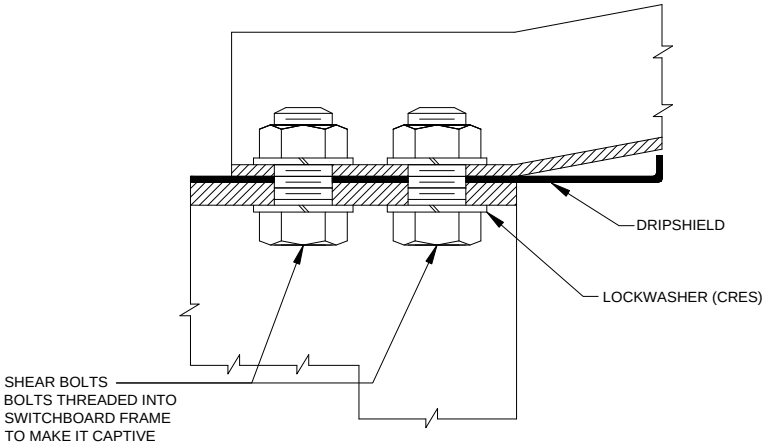
METHOD 2B-6-1



METHOD 2B-6-2



METHOD 2B-6-3
METHOD OF ATTACHING BRACE TO SWITCHBOARD
HAVING DRIPSHIELD



NOTE:

1. Shear bolts, nuts, and washers in switchboard frameworks shall be made captive.

FIGURE 2B6. Switchboard bracing.

GROUP C – BATTERY RACK MOUNTING

C.1 SCOPE

C.1.1 Scope. This section describes procedures for the proper installation and mounting of battery racks.

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.

FEDERAL SPECIFICATIONS

FF-S-92	-	Screw, Machine: Slotted, Cross-Recessed or Hexagon Head
MM-L-736	-	Lumber; Hardwood

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-E-917	-	Electric Power Equipment, Basic Requirements
MIL-W-21157	-	Weldment, Steel, Carbon and Low Alloy (Yield Strength 30,000-60,000 PSI)
MIL-S-22698	-	Steel Plate, Shapes and Bars, Weldable Ordinary Strength and Higher Strength: Structural
MIL-DTL-24441	-	Paint, Epoxy-Polyamide, General Specification for

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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.

ASTM INTERNATIONAL

ASTM A36/A36M	-	Standard Specification for Carbon Structural Steel
ASTM A1008/A1008M	-	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM F1145	-	Standard Specification for Turnbuckles, Swaged, Welded, Forged
ASTM F1267		Standard Specification for Metal, Expanded, Steel

(Copies of these documents are available from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2959 or online at www.astm.org.)

NATIONAL AEROSPACE STANDARDS COMMITTEE (NA/NAS)

NASM 25027 - Nut, Self-Locking, 250 Deg F, 450 Deg F, and 800 Deg F

(Copies of this document are available from Aerospace Industries Association, 1250 Eye Street NW, Washington, DC 20005-3924 or online at www.aia-aerospace.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 required for the proper installation and mounting of battery racks are specified in figures 2C1 through 2C4.

C.4 NOTES AND PROCEDURES

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

C.4.2 Figures. Table 2CI provides information for the figures in this group.

TABLE 2CI. Figures for the installation and mounting of battery racks.

Figure number	Battery rack installation	Page
2C1	Open battery racks	58
2C2	Open battery rack details	62
2C3	Enclosed battery racks	66
2C4	Enclosed battery rack details	67
2C5	Details of wood spacer blocks for battery racks	69
2C6	Battery clamp details	70
2C7	Battery clamp details	71
2C8	Battery clamp details	73

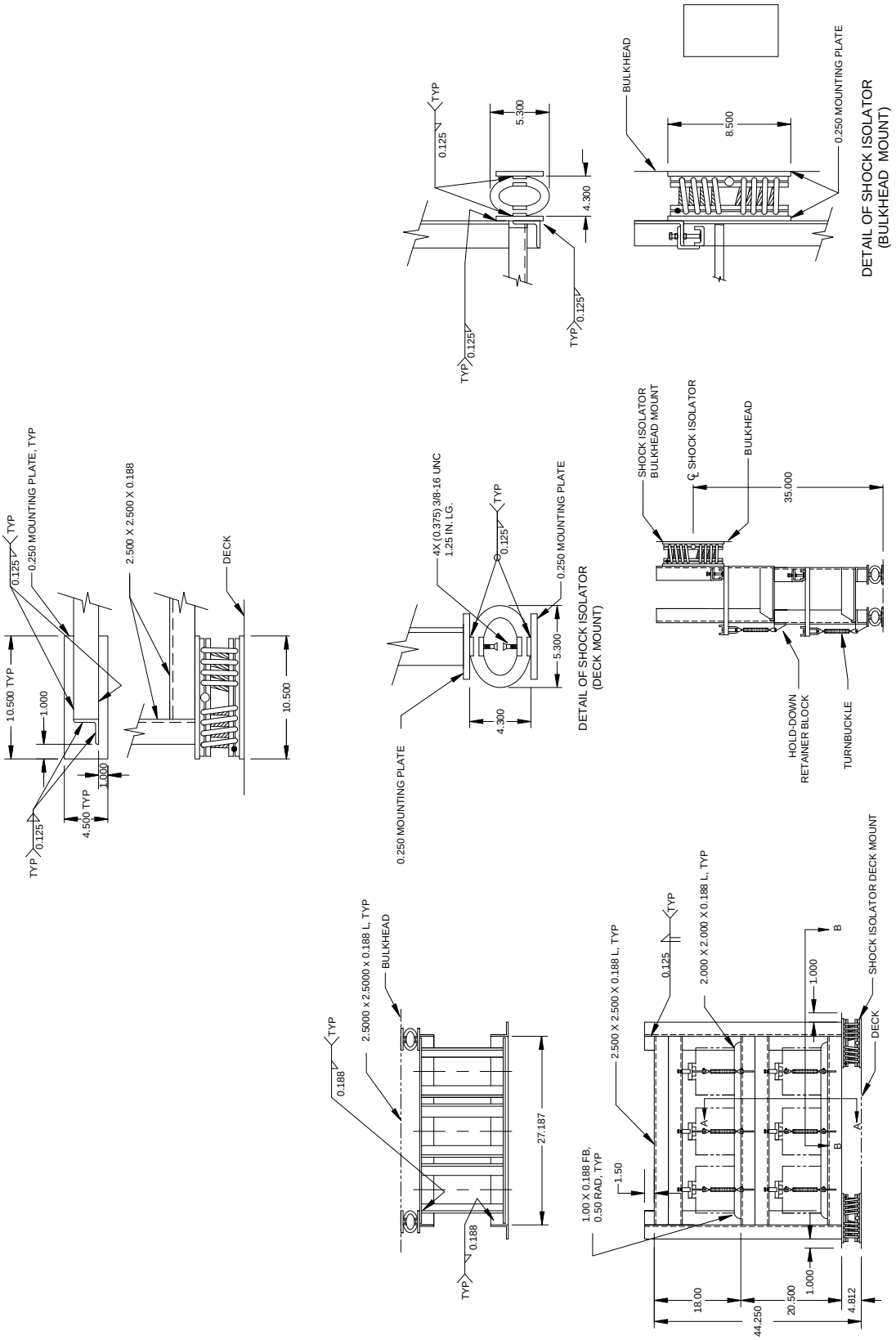


FIGURE 2C1. Open battery racks.

NOTES:

1. L-angles and plate steel shall be in accordance with MIL-S-22698, Grade A.
2. Battery racks shall be painted prior to assembly with black acid-resistant paint, NAVSEA paint formula no. 28.
3. Turnbuckles shall be in accordance with ASTM F1145, Class 7.
4. Retainer blocks shall be clean hard maple in accordance with MM-L-736.
5. Machine screws shall be corrosion-resistant steel in accordance with FF-S-92. Self-locking nuts shall be corrosion-resistant steel in accordance with NASM 25027.
6. All welding shall conform to MIL-W-21157.
7. Horizontal spacing shall be such as to provide equal space on sides and between adjacent batteries.
8. This battery rack is intended to accommodate sealed, lead-acid batteries having a length of 16.6", width of 6.8", case height of 8.6", and terminals located on the battery top near the battery corners. If batteries having other dimensions are used, battery rack dimensions shall be adjusted accordingly.

Shock isolator shall be Aeroflex isolator part no. CB1500-20-C2 with the following characteristics:

A. Helical 0.625" wire rope shock mount.
B. Height 4.30", width 5.30", length 10.50".
C. Compression average, K=1800 pounds/inch, shear average, K=1300 pounds/inch, roll average, K=1300 pounds/inch.
D. Max. rated dynamic travel = 1.80" for compression and shear, 2.80" for 45-degree compression roll.
E. Max. rated shock load = 3200 pounds compression, and 2400 pounds for shear or roll.
F. Damping factor = 0.15.
G. Lateral stiffness (percent of vertical) = 0.60.
H. Oil, grease, ozone, salt spray, organic solvents, and fatigue resistant.
I. Allows movement in any direction.
J. Operating temperature range is -40 to +212 °F (-40 to +100 °C).

FIGURE 2C1. Open battery racks - Continued.

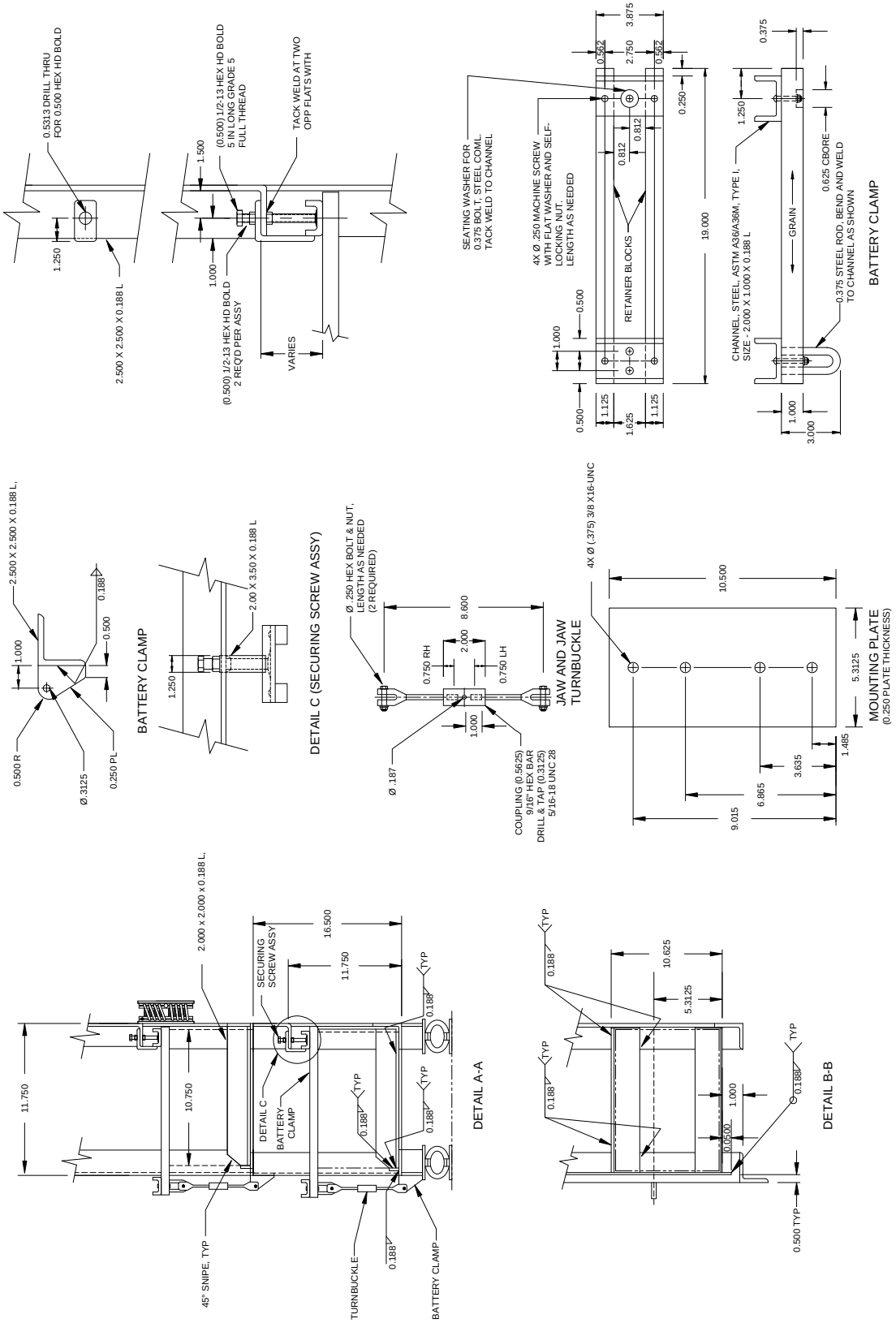


FIGURE 2C1. Open battery racks - Continued.

NOTES:

1. L-angles and plate steel shall be in accordance with MIL-S-22698, Grade A.
2. Battery racks shall be painted prior to assembly with black acid-resistant paint, NAVSEA paint formula no. 28.
3. Turnbuckles shall be in accordance with ASTM F1145, Class 7.
4. Retainer blocks shall be clean hard maple in accordance with MM-L-736.
5. Machine screws shall be corrosion-resistant steel in accordance with FF-S-92. Self-locking nuts shall be corrosion-resistant steel in accordance with NASM 25027.
6. All welding shall conform to MIL-W-21157.
7. Horizontal spacing shall be such as to provide equal space on sides and between adjacent batteries.
8. This battery rack is intended to accommodate sealed, lead-acid batteries having a length of 16.6", width of 6.8", case height of 8.6", and terminals located on the battery top near the battery corners. If batteries having other dimensions are used, battery rack dimensions shall be adjusted accordingly.

FIGURE 2C1. Open battery racks - Continued.

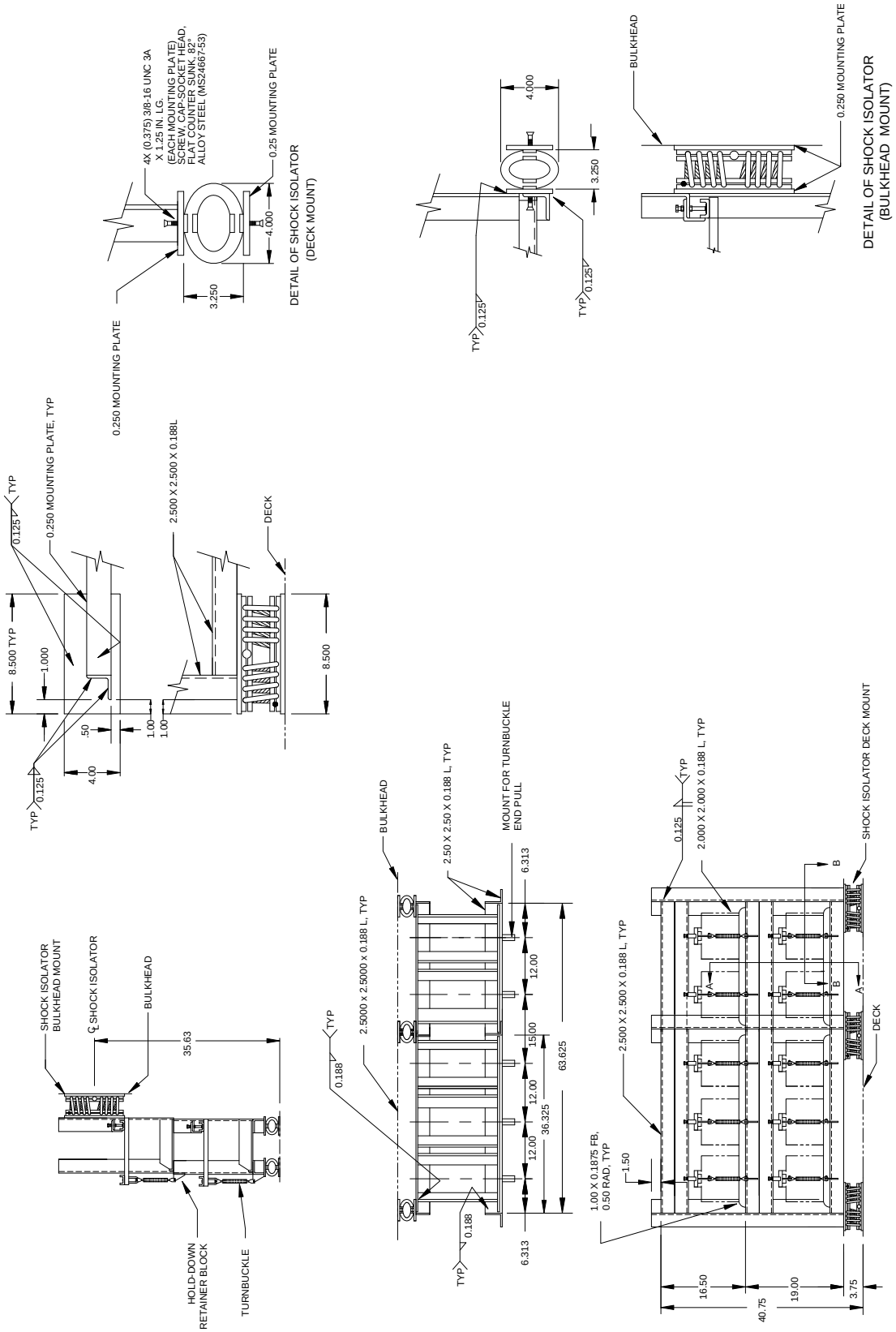


FIGURE 2C2. Open battery rack details.

NOTES:

1. L-angles and plate steel shall be in accordance with MIL-S-22698, Grade A.
2. Battery racks shall be painted prior to assembly with black acid-resistant paint, NAVSEA paint formula no. 28.
3. Turnbuckles shall be in accordance with ASTM F1145, Class 7.
4. Retainer blocks shall be material that is electrically non-conductive. Melamine or clean hard maple in accordance with MM-L-736 is recommended. Alternate material is permitted when approved by NAVSEA.
5. Machine screws shall be corrosion-resistant steel in accordance with FF-S-92. Self-locking nuts shall be corrosion-resistant steel in accordance with NASM 25027.
6. All welding shall conform to MIL-W-21157.
7. Horizontal spacing shall be such as to provide equal space on sides and between adjacent batteries.
8. This battery rack is intended to accommodate sealed, lead-acid batteries having a length of 10.6", width of 10.1", height of 8.1", and terminals located on the battery top near the battery diagonal corners. If batteries having other dimensions are used, battery rack dimensions shall be adjusted accordingly.
9. Assemble isolators to mounting plates before welding mounting plates.

Shock isolator shall be Aeroflex isolator part no. CB1400-15-T2 or equivalent with the following characteristics:

A. Helical 0.50" wire rope shock mount.
B. Height 3.25", width 4.00", length 8.50".
C. Compression average, K=1670 pounds/inch, shear average, K=1500 pounds/inch, roll average, K=720 pounds/inch.
D. Max. rated dynamic travel = 2.50" for 45 for compression roll, 1.50" for compression, and 1.20" for shear.
E. Max. rated shock load = 2500 pounds compression, and 1800 pounds for shear or roll.
F. Oil, ozone, grease, salt spray, organic solvents, and fatigue resistant.
G. Operating temperature range is -40 to +212 °F (-40 to +100 °C) or greater inclusive range.

FIGURE 2C2. Open battery rack details - Continued.

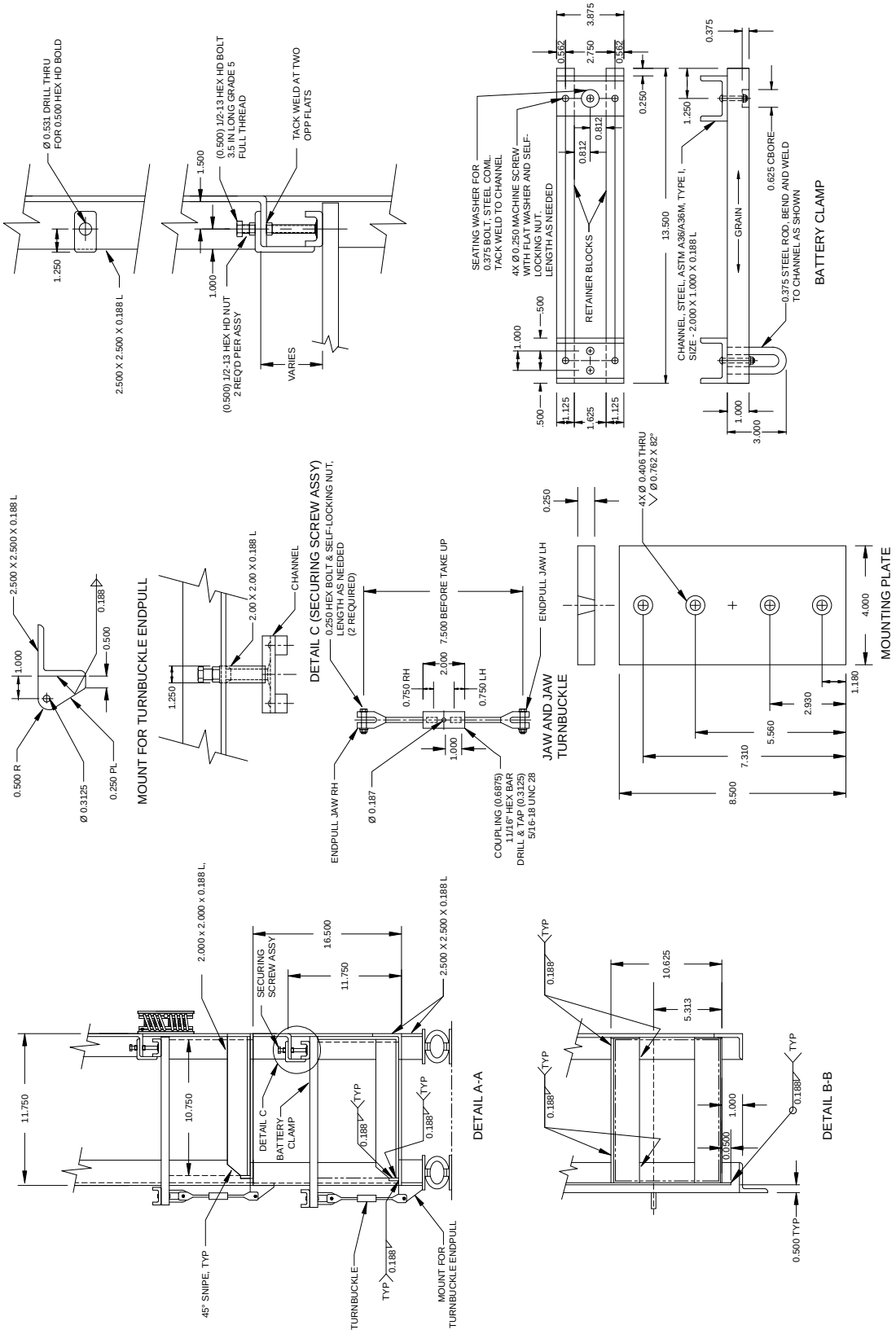


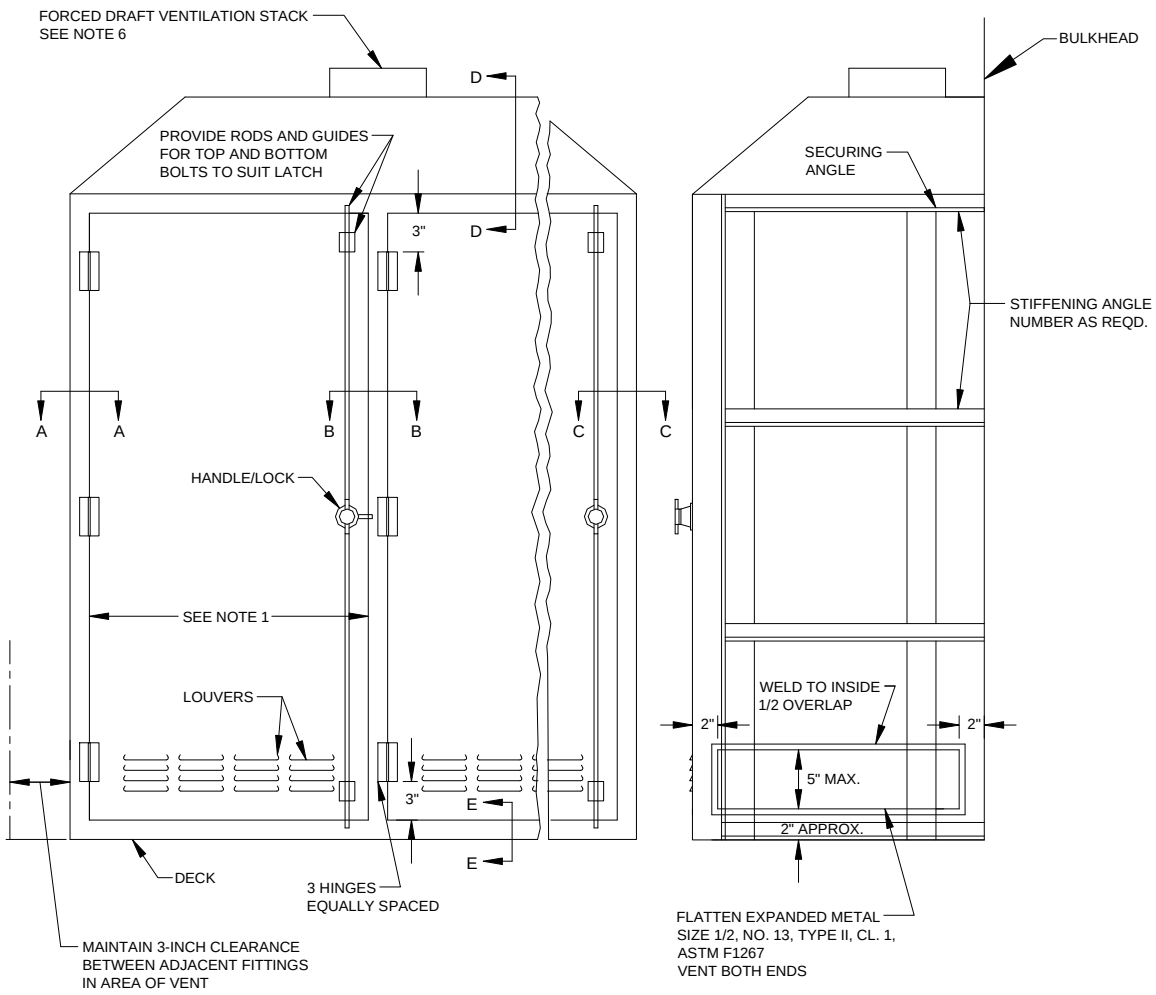
FIGURE 2C2. Open battery rack details - Continued.

NOTES:

1. L-angles and plate steel shall be in accordance with MIL-S-22698, Grade A.
2. Battery racks shall be painted prior to assembly with black acid-resistant paint, NAVSEA paint formula no. 28.
3. Turnbuckles shall be in accordance with ASTM F1145, Class 7.
4. Retainer blocks shall be clean hard maple in accordance with MM-L-736.
5. Machine screws shall be corrosion-resistant steel in accordance with FF-S-92. Self-locking nuts shall be corrosion-resistant steel in accordance with NASM 25027.
6. All welding shall conform to MIL-W-21157.
7. Horizontal spacing shall be such as to provide equal space on sides and between adjacent batteries.
8. This battery rack is intended to accommodate sealed, lead-acid batteries having a length of 10.6", width of 10.1", height of 8.1", and terminals located on the battery top near the battery diagonal corners. If batteries having other dimensions are used, battery rack dimensions shall be adjusted accordingly.

FIGURE 2C2. Open battery rack details - Continued.

METHOD 2C-3-1



NOTES:

1. Maximum width of cabinet doors shall be not more than 32".
2. Interior of closed cabinets shall be coated with an epoxy conforming to MIL-DTL-24441 and applied in accordance with note 3 of figure 2C2.
3. Exterior shall be finished in accordance with MIL-E-917.
4. Enclosure is designed to accommodate open racks shown on figure 2C1 and 2C2.
5. Material shall be steel in accordance with ASTM A1008/A1008M, Class 1, Fin Matte.
6. Ventilation exhaust shall be discharged overboard or into a non-recirculating duct.
7. Section details are shown on figure 2C4.

FIGURE 2C3. Enclosed battery racks.

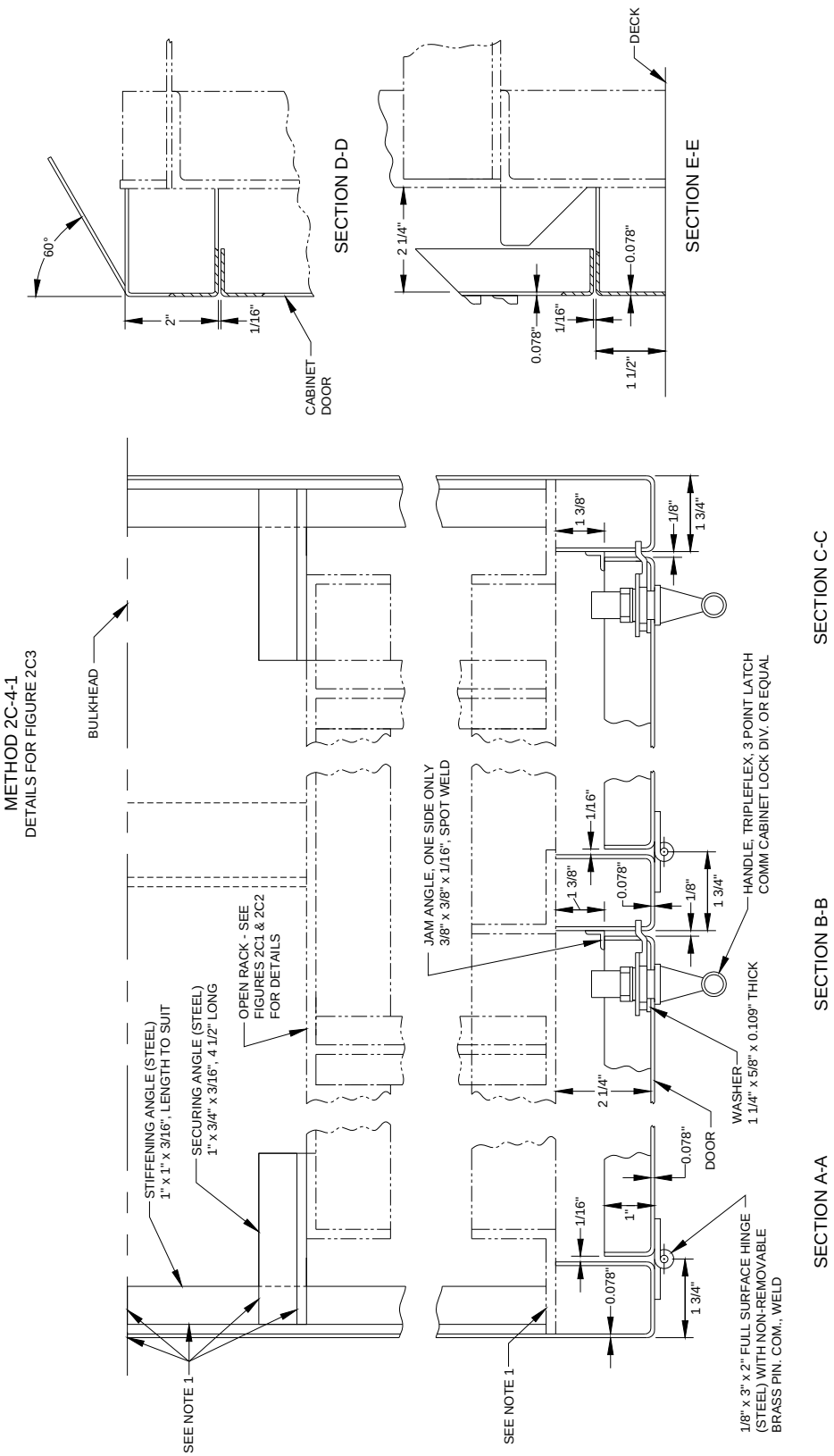
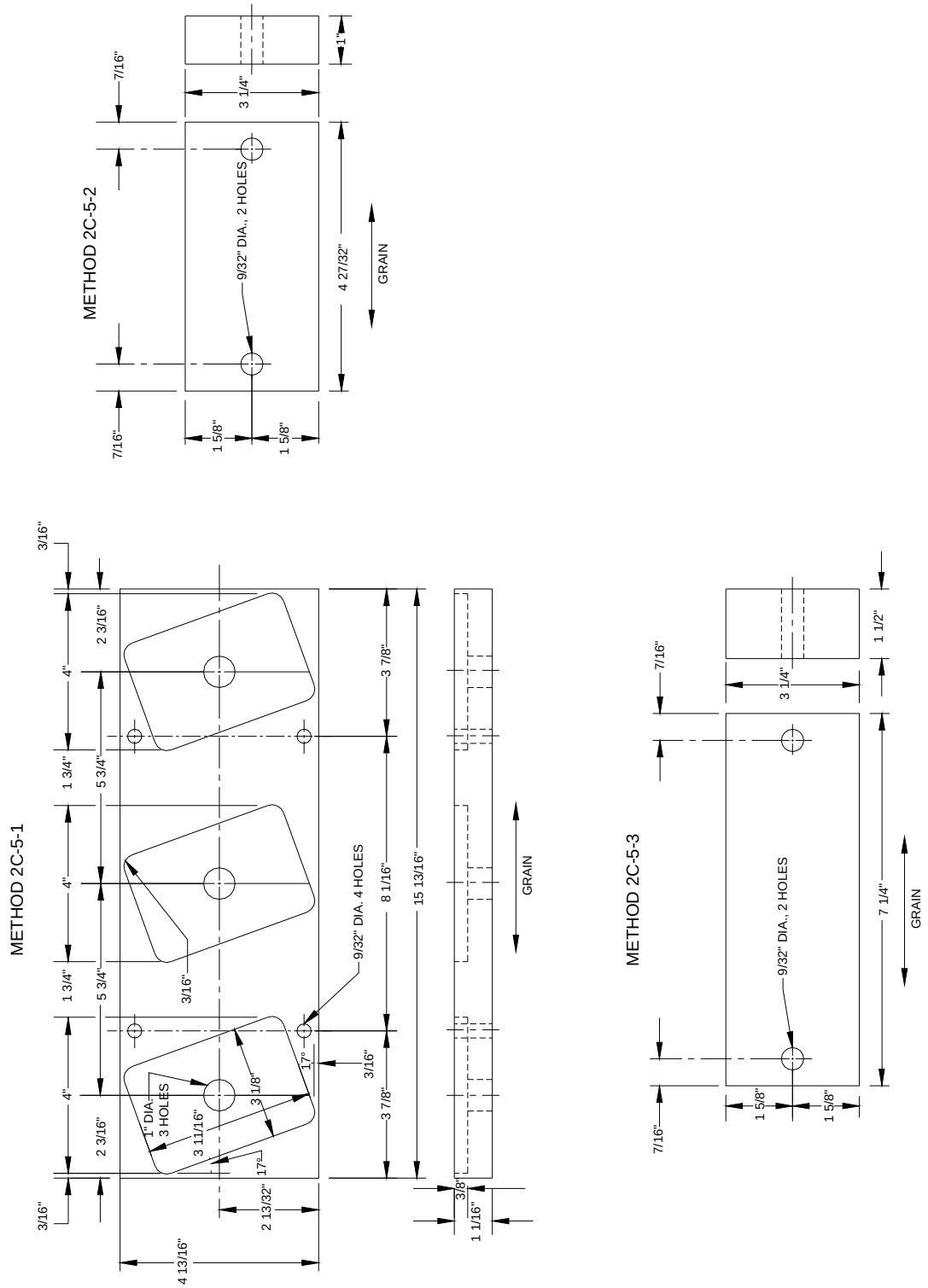


FIGURE 2C4. Enclosed battery rack details.

NOTES:

1. For weld size, see 4.1.1.
2. These details are for figure 2C3.

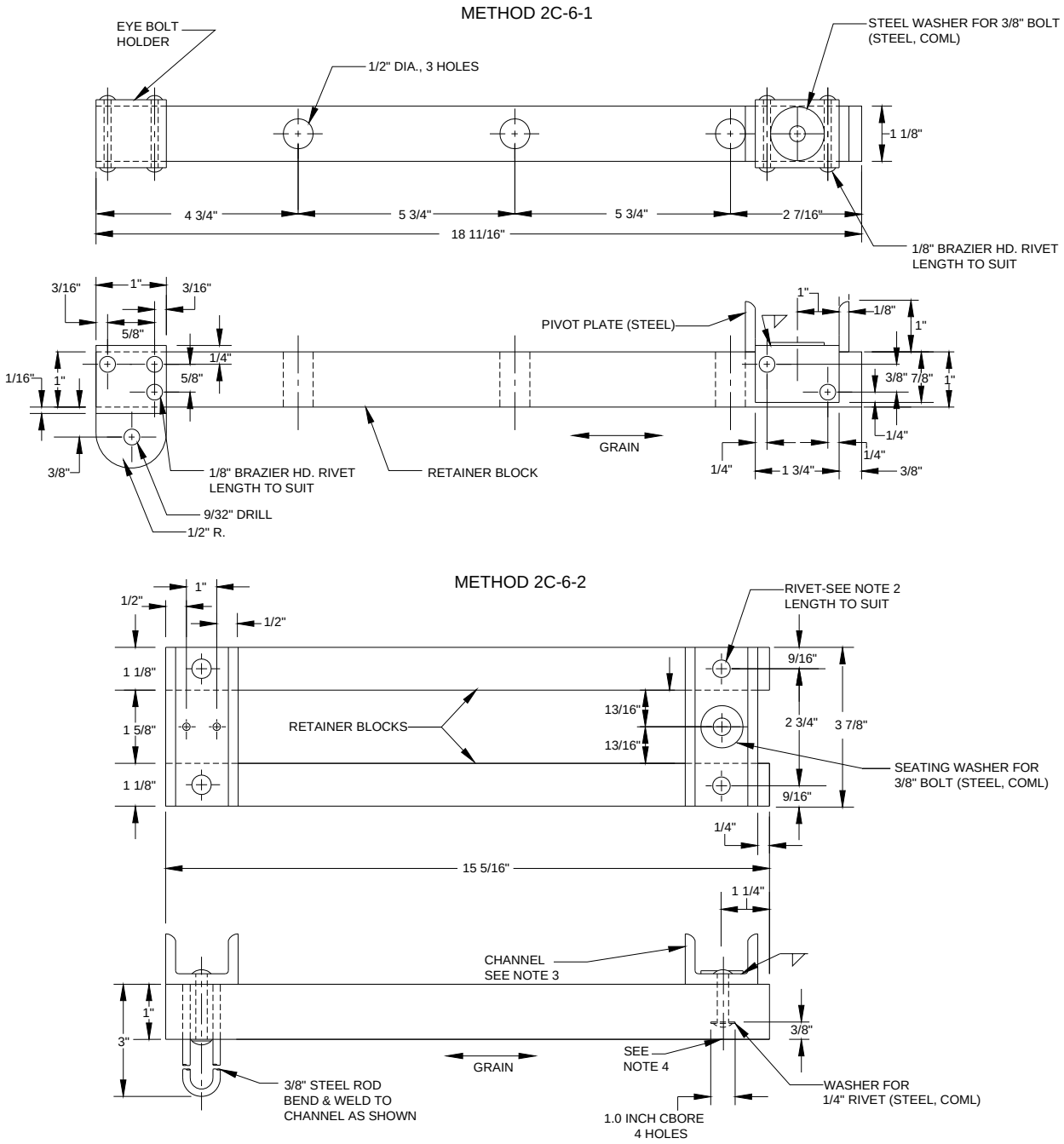
FIGURE 2C4. Enclosed battery rack details - Continued.



NOTES:

1. All components shall be coated with epoxy before assembly in accordance with note 3 of figure 2C2.
2. Retainer blocks to be clear hard maple in accordance with MM-L-736.

FIGURE 2C5. Details of wood spacer blocks for battery racks.



NOTES:

1. All components shall be coated with epoxy before assembly in accordance with note 3 of figure 2C2.
2. Rivet shall be ¼ brazier head, high tensile steel.
3. Channel shall be steel, ASTM A36/A36M, Type 1, Size 2 by 1 by 3⁄16.
4. Retainer blocks to be clear hard maple in accordance with MM-L-736.

FIGURE 2C6. Battery clamp details.

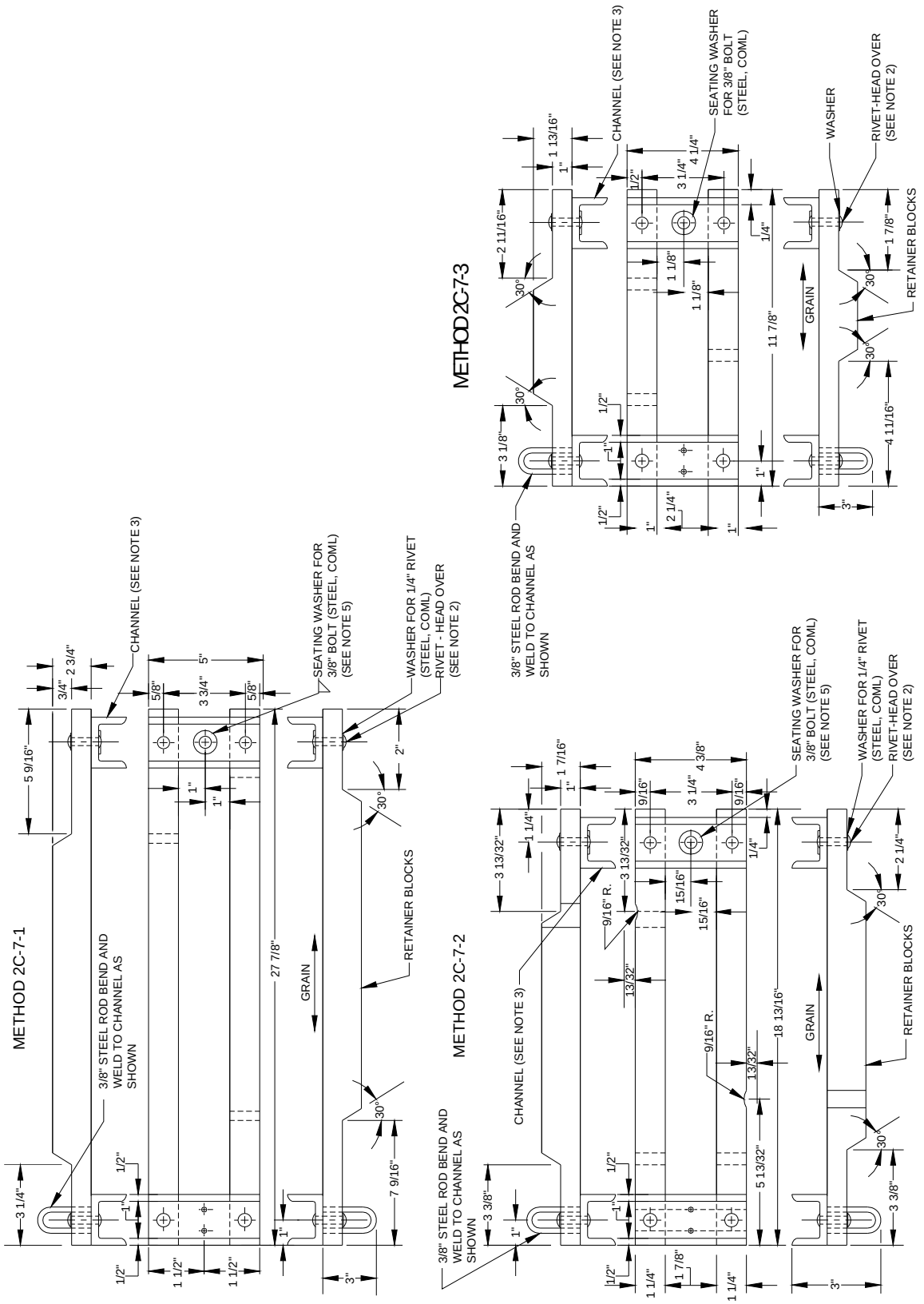


FIGURE 2C7. Battery clamp details.

NOTES:

1. All components shall be coated with epoxy before assembly in accordance with note 3 of figure 2C2.
2. Rivet shall be ¼ brazier head, high tensile steel.
3. Channel shall be steel, ASTM A36/A36M, Type 1, Size 2 by 1 by 3⁄16.
4. Retainer blocks to be clear hard maple in accordance with MM-L-736.
5. For weld size, see 4.1.1.

FIGURE 2C7. Battery clamp details - Continued.

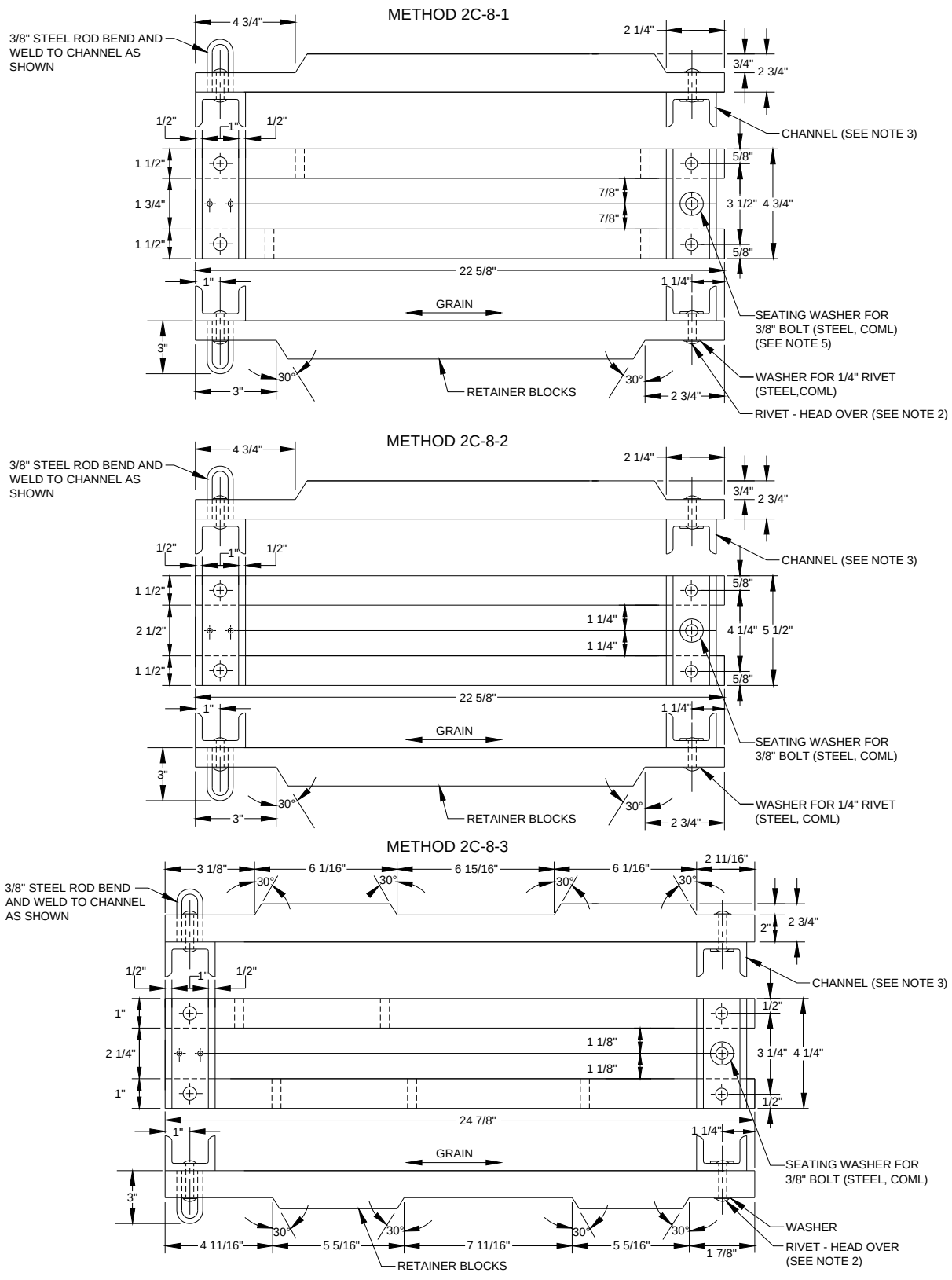


FIGURE 2C8. Battery clamp details.

NOTES:

1. All components shall be coated with epoxy before assembly in accordance with note 3 of figure 2C2.
2. Rivet shall be ¼ brazier head, high tensile steel.
3. Channel shall be steel, ASTM A36/A36M, Type 1, size 2 by 1 by 3⁄16.
4. Retainer blocks to be clear hard maple in accordance with MM-L-736.
5. For weld size, see 4.1.1.

FIGURE 2C8. Battery clamp details - Continued.

GROUP D – CASUALTY POWER

D.1 SCOPE

D.1.1 Scope. This section describes procedures for the proper installation of casualty power.

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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-DTL-5516	-	Packing, Preformed, Petroleum Hydraulic, Fluid Resistant, 160 °F (71 °C)
MIL-DTL-15024	-	Plates, Tags, and Bands for Identification of Equipment, General Specification for
MIL-I-15265	-	Insulation, Electrical, Plastic (Submarine Bus Bar Covering)
MIL-DTL-16878/8	-	Wire, Electrical, Silicone Rubber Insulated, 200 Deg. C, 1000 Volts
MIL-S-24235	-	Stuffing Tubes, Metal, and Packing Assemblies For Electric Cables, General Specification for
MIL-DTL-24552	-	Terminals and Seals, Plugs and Switch, Casualty Power Systems, Receptacle Type, General Specification for
MIL-DTL-24552/1	-	Terminals and Seals, Plugs and Switch, Casualty Power, Receptacle Type, Back Connected 200 Ampere, 450-Volt, Alternating Current, Three-Phase, Symbol No. 1046
MIL-DTL-24552/2	-	Terminals and Seals, Plugs and Switch, Casualty Power, Receptacle Type, Upper and Lower Riser, 200-Ampere, 450-Volt, Alternating Current, Three-Phase, Symbol No. 1047
MIL-DTL-24552/3	-	Terminals and Seals, Plugs and Switch, Casualty Power, Seal, Symbol No. 1048
MIL-DTL-24552/4	-	Terminals and Seals, Plugs and Switch, Casualty Power, Plug, 100-Ampere, 450-Volt, Alternating Current, Three-Phase, Symbol No. 1049
MIL-DTL-24643/3	-	Cable, Electrical, 600 Volts, Types LSSHOF, LSDHOF, LSTHOF, and LSFHOF
MIL-DTL-24643/16	-	Cable, Electrical, 1000 Volts, Type LSTSGU (Including Variation LSTSGA)

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

D.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 B209	-	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B211	-	Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B633	-	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM F1836M	-	Standard Specification for Stuffing Tubes, Nylon, and Packing Assemblies (Metric)

(Copies of these documents are available from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2959 or online at www.astm.org.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA HP 6	-	Electrical and Electronic Silicone and Silicone-Braided Insulated Hook-Up Wire Types S (600 V), ZHS (600 V), SS (1000 V), ZHSS (1000 V) and SSB Braided (1000 V)

(Copies of this document are available from the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209 or online at www.nema.org.)

SAE INTERNATIONAL

SAE-AMS-DTL-23053/5	-	Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Flexible Crosslinked
SAE-AMS-DTL-23053/18	-	Insulation Sleeving, Electrical, Heat Shrinkable, Modified Fluoroploymer, Crosslinked
SAE-AMS-QQ-A-250/8	-	Aluminum Alloy 6061, Bar, Rod, Wire, and Special Shapes; Rolled, Drawn, or Cold Finished

(Copies of these documents are available from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or online at www.sae.org.)

D.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.

D.3 REQUIRED EQUIPMENT AND MATERIALS

D.3.1 Required equipment and materials. The equipment and materials required for the proper installation of casualty power component are specified in figures 2D1 through 2D7.

D.4 NOTES AND PROCEDURES

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

D.4.2 Figures. Table 2DI provides information for the figures in this group.

TABLE 2DI. Figures for the installation casualty power components.

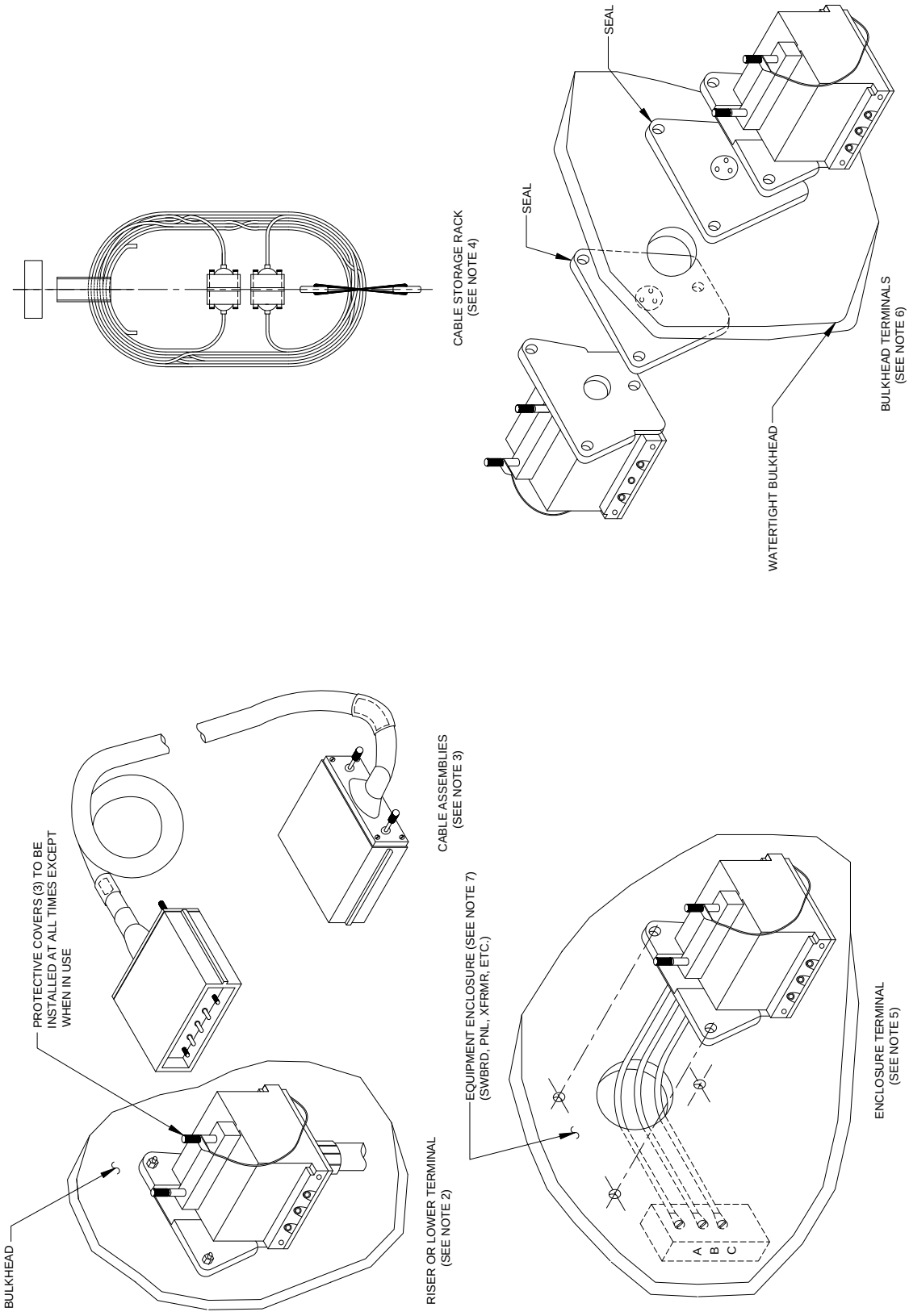


FIGURE 2D1. Casualty power distribution system.

NOTES:

1. The casualty power distribution system shall be arranged to provide temporary transmission of power to span damaged areas in accordance with section 320 of the ship specifications.
2. Vertical risers for transmission of power to a deck above or below shall be installed in accordance with figure 2D2.
3. Portable jumper cable assemblies shall be provided for connecting riser terminals to horizontal run bulkhead terminals and to terminals on switchboards, panels, and controllers in accordance with figure 2D5.
4. Cable storage racks shall be installed to stow the portable jumper cable assemblies in compartments where the cable is used in accordance with figure 2D4.
5. Equipment terminals shall be mounted on equipment enclosures in accordance with Method 2D-3-2.
6. Bulkhead terminals for horizontal fore-and-aft casualty power runs shall be installed in accordance with Methods 2D-3-1 and 2D-3-3.
7. When equipment enclosure is watertight, the seal MIL-DTL-24552/2 shall be used.

FIGURE 2D1. Casualty power distribution system - Continued.

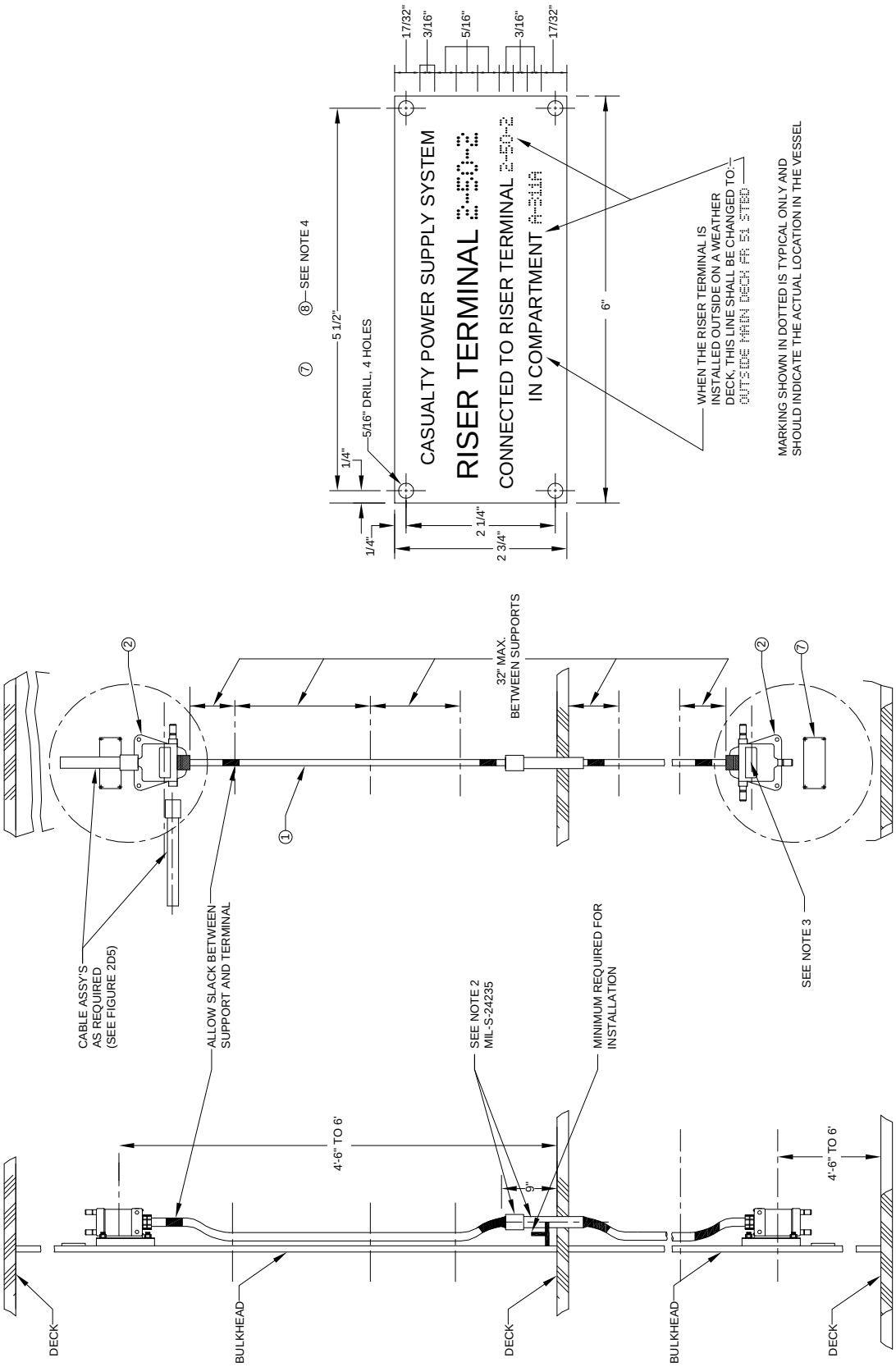


FIGURE 2D2. Casualty power riser terminal.

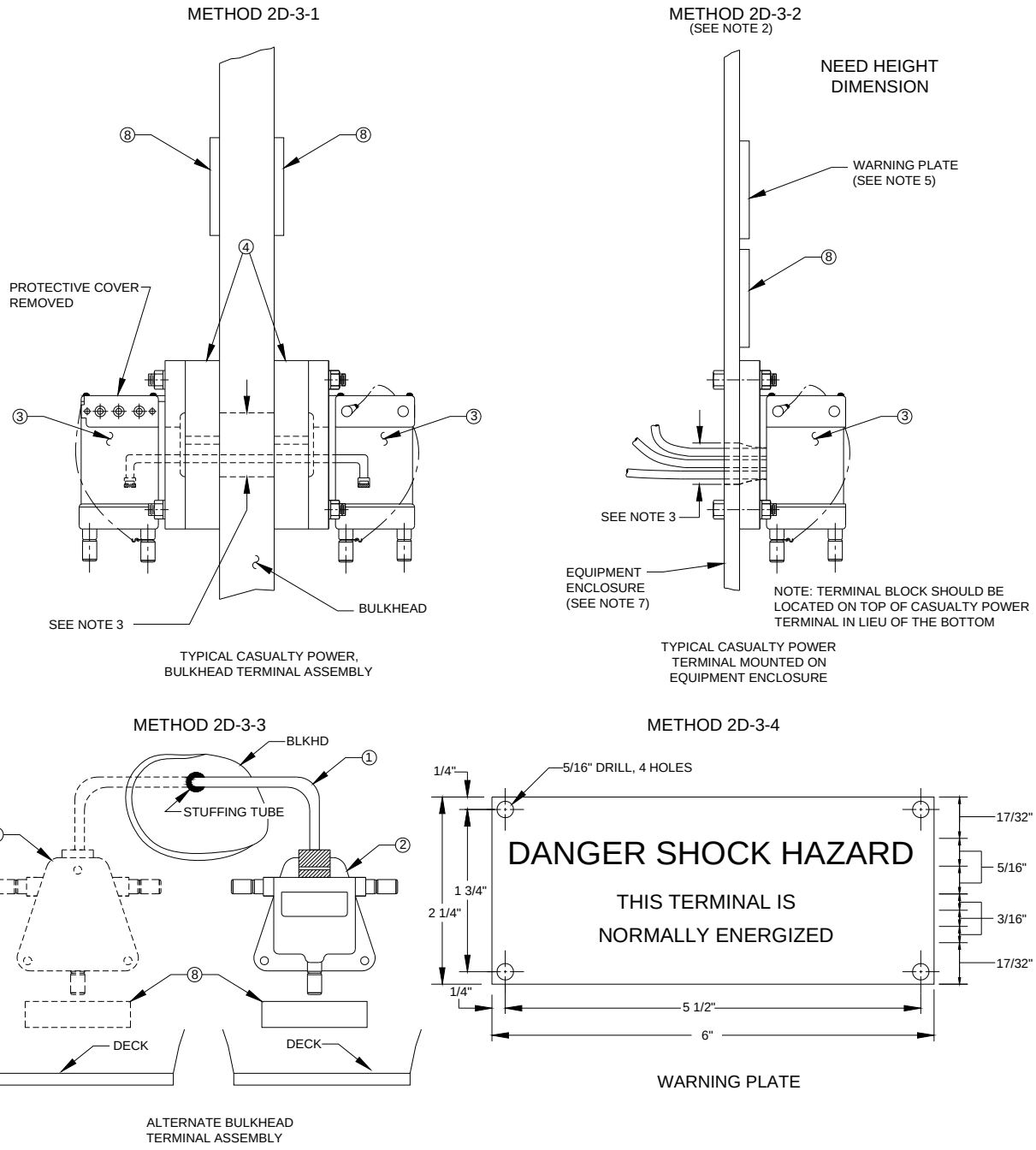
TABLE 2D2-I. List of materials for casualty power.

Part no.	Quantity	Casualty power component	Material	Material specification or reference
9	--	Wire		NEMA HP 6, Type FF-2
8	As required	Nameplate - BHD	Brass	See note 4
7	2	Nameplate –Riser	Brass	See note 4
6	--	Cable, LSTHOF-42	--	MIL-DTL-24643/3
5	--	Terminals, Casualty Power, Plug, Sym. No. 1049	--	MIL-DTL-24552/4
4	--	Terminals, Casualty Power, Seal, Sym. No. 1048	--	MIL-DTL-24552/3
3	--	Terminals, Casualty Power. Receptacle Type, Back Connected, Sym. No. 1046	--	MIL-DTL-24552/1
2	--	Terminals, Casualty Power. Receptacle Type, Upper and Lower Riser, Sym. No. 1047	--	MIL-DTL-24552/2
1	--	Cable, LSTSGU-75	--	MIL-DTL-24643/16

NOTES:

1. The riser shall be installed as shown or in accordance with specifically approved deviations.
2. Stuffing tube shall be of the type required for the particular deck construction where installed.
3. A 12" radius minimum handling clearance shall be maintained about center of riser terminals as shown.
4. Nameplates shall comply with MIL-DTL-15024, Type B, and marked as shown. PC 8 is the same as PC 7 except marked “bulkhead terminal” in lieu of “riser terminal”.
5. See figure 2D6 for wiring and installation of terminals.

FIGURE 2D2. Casualty power riser terminal - Continued.



NOTES:

1. Part no. are shown on figure 2D2.
2. Method 2D-3-2 is shown for NWT installations. Seal PC. 4 on figure 2D2 shall be used for all other installations.
3. A 2" diameter opening in equipment enclosure or bulkhead is required.
4. See figure 2D6 for wiring and installation of terminals.

FIGURE 2D3. Casualty power bulkhead terminal.

NOTES (continued):

5. Normally energized casualty power terminals (those connected to transformers, power panels, or motor controllers) shall have a warning plate installed inscribed as shown in Method 2D-3-4. Plate shall be Type B (brass) of MIL-DTL-15024.
6. A 12" radius minimum handling clearance shall be maintained center of bulkhead terminal.
7. When equipment enclosure is watertight, then seal MIL-DTL-24552/3 shall be used.

FIGURE 2D3. Casualty power bulkhead terminal - Continued.

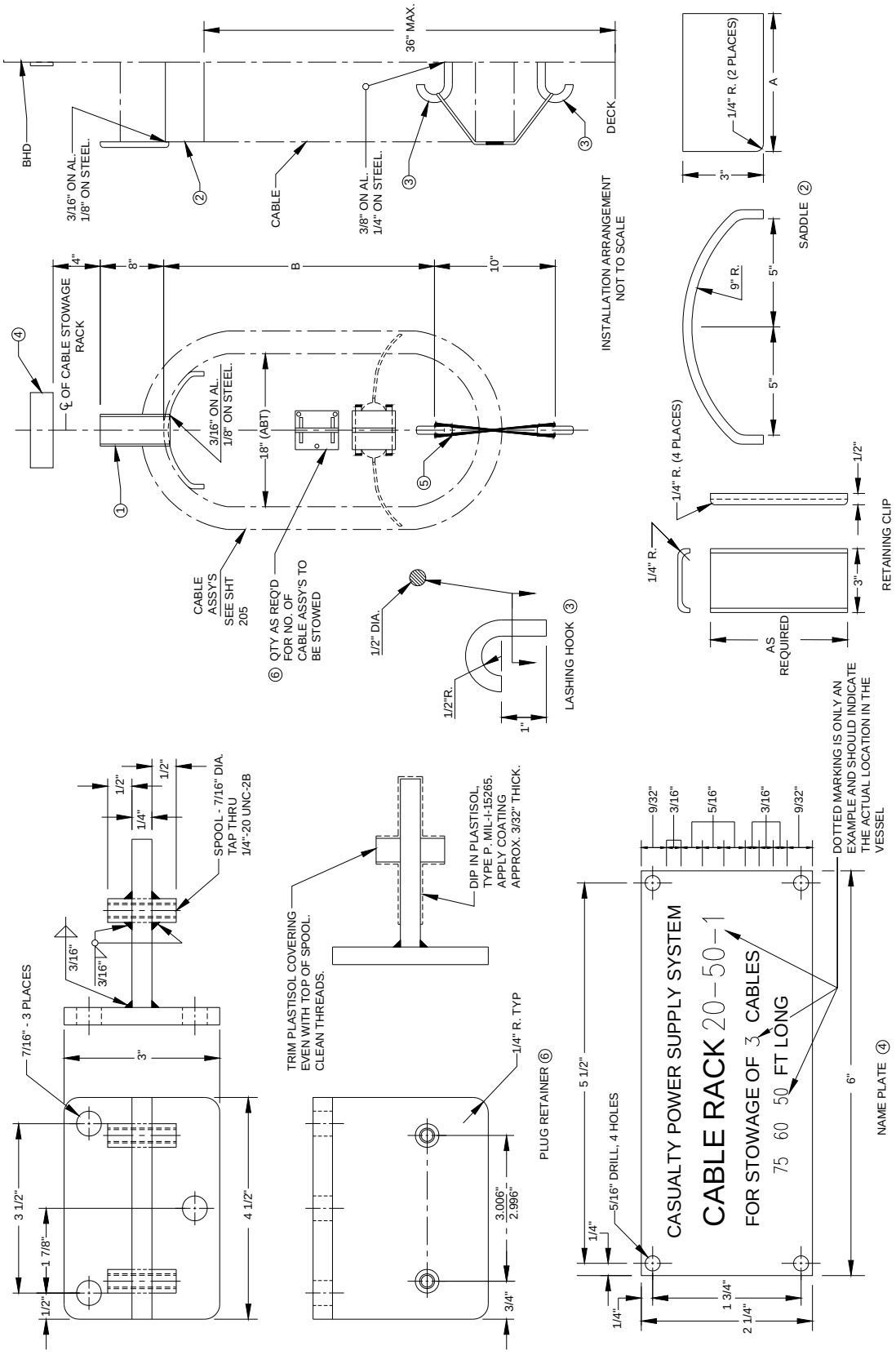


FIGURE 2D4. Casualty power cable stowage rack.

TABLE 2D4-I. Table of dimensions.

Length of cable stowed	A	B
Up to 150'	6"	26"
150' to 325'	9"	40"

TABLE 2D4-II. List of materials – quantities for one rack.

Part no.	Quantity	Name	Material	Material specification or reference
6	As required	Plug retainer	Steel	--
5	1	Lashing 36" long, ¼" thick	Hemp	T-R-650; see note 7
4	1	Name plate	Brass	See note 9
3	2	Lashing hook	Note 10	See notes 8 & 10.
2	1	Saddle	Note 1	See notes 1 & 8
1	1	Retaining clip	Note 1	See notes 1 & 10

NOTES:

1. Saddle and retaining clip to be mild steel of weldable and drawable quality for steel bulkheads and aluminum alloy SAE-AMS-QQ-A-250/8 (or if applicable, ASTM B209) for aluminum bulkheads.
2. Depth of saddle and location of lashing hooks to be determined by amount of cable stowed.
3. Brackets shall not be welded on aluminum bulkheads less than ⅛" thick without proper reinforcement.
4. After installation, the entire fixture shall be painted to match surrounding structure.
5. All steel or aluminum parts shall be assembled by welding as specified.
6. All sharp corners shall be slightly rounded.
7. Both ends of lashing shall be served. Lashing not furnished.
8. When rack assembly is mounted on steel ends, all steel parts should be zinc-plated to conform to the requirements of ASTM B633, Type I, Class 2.
9. Identification plates shall be Type B (brass) of MIL-DTL-15024 and shall be marked as shown.
10. Lashing hook to be ½" diameter mild steel KSM J welding pin or ½" diameter rod ASTM A36/A36M on steel bulkheads and ½" diameter aluminum alloy KSM J welding pin or ½" diameter aluminum alloy ASTM B211 on aluminum bulkheads.
11. Stowage rack shall pass hi-shock test in accordance with MIL-S-901 while supporting coil of 75' of LSTHOF-42 cable or 72-pound equivalent dummy weight.

FIGURE 2D4. Casualty power cable stowage rack - Continued.

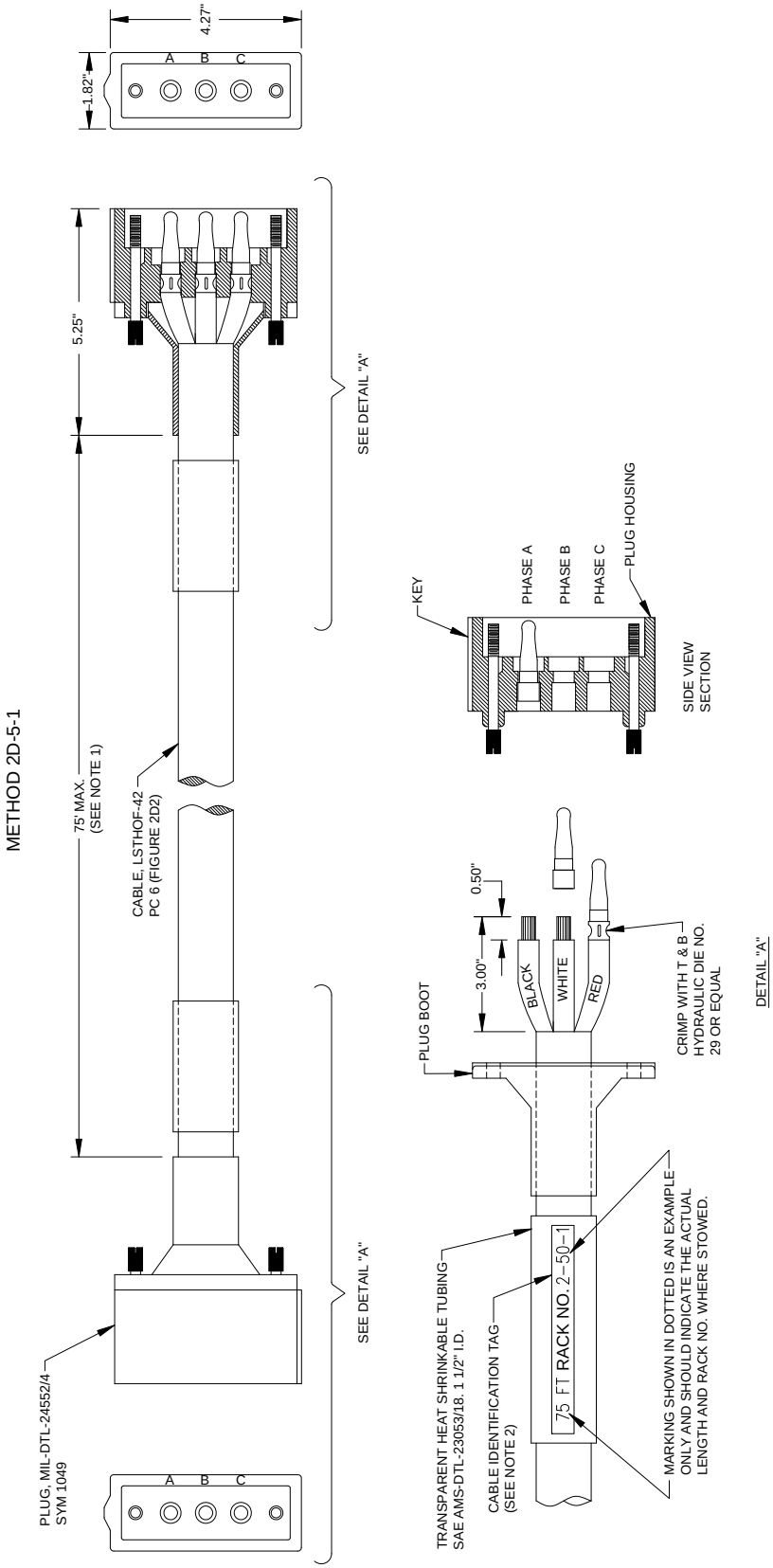
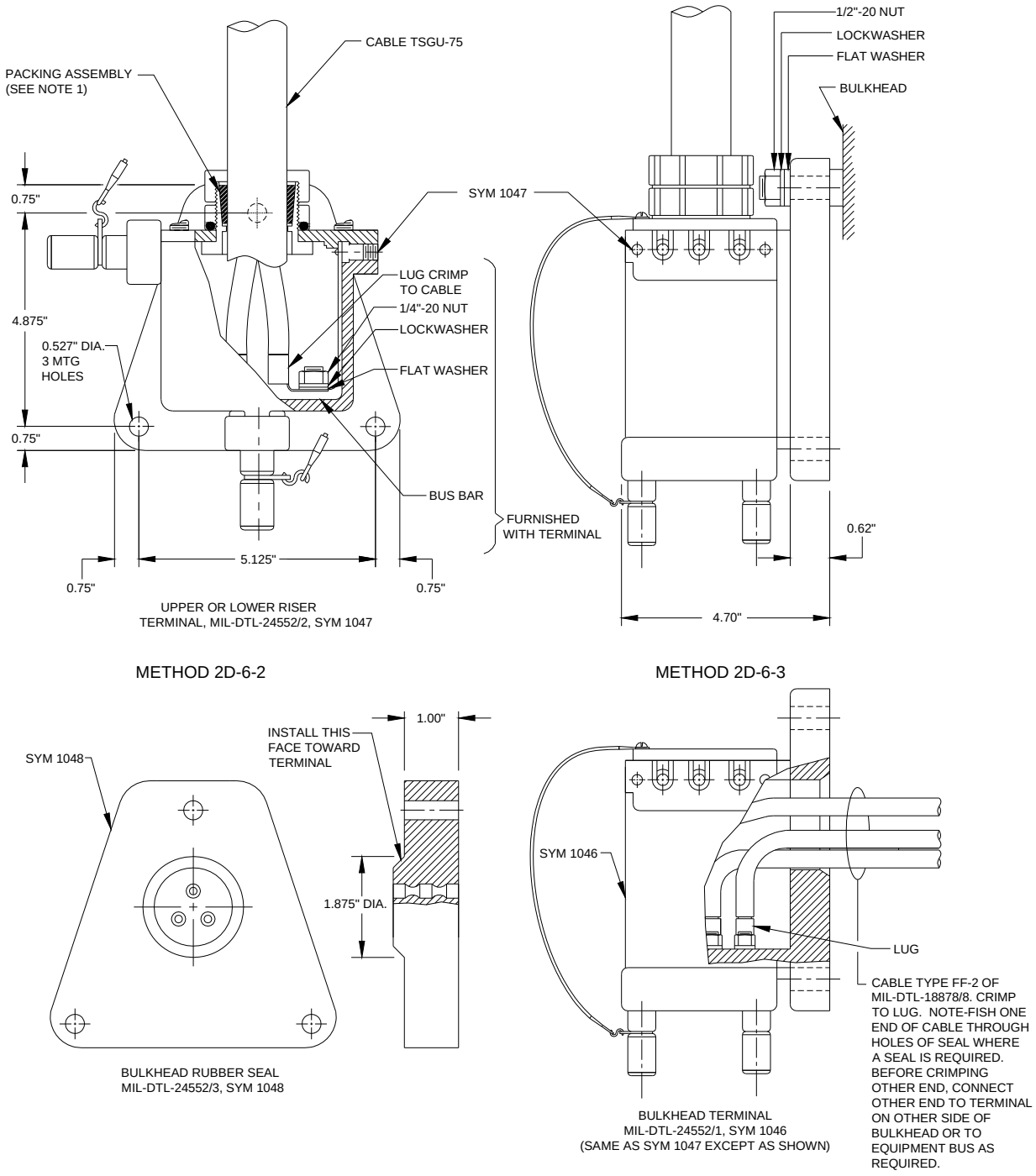


FIGURE 2D5. Casualty power jumper cable assembly.

NOTES:

1. Cable length shall not exceed 75' in length unless approved by NAVSEA.
2. Each cable end shall be marked as shown.
3. See list of material on figure 2D4.

FIGURE 2D5. Casualty power jumper cable assembly - Continued.



NOTE:

1. Packing assembly ASTM F1836M, NSN 5975-00-202-2607 for size 5 stuffing tube to be furnished by installing activity, sym. 1047 only.

FIGURE 2D6. Casualty power terminal preparation.

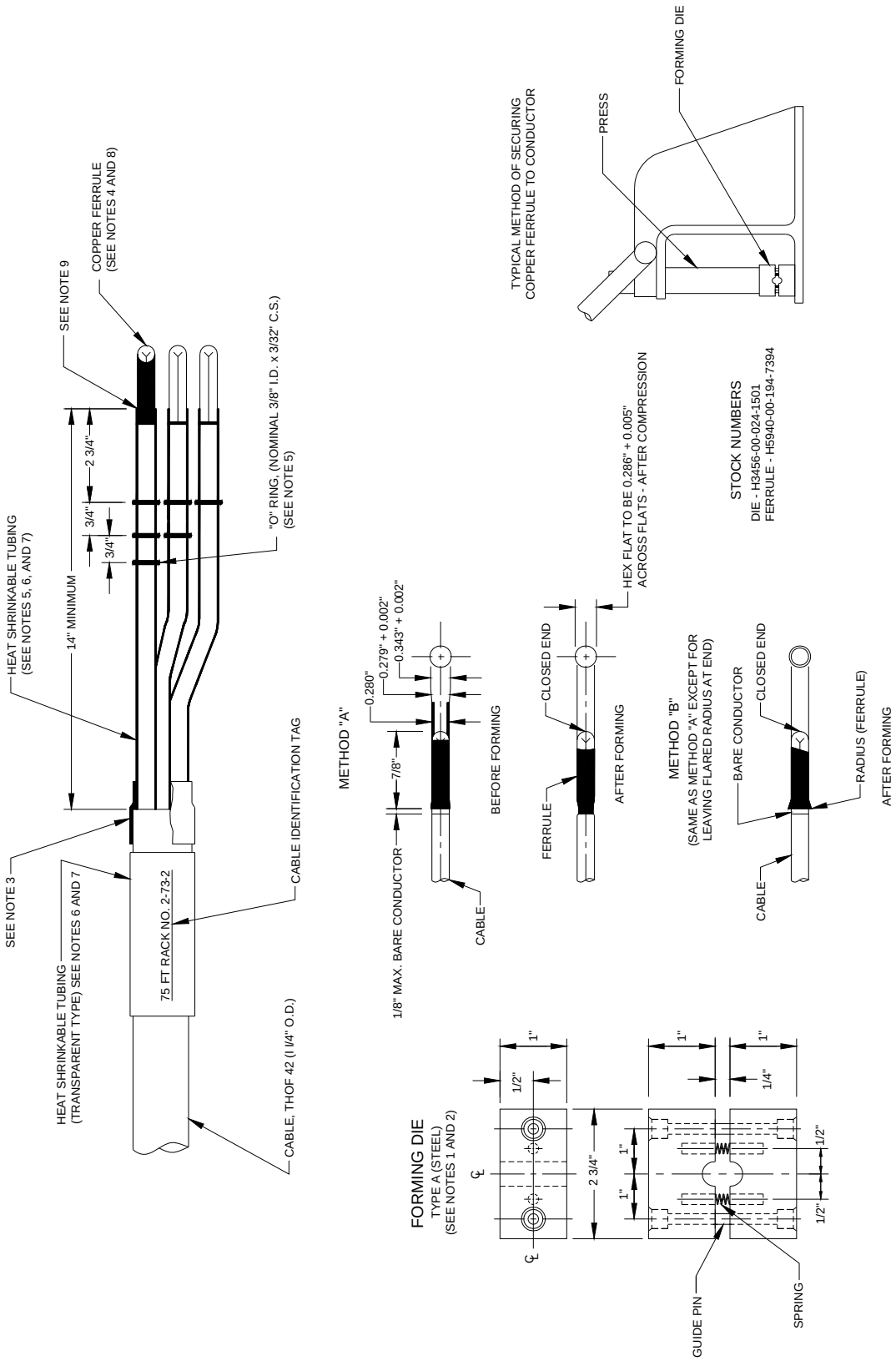


FIGURE 2D7. Identification and end preparation of casualty power cables used with equipment in accordance with MIL-DTL-24552.

NOTES:

1. Forming die shall be so constructed as to prevent disassembly while handling.
2. Springs shall be of a type and design that will hold the die halves normally in the open position.
3. Exposed end of cable sheath insulation at crotch shall be made effectively watertight by use of heat shrinkable boot.
4. Place round copper ferrule on conductor and secure by forming as shown in detail by method “A” or “B”.
5. For phase identification by touch-install, heat shrink tubing. See notes 6 and 7 and non-metallic “O” rings, NSN 5330-00-050-1211, MIL-DTL-5516 or equivalent black wire.
   Black wire (“A” phase) 1 “O” ring, black H.S. tube
   White wire (“B” phase) 2 “O” rings, white H.S. tube
   Red wire (“C” phase) 3 “O” rings, red H.S. tube
6. Phase and cable identification: Heat shrinkable tubing for phase identification shall be flexible type, SAE-AMS-DTL-23053/5, Class 1, and for cable identification shall be transparent SAE-AMS-DTL-23053/18.
7. Tubing size as supplied:
   a. For cable identification - 1½ I.D.
   b. For phase identification - ¾ I.D.
   c. ½" and 2¾" lengths
8. Pull out strength of ferrule shall be at least 150 pounds. If this cannot be accomplished by forming of ferrule directly over conductor, add a few copper strands in space between conductor and ferrule before forming. After the ferrules are formed on the conductors, remove any sharp fins and edges, replace ferrules cracked in forming.
9. Heat shrink tubing shall extend over the ferrule approximately ⅛" for watertight effectiveness.

For repair only; not for new construction.

FIGURE 2D7. Identification and end preparation of casualty power cables used with equipment in accordance with MIL-DTL-24552 - Continued.

GROUP E – SHORE POWER

E.1 SCOPE

E.1.1 Scope. This section describes procedures for the proper installation of shore power.

E.2 APPLICABLE DOCUMENTS

E.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.

E.2.2 Government documents.

E.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.

A-A-59296	-	Insulating Compound, Electrical (for Field Splicing Applications)

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-915/6	-	Cable, Power Electrical, 600 Volts, for Outboard Use Only (Not for Inboard Use), Type THOF
MIL-DTL-16036	-	Switchgear, Power, Low Voltage, Naval Shipboard
MIL-T-16366	-	Terminals, Electrical Lug and Conductor Splices, Crimp-Style
MIL-S-24235	-	Stuffing Tubes, Metal, and Packing Assemblies for Electric Cables, General Specification for
MIL-C-24368/1	-	Connector Assemblies; Plug, Power Transfer, Shore to Ship and Ship to Ship, 500 Volts, 500 Amperes, 60 Hertz, Symbol Number 1160
MIL-C-24368/2	-	Connector Assemblies; Receptacle, and Receptacle - Cabled, Power Transfer, Shore to Ship and Ship to Ship, 500 Volts, 500 Amperes, 60 Hertz, Symbol Number 1161
MIL-C-24368/4	-	Connector Assemblies; Plugs and Receptacles, Electric, Power Transfer, Shore to Ship and Ship to Ship, 500 Volts, 500 Amperes, 60 Hertz, Symbol Numbers 1162.1, 1162.2 and 1162.3
MIL-C-24368/5	-	Connector Assemblies; Plug, Submarine Shore Power Transfer, Shore to Ship and Ship to Ship, 500 Volts, 400 Amperes, 60 Hertz, Three-Phase, Symbol Number 1149
MIL-C-24368/6	-	Connector Assemblies; Dual Purpose, Submarine Shore Power Transfer (AC) and DSRV Battery Charging (DC), 500 Volts, 400 Amperes, 60 Hertz, Three-Phase, Symbols 1150 and 1150.1
MIL-I-24768/1	-	Insulation, Plastic, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin (GME)

DEPARTMENT OF DEFENSE STANDARDS

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-2003-4	-	Electric Plant Installation Standard Methods for Surface Ships and Submarines (Cableways)
MIL-STD-3007	-	Unified Facilities Criteria and Unified Facilities Guide Specifications

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

E.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) DESIGN DATA SHEETS

DDS 100-1	-	Reinforcement of Openings in Structure of Surface Ships Other than in Protective Planting

(Copies of this document are available from Commander, Naval Sea Systems Command, ATTN: SEA 05M2, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160, or by email at CommandStandards@navy.mil with the subject line "DDS request".)

NAVAL SEA SYSTEMS COMMAND (NAVSEA) DRAWINGS

815-1197055	-	Connection Box, Wt for Ship to Ship Power, Sym 490
815-1197056	-	Cable Assembly, Sym 762,762.1
815-1197071	-	Shore Terminal Box, 492.3,492.4
815-1197074	-	Connector, Plug, Sym 761.1
815-1197217	-	Shore Terminal Box-SBM15,493.3-493.4

(Copies of these documents are available from Commander, Portsmouth Naval Shipyard, ATTN: Code 280.1, Kittery, ME 03904.)

E.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.

SAE INTERNATIONAL

SAE-AMS-DTL-23053/4	-	Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Dual-Wall, Outer Wall Crosslinked
SAE-AMS-DTL-23053/15	-	Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Heavy-Wall, Coated, Flexible, Outer Wall Crosslinked
SAE-AS81765/1	-	Insulating Components, Molded, Electrical, Heat Shrinkable Polyolefin, Crosslinked, Semi-Rigid and Flexible

(Copies of these documents are available from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or online at www.sae.org.)

E.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.

E.3 REQUIRED EQUIPMENT AND MATERIALS

E.3.1 Required equipment and materials. The equipment and materials required for the proper installation of shore power component are specified in figures 2E1 through 2E23.

E.4 NOTES AND PROCEDURES

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

E.4.2 Figures. Table 2EI provides information for the figures in this group.

TABLE 2EI. Figures for the installation of casualty power components.

Figure number	Shore power installation	Page
2E1	Shore power installations	94
2E2	Shore power installations	96
2E3	Mounting shore receptacles with 90-degree potting inside of bulkhead	98
2E4	Mounting shore power receptacles inside of bulkhead	100
2E5	Stagger mounting of shore power receptacles with 90-degree potting inside of bulkhead	102
2E6	Mounting shore power receptacles outside of bulkhead	104
2E7	Mounting shore power receptacles outside of bulkhead	106
2E8	Incline mounted shore power receptacles in protected areas	108
2E9	Free standing multiple shore power station	110
2E10	In-line connectors on alongside power cables (destroyer tenders and repair ships only)	112
2E11	In-line connectors on alongside power cables (for submarine tenders only)	114
2E12	Protection of shore power cable when exiting trunks (submarines)	116
2E13	Portable shore power cable jumper assemblies	118
2E14	Shore power installation for submarines	120
2E15	Termination and potting ship-or-shore power plug MIL-C-24368/1	122
2E16	Termination and potting ship-or-shore power receptacle MIL-C-24368/2	125
2E17	Alongside power in-line connectors MIL-C-24368/4 (tenders and repair ships)	128
2E18	Installation details for shore power receptacle MIL-C-24368/2	130
2E19	Typical shore power cable supports	132

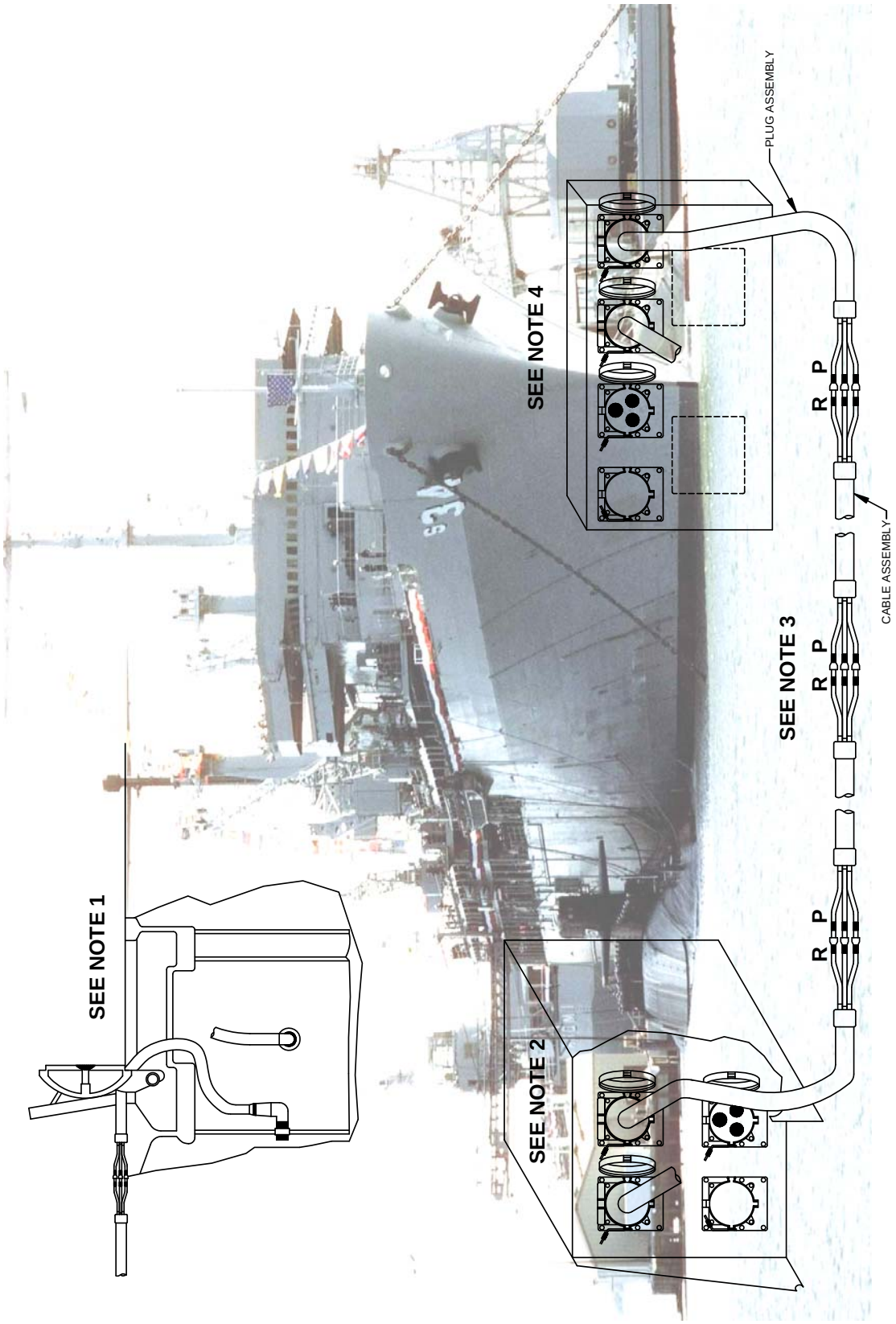


FIGURE 2E1. Shore power installations.

LEGEND:

P - Plugs (See figures 2E13 and 2E17)

R - Receptacles

NOTES:

1. Typical shore power installations for submarines are shown on figures 2E13 and 2E14.
2. Reference should be made to MIL-STD-3007 for typical shore power installations for shore activities.
3. In-line connector installations in accordance with figure 2E17 are used to connect cable assemblies to shore power plugs. For ease of handling, approximately 10' of THOF-500 cable (15' of THOF-500 cable for submarines) is used for each plug assembly and approximately 150' of THOF-500 for each cable assembly. In-line connectors shall not be used in lieu of a splice of short run cables. Further, in-line connectors may be omitted in favor of a continuous length of cable.
4. Typical shore power installations for surface ships are shown on figures 2E1 through 2E13.
5. Portable shore-to-ship power cables are the responsibility of the shore activity. Portable ship-to-ship or ship-to-shore cables onboard ship (tenders, repair ships, etc.) are the responsibility of the ship. Splicing of shore power cables is not recommended. If they cannot be avoided, splices and cable jacket repair should be in accordance with the hot splice vulcanized neoprene method described in the Civil Engineering (Naval Construction and Battalion Center, Port Hueneme, CA 93043) Technical Note TN No. N-1503.
6. Provide ungrounded electrical power at the ship's shore power connection. Power shall be ungrounded from a dedicated transformer secondary serving only the ship and no industrial grounded type loads. The transformer amphere rating is not to be demanded or have a diversity factor applied.
7. Voltage shall not exceed the steady state voltage, ±5 percent, as measured at the ship's main switchboard, i.e., for a 450-volt nominal ship system the allowable range is 427.5 to 472.5 volts.
8. Current rating requirement shall be achieved via multiple 400-amp shore power cabling circuits.
9. Install safety devices at dockside capable of automatically maintaining services during power surges and equipped with circuit breakers to de-energize the electrical power during overloads. A 400-amp circuit breaker (100 KAIC rating) shall be provided for each portable shore power cable circuit serving ship. Ensure circuit breaker KAIC rating equals or exceeds (450 volt) transformer and cabling system capability.
10. Portable shore power cabling and connectors serving ship shall have a total current carrying capacity equal to or exceeding the specified shore power current requirements.
11. Type and condition of portable cabling and connectors shall be in accordance with (MIL-STD-2003-2) figure 2E1.
12. Spliced portable cabling is not to be used.
13. All portable cable circuits are to be of equal lengths (within 10 percent).
14. Cabling shall not be allowed to droop into river/sea.
15. Route excess lengths of portable cabling along length of pier and not in coils.
16. Post safety barriers at ship and shore connections.
17. Connect the portable shore power cabling and connectors to the ship.
18. Comply with the ship's polarity requirements.
19. Shore power cables shall be wrapped with protective covering at locations where chafing may occur.
20. PE-stamped power system one-line diagram shall be reviewed/accepted by government electrical engineer prior to award of contract or connection of ships power to commercial facilities. The drawing is to show both permanent and portable conductors (size/type), switchgear bus ratings, other disconnects, pier connections, circuit breaker ratings, or other features from utility (source) to ships terminals.

FIGURE 2E1. Shore power installations - Continued.

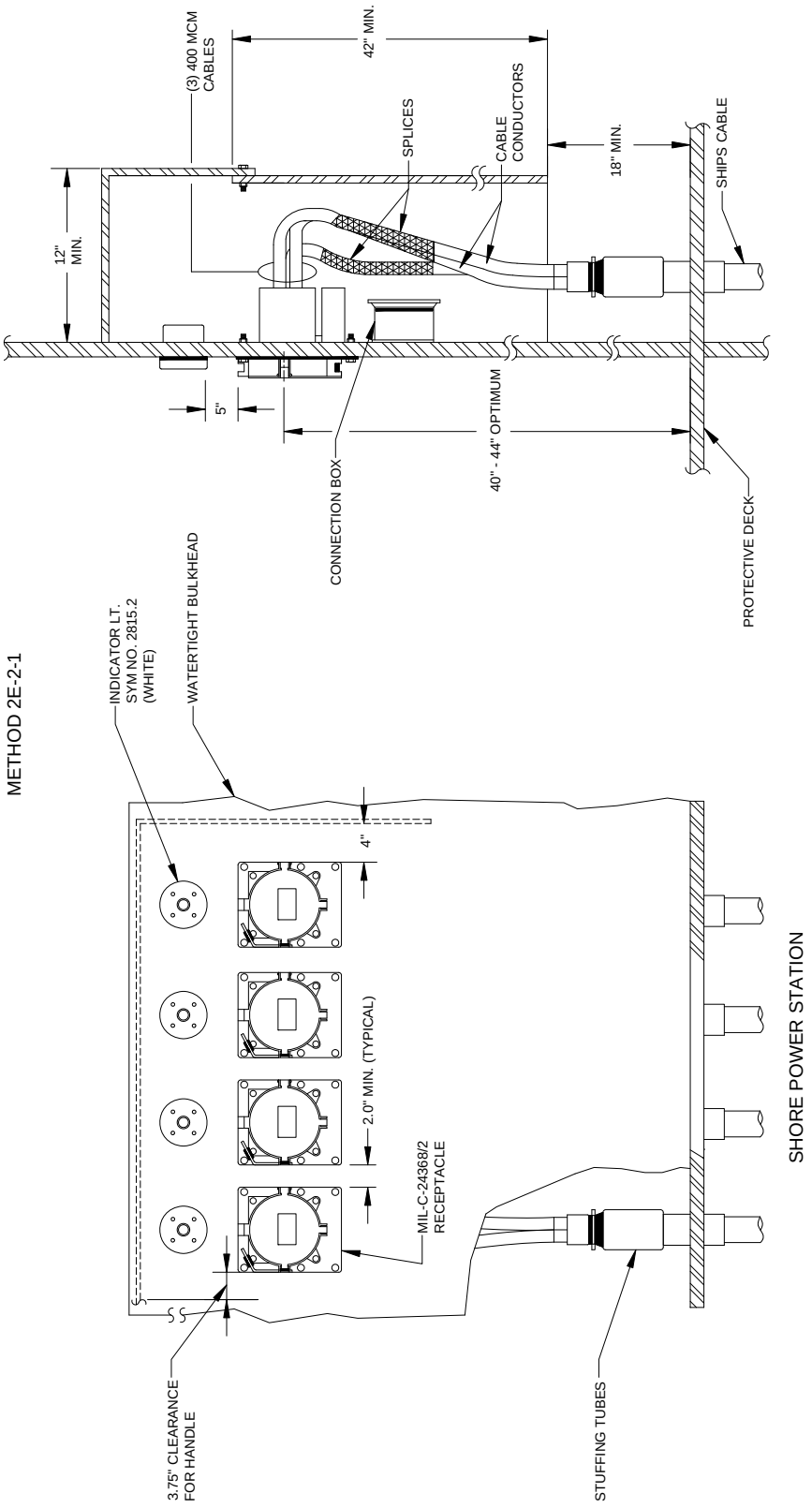


FIGURE 2E2. Shore power installations.

NOTES:

1. See figures 2E16 and 2E18 for installation details of receptacles.
2. Configuration of shore power station as shown hereon is optimum and should be followed to the greatest extent possible.

FIGURE 2E2. Shore power installations - Continued.

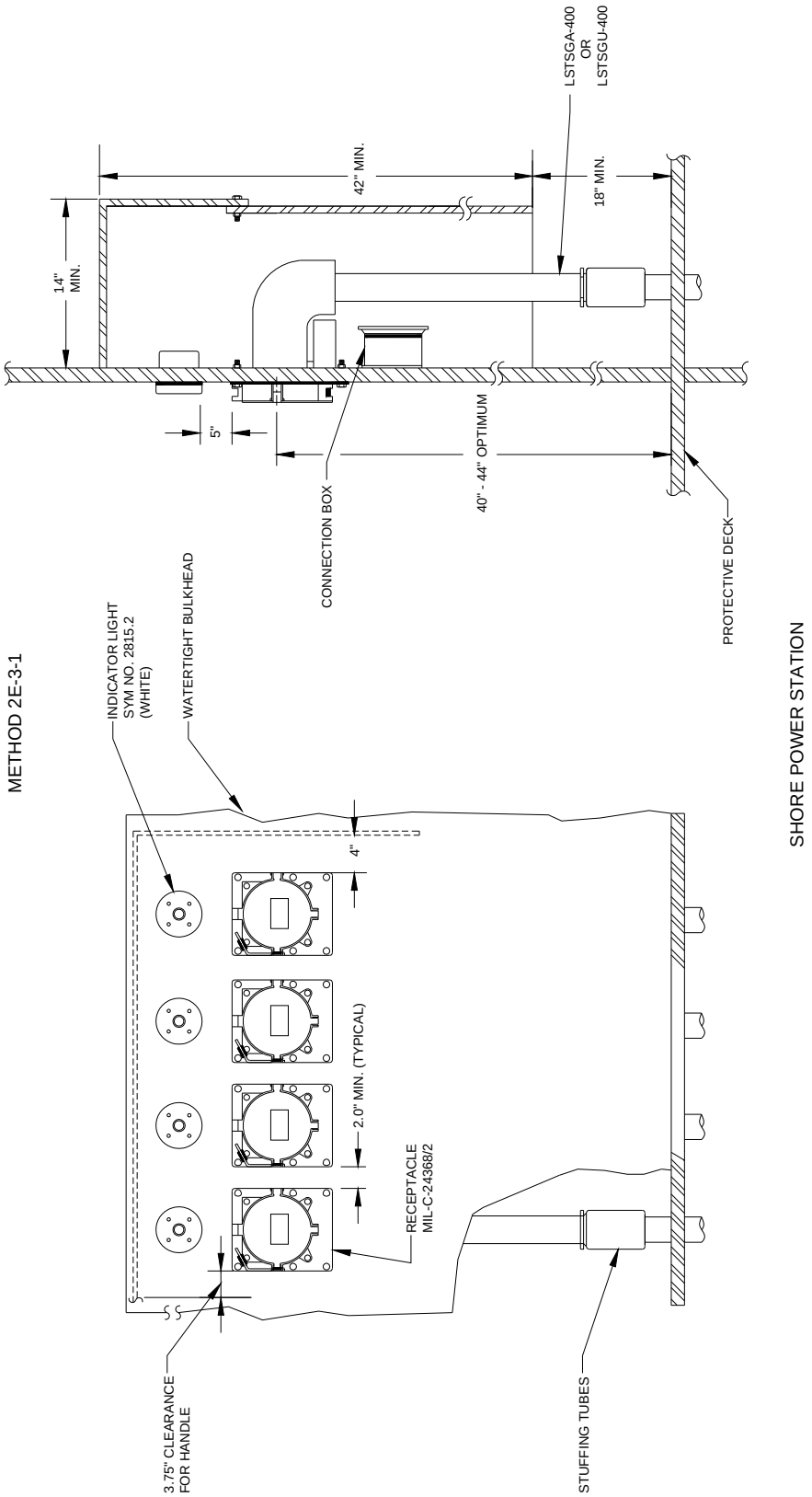


FIGURE 2E3. Mounting shore receptacles with 90-degree potting inside of bulkhead.

NOTES:

1. See figures 2E16 and 2E18 for installation details of receptacles.
2. Configuration of shore power station as shown hereon is optimum and should be followed to the greatest extent possible.

FIGURE 2E3. Mounting shore receptacles with 90-degree potting inside of bulkhead - Continued.

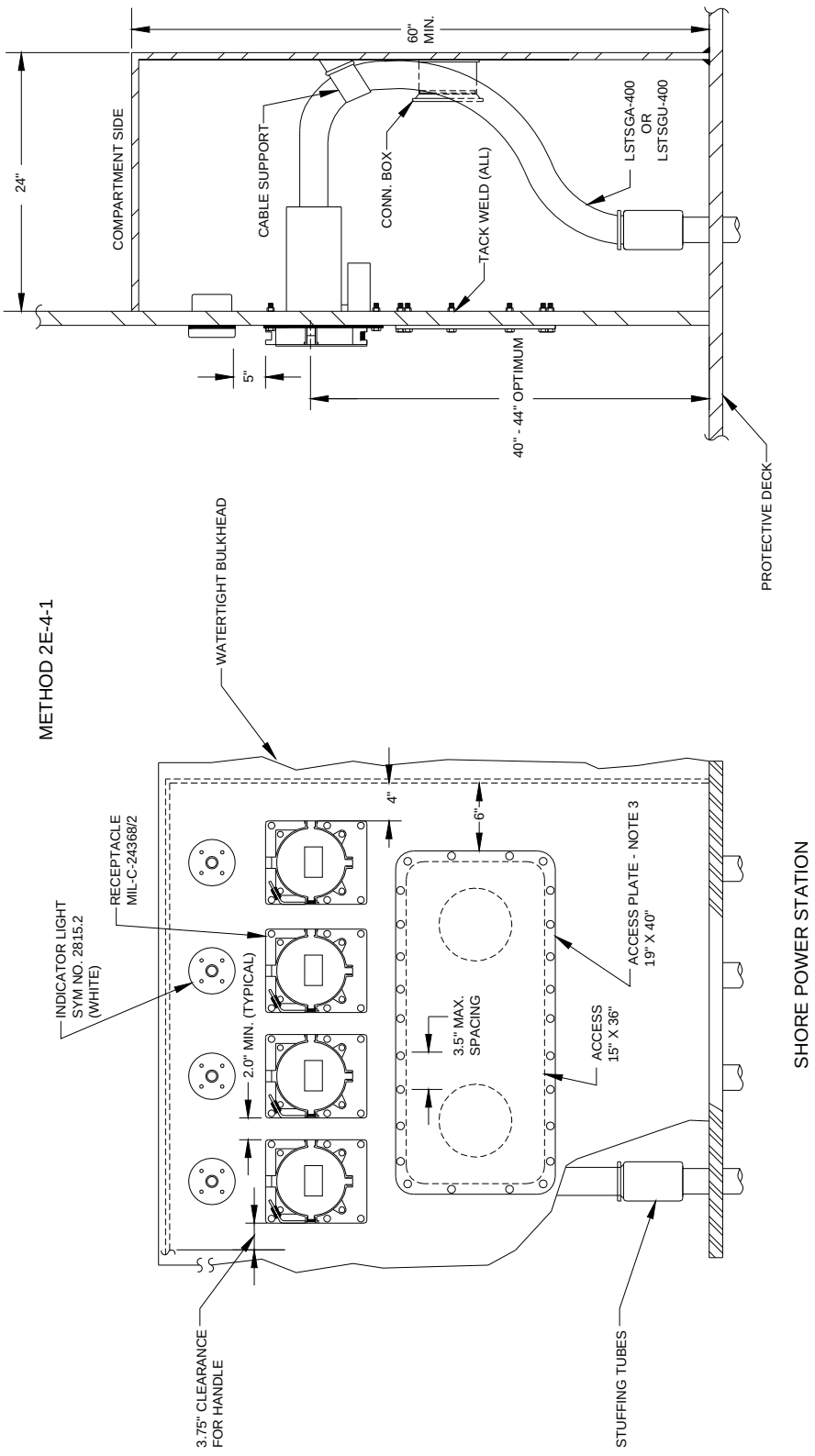


FIGURE 2E4. Mounting shore power receptacles inside of bulkhead.

NOTES:

1. See figures 2E16 and 2E18 for installation details of receptacles.
2. Configuration of shore power station as shown hereon is optimum and should be followed to the greatest extent possible.
3. Strength of access plate shall be equivalent to bulkhead. Front access shall be provided only when access from the compartment side cannot be provided.

FIGURE 2E4. Mounting shore power receptacles inside of bulkhead - Continued.

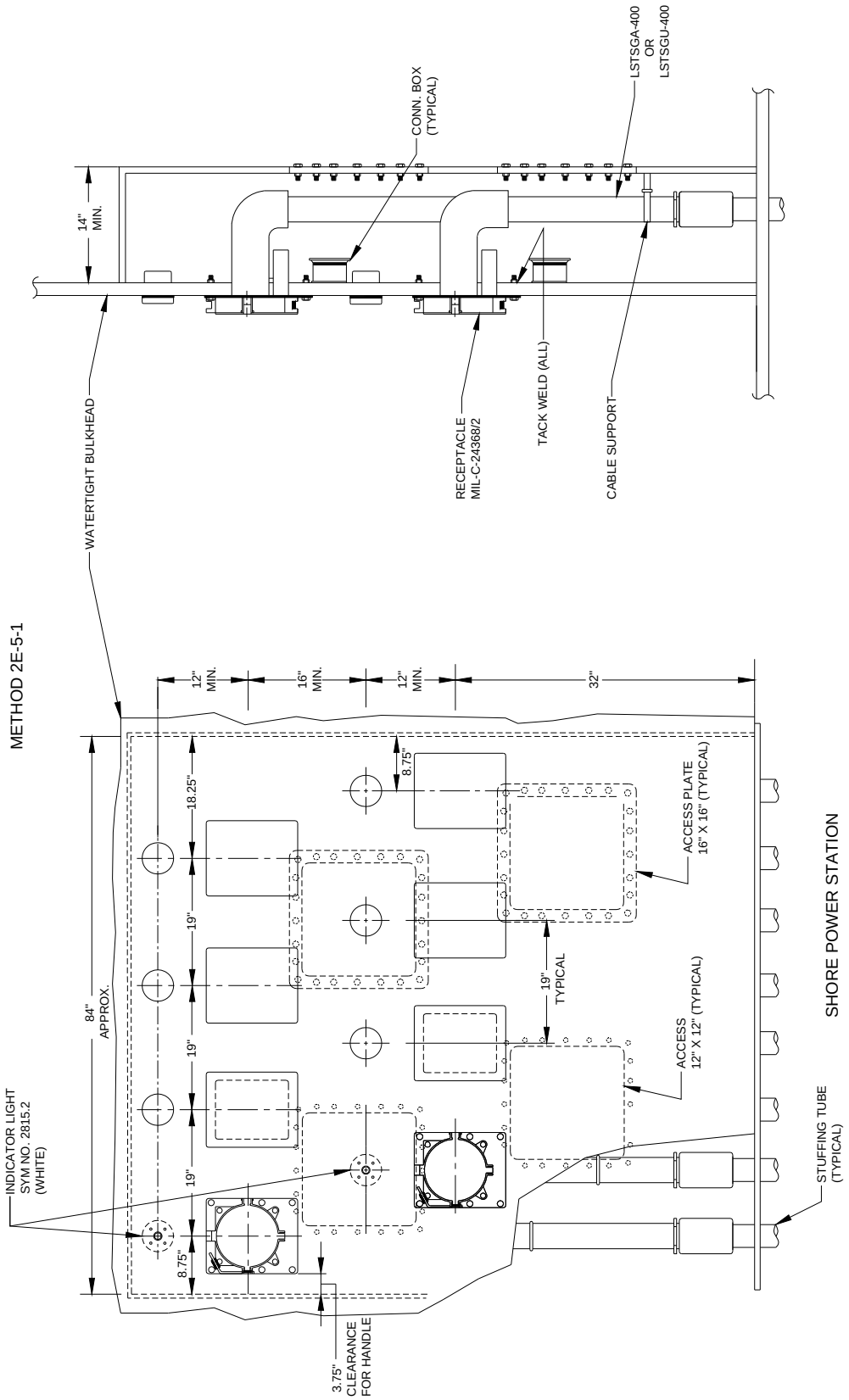


FIGURE 2E5. Stagger mounting of shore power receptacles with 90-degree potting inside of bulkhead.

NOTES:

1. See figures 2E16 and 2E18 for installation details of receptacles.
2. Configuration of shore power station as shown hereon is optimum and should be followed to the greatest extent possible.

FIGURE 2E5. Stagger mounting of shore power receptacles with 90-degree potting inside of bulkhead - Continued.

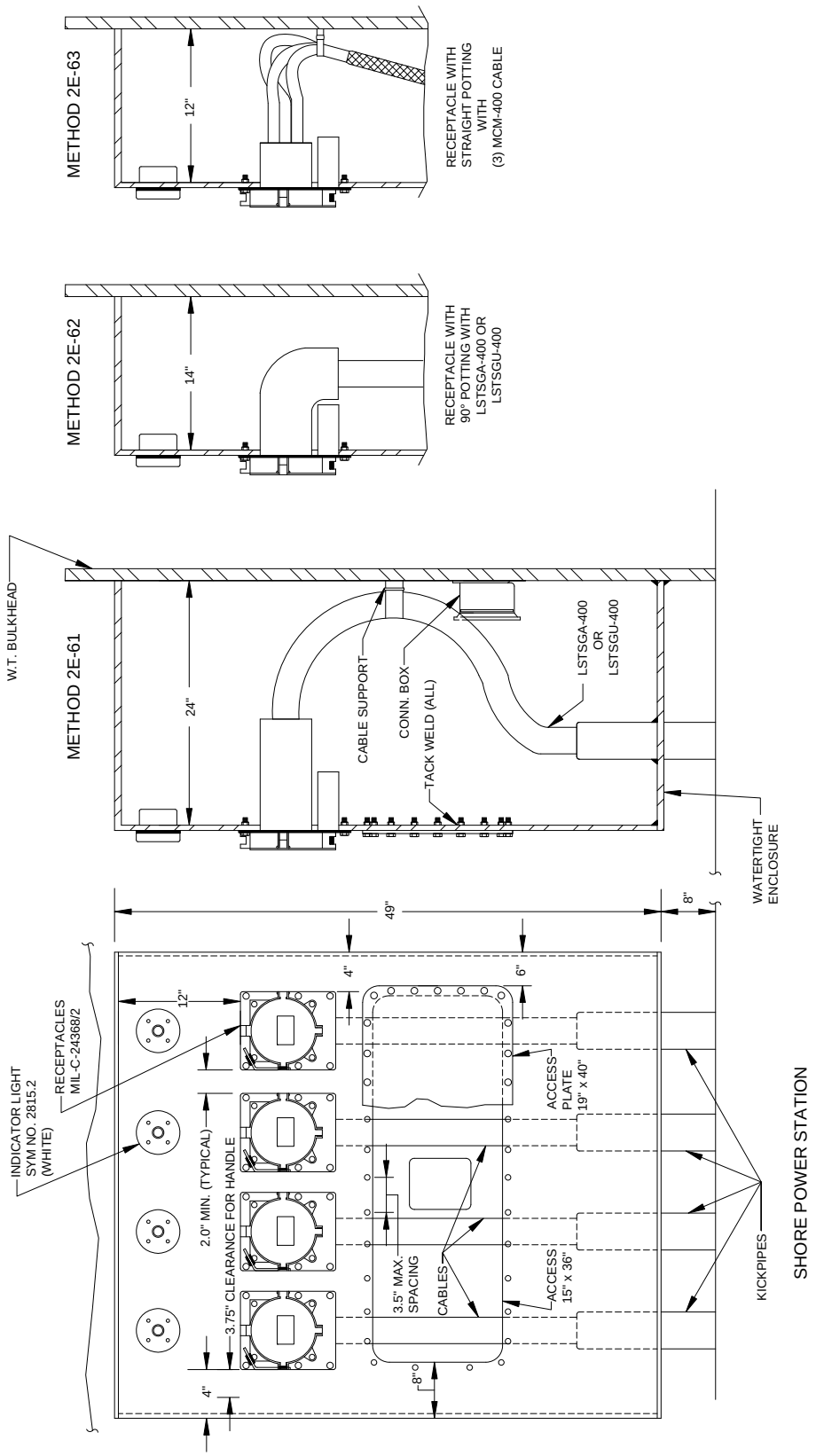


FIGURE 2E6. Mounting shore power receptacles outside of bulkhead.

NOTES:

1. See figures 2E16 and 2E18 for installation details of receptacles.
2. Configuration of shore power station as shown hereon is optimum and should be followed to the greatest extent possible.

FIGURE 2E6. Mounting shore power receptacles outside of bulkhead - Continued.

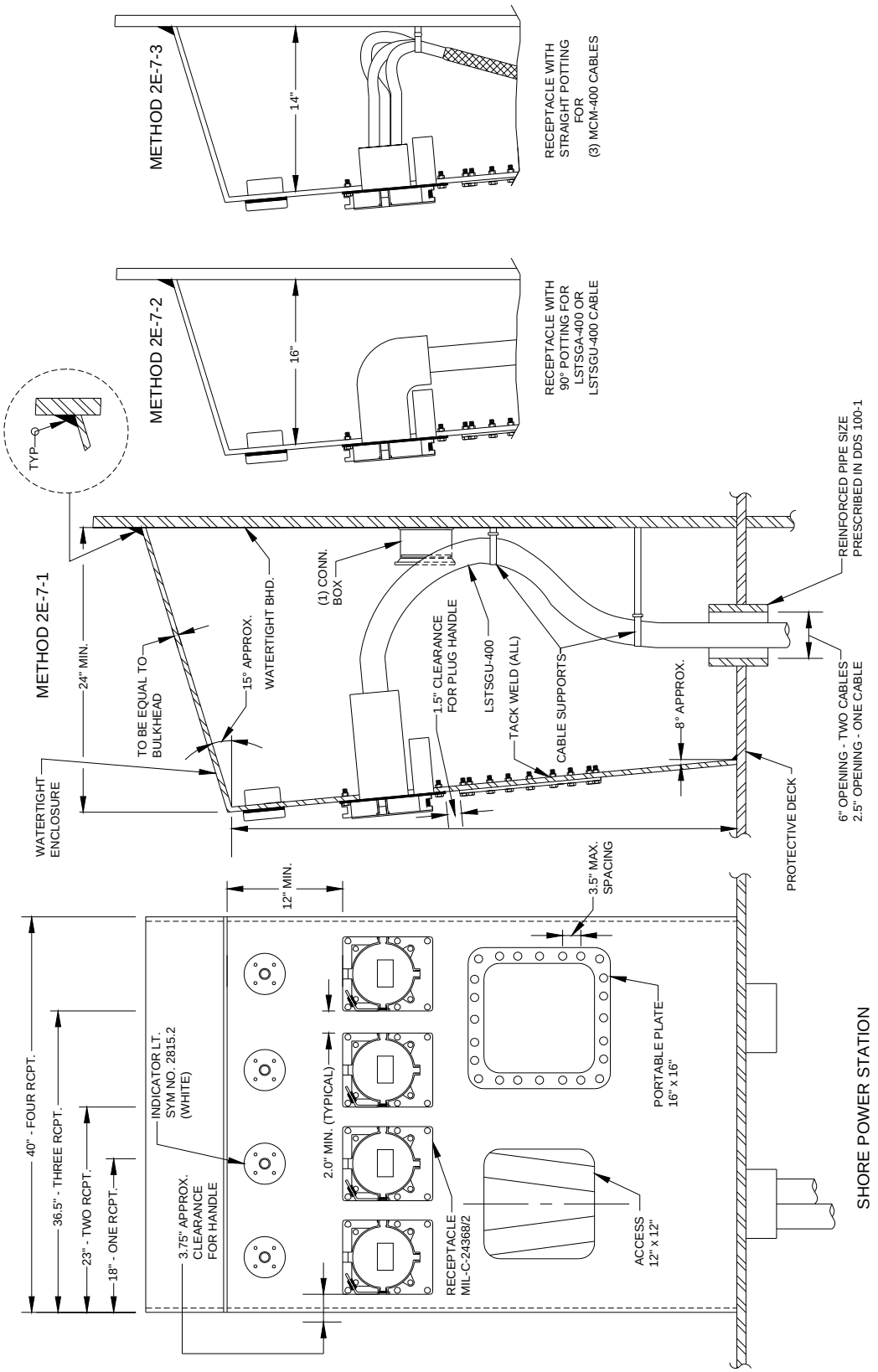


FIGURE 2E7. Mounting shore power receptacles outside of bulkhead.

NOTES:

1. See figures 2E16 and 2E18 for installation details of receptacles.
2. Configuration of shore power station as shown hereon is optimum and should be followed to the greatest extent possible.

FIGURE 2E7. Mounting shore power receptacles outside of bulkhead - Continued.

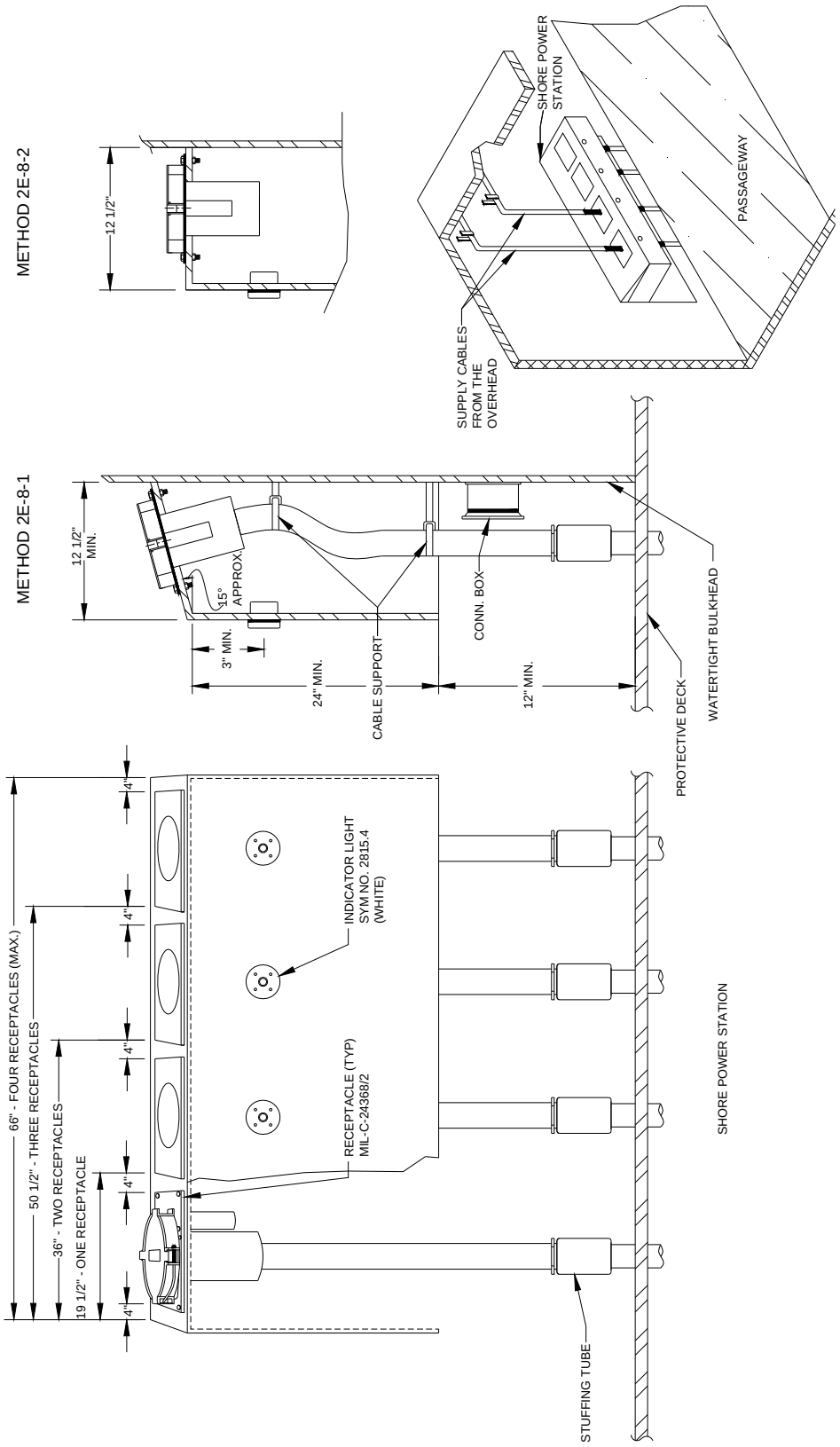


FIGURE 2E8. Incline mounted shore power receptacles in protected areas.

NOTES:

1. See figures 2E16 and 2E18 for installation details of receptacles.
2. Configuration of shore power station as shown hereon is optimum and should be followed to the greatest extent possible.
3. This method shall be used only in protected areas such as passageways, storerooms, and similar compartments not exposed to the weather.

FIGURE 2E8. Incline mounted shore power receptacles in protected areas - Continued.

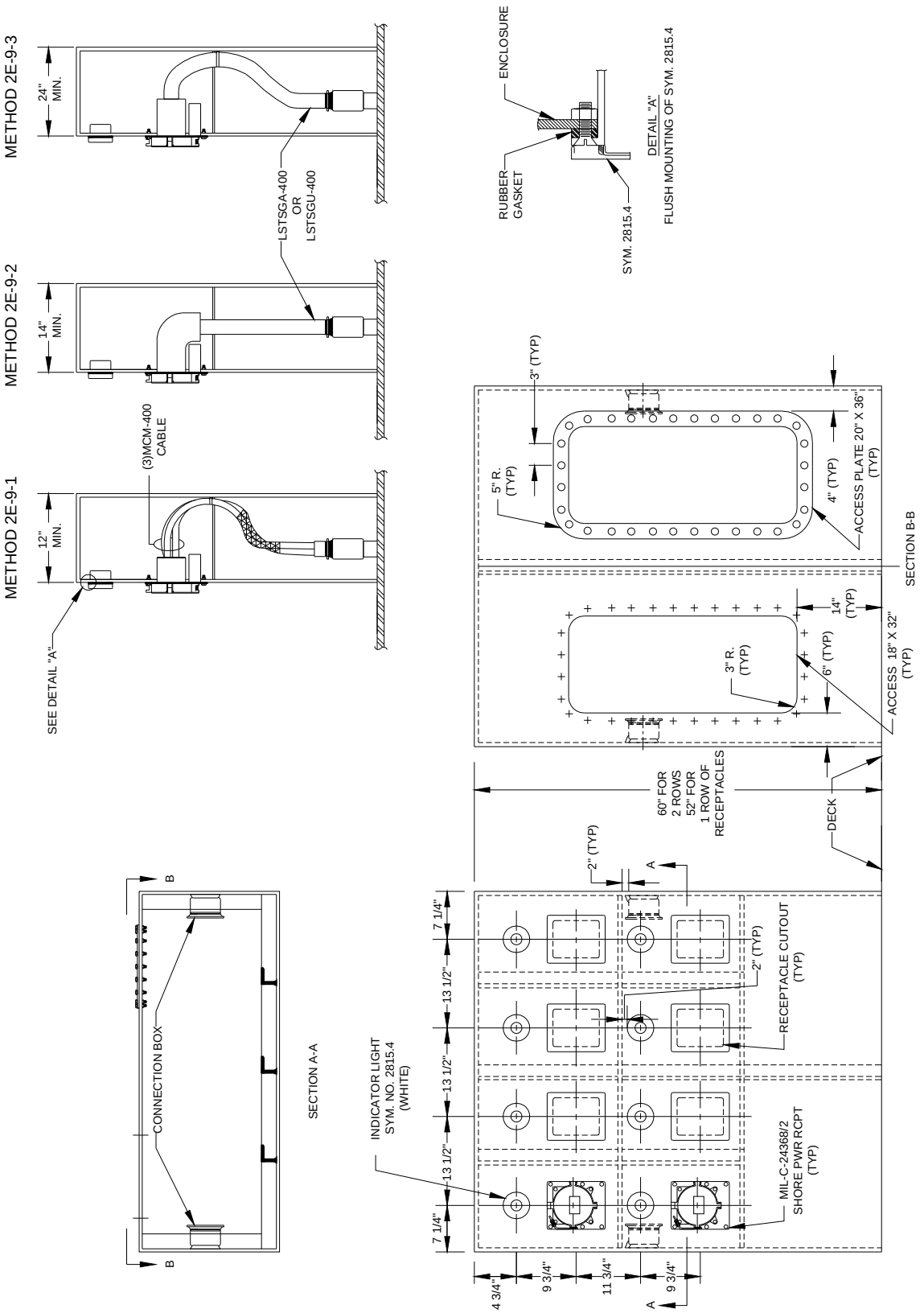


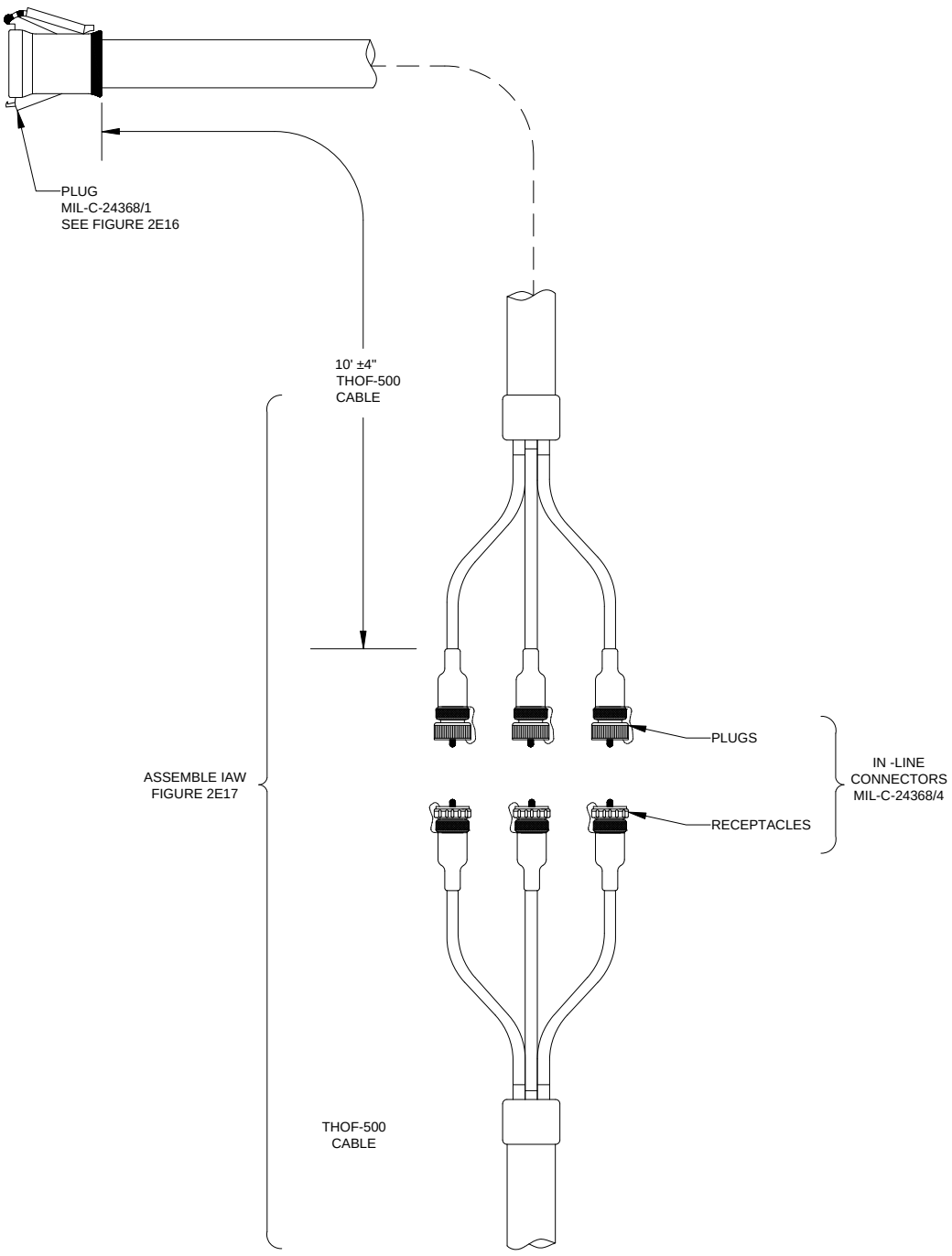
FIGURE 2E9. Free standing multiple shore power station.

NOTES:

1. See figures 2E16 and 2E18 for installation details of receptacles.
2. Configuration of shore power station as shown hereon is optimum and should be followed to the greatest extent possible.

FIGURE 2E9. Free standing multiple shore power station - Continued.

METHOD 2E-10-1
DESTROYER
TENDERS



NOTES:

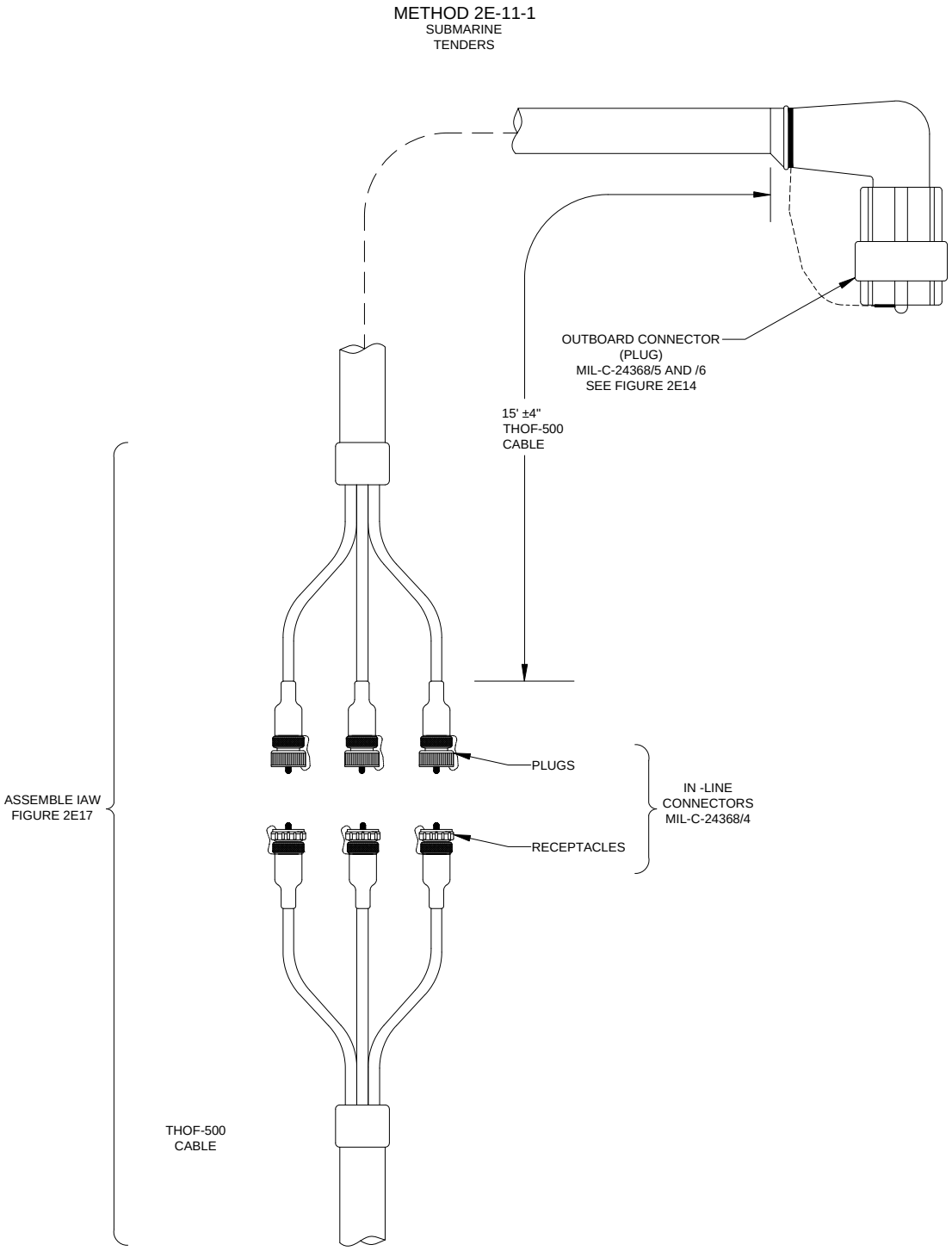
1. Cable assembly Method 2E-10-1 is permitted on destroyer tender and repair ships to join two lengths of cable together. Every effort should be made to install the required length of cable in lieu of using in-line connections.

FIGURE 2E10. In-line connectors on alongside power cables (destroyer tenders and repair ships only).

NOTES (continued):

2. Shore facilities may utilize available commercial single-phase or three-phase in-line connectors to facilitate shore power connection to ship. The type of connector used shall be determined by responsible shore facility. For non-MIL-Spec in-line connectors, installation methods shall be in accordance with manufacturers' instructions.

FIGURE 2E10. In-line connectors on alongside power cables (destroyer tenders and repair ships only) - Continued.



NOTES:

1. Cable assembly Method 2E-11-1 is permitted on submarine tenders when it is necessary to replace a damaged MIL-C-24368/5 or /6 type plug connector. The tender may purchase a 15' length of cable with a MIL-C-24368/5 or /6 type plug connector at one end. This cable may be connected to the alongside power cable via in-line connectors.

FIGURE 2E11. In-line connectors on alongside power cables (for submarine tenders only).

NOTES (continued):

2. Shore facilities may utilize available commercial single-phase or three-phase in-line connectors to facilitate shore power connection to ship. The type of connector used shall be determined by responsible shore facility, for non-MIL-Spec in-line connector, installation shall be in accordance with manufacturers' instructions.

FIGURE 2E11. In-line connectors on alongside power cables (for submarine tenders only) - Continued.

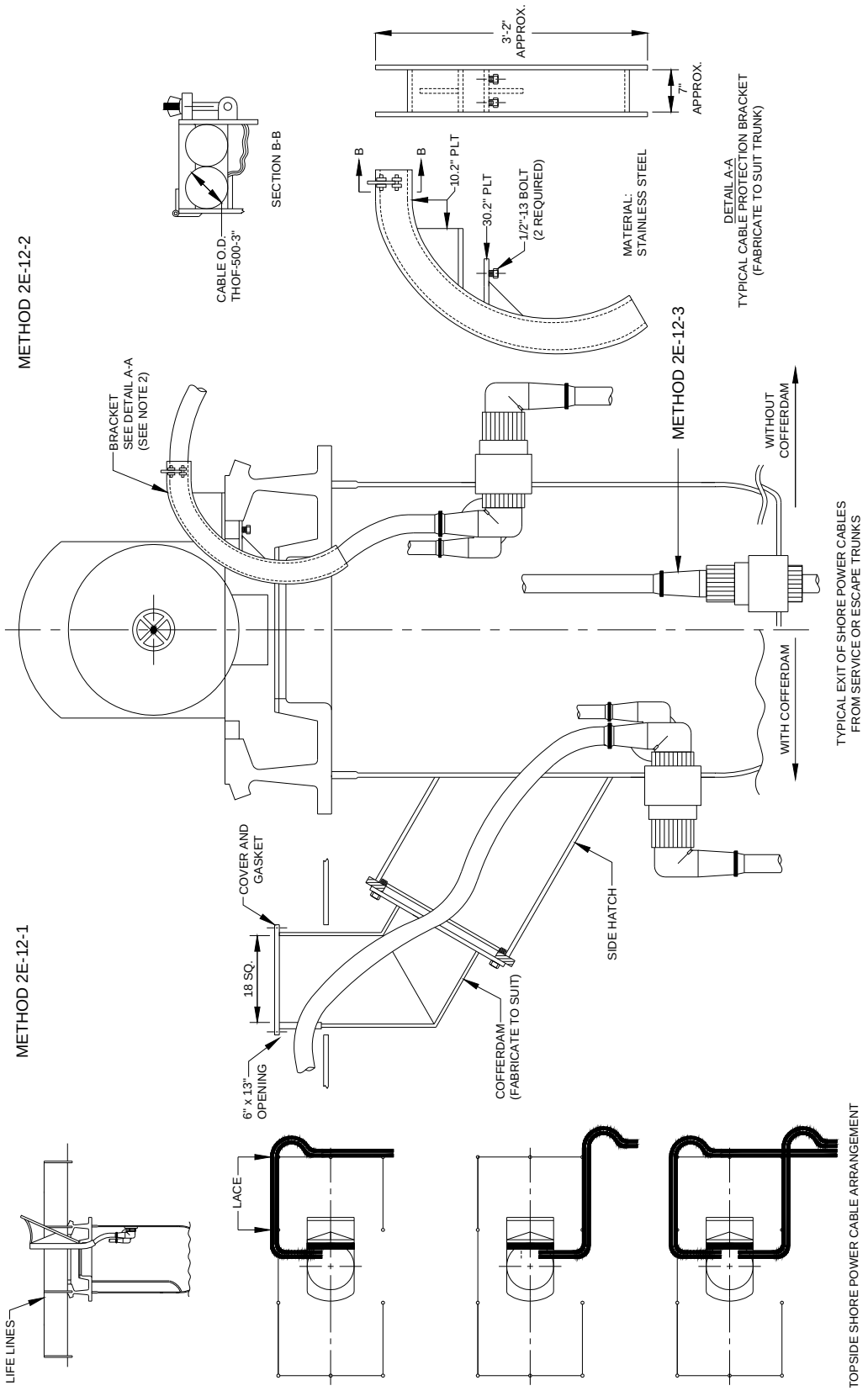


FIGURE 2E12. Protection of shore power cable when exiting trunks (submarines).

NOTES:

1. Location and arrangement of cables in trunks must facilitate their exit.
2. Cables must be protected against cuts resulting of personnel traffic through the trunk, and of cable resting against sharp edges. Sharp bend radius of cables shall be avoided.

FIGURE 2E12. Protection of shore power cable when exiting trunks (submarines) - Continued.

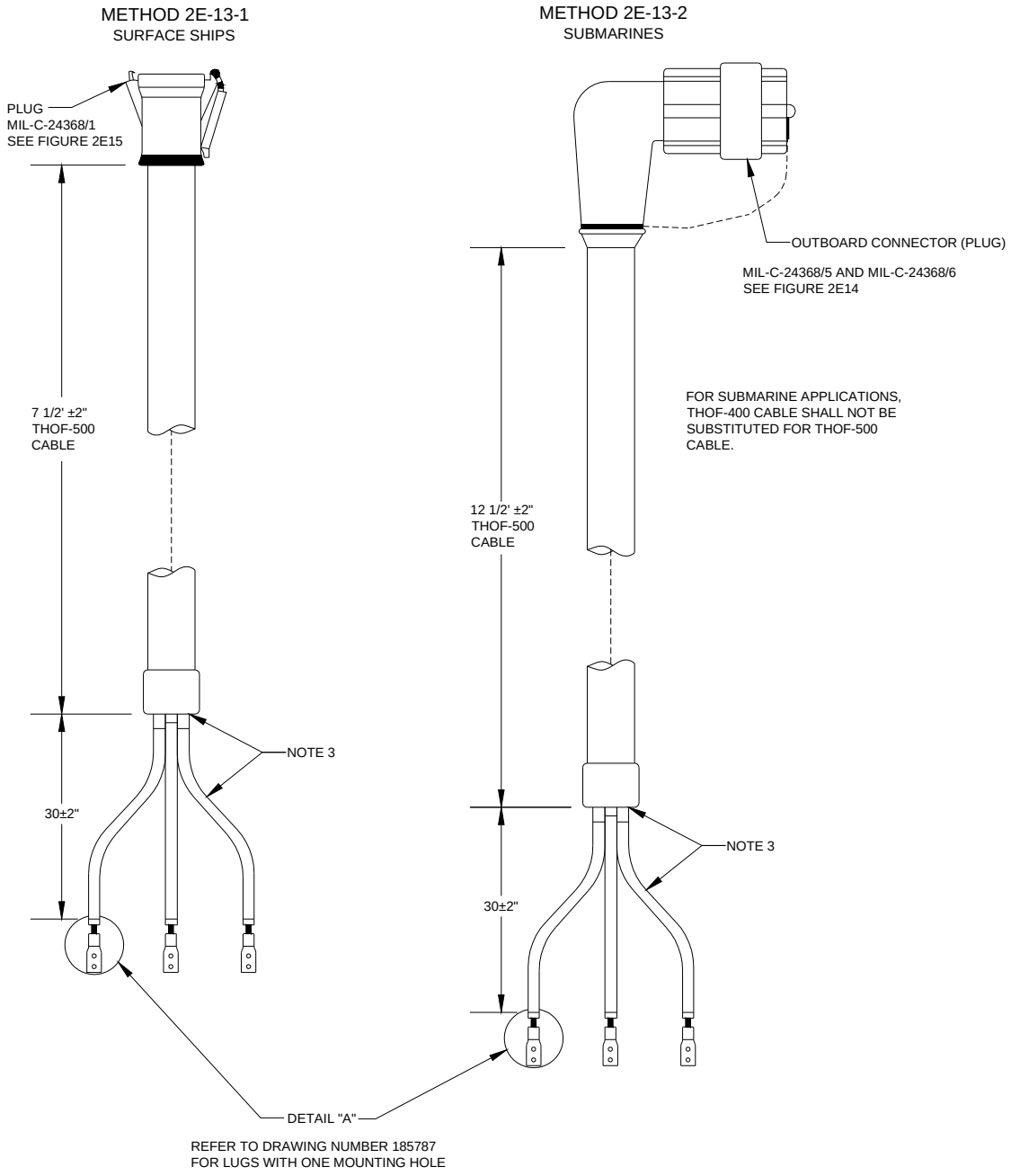
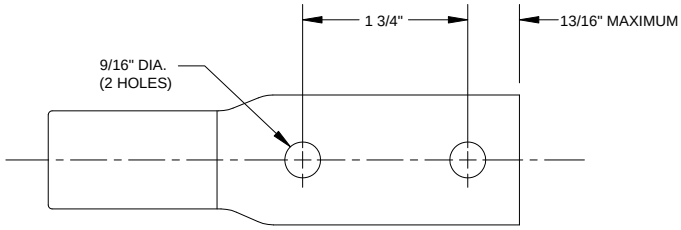


FIGURE 2E13. Portable shore power cable jumper assemblies.



COPPER CRIMP LUG (SILVER - PLATED), TYPE CLC, MIL-T-16366. CRIMP LUG TO CABLE. SEE CRIMP LUG TABLE.

DETAIL "A"

TABLE 2E13-I. Crimp lugs.

Cable type	Nominal diameter of conductor (inch)	Lug size*	Crimp lug (MIL-T-16366) Thomas & Betts or equivalent
THOF-500	0.960	500 MCM	256-30695-555
		600 MCM	54289
THOF-400	0.850	400 MCM	256-30695-535
		500 MCM	256-30695-555
Equivalent crimp lugs may be substituted for the ones specified above. Order lugs (silver-plated) with blank tongue and drill (two holes) as shown in Detail A. * Flexible cable, such as THOF (MIL-DTL-915/6), may require the next larger size lug due to the larger outside diameter of the flexible conductors (see MIL-T-16366).			

NOTES:

1. Portable shore power cable jumper assemblies are a NATO requirement. They are furnished onboard ships to connect to shore cable assemblies in foreign ports or in places where the proper plugs are not available. Normally, the supply activity provides both the cable assembly and the appropriate plugs.
2. Stowage facilities shall be furnished for these assemblies.
3. Install a crotch boot and tubing in accordance with figure 2E17.
4. The NATO required adapter cables should not include in-line connectors.
5. Jumper cables for in-service vessels may be Type THOF-400. However, there shall be no mixing of jumper cable sizes for each installation. For submarine applications, THOF-400 cable shall not be substituted for THOF-500 cable.

FIGURE 2E13. Portable shore power cable jumper assemblies - Continued.

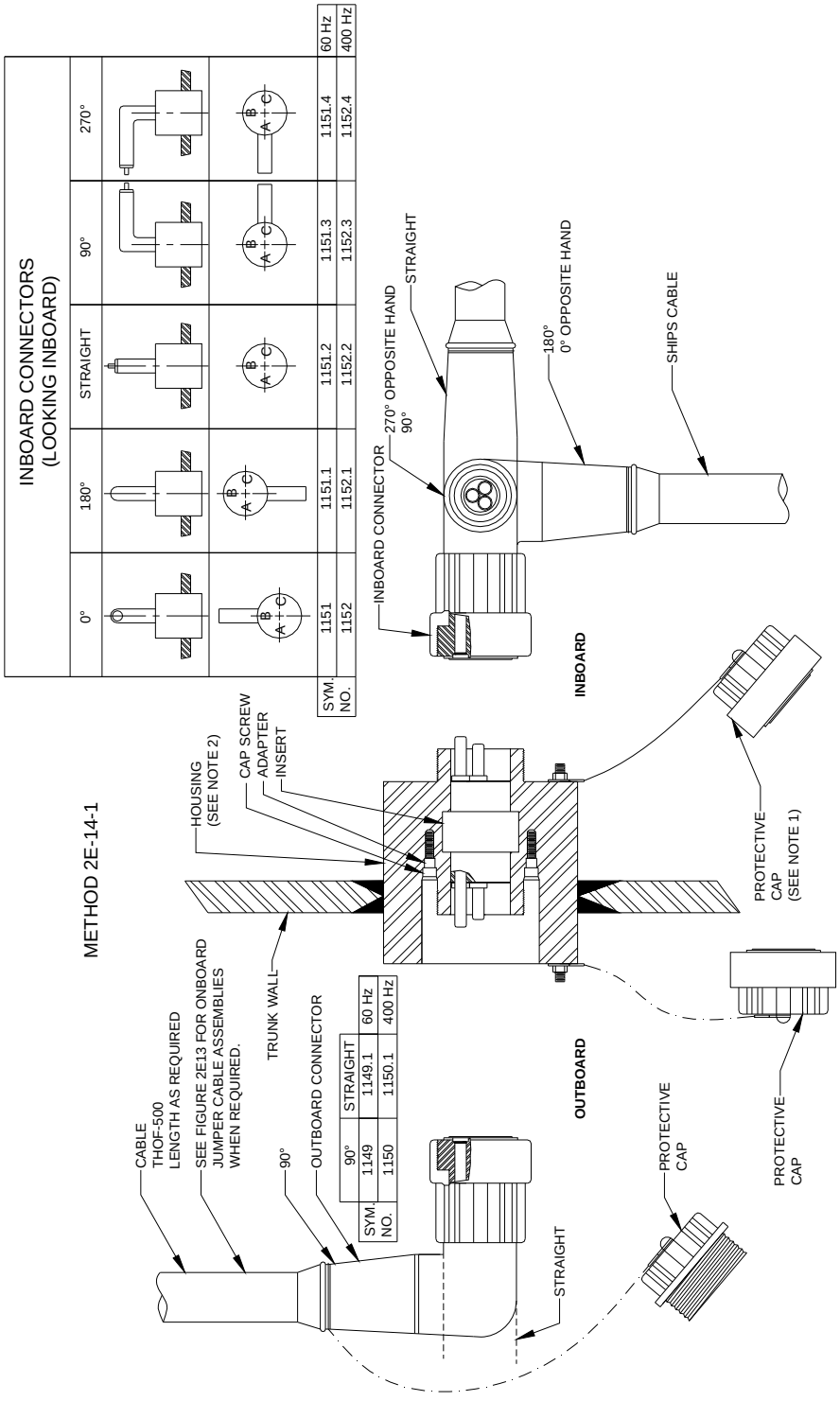


FIGURE 2E14. Shore power installation for submarines.

NOTES:

1. Protective caps are not necessary inboard unless required by the installing activity.
2. Housing shall be made of steel matching that of the submarine hull by the supplier in accordance with MIL-C-24368/5.
3. A spanner is required for the installation of connectors of protective caps. Spanner wrench shall be J.H. Williams & Co. 3" face spanner wrench part no. 434 or equivalent.
4. Hardware shown hereon is in accordance with MIL-C-24368/5.

FIGURE 2E14. Shore power installation for submarines - Continued.

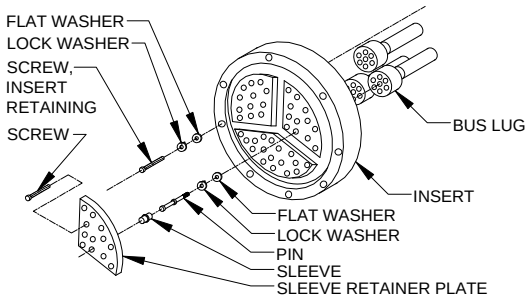


ILLUSTRATION 1 - PLUG DISASSEMBLY

Step 1 – Plug disassembly:

If plug is received partially assembled, remove insert retaining screws and remove insert, by pushing from rear. Remove sleeve retaining plates, sleeves, pins, and bus lugs.

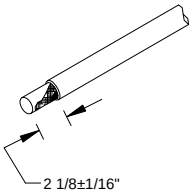


ILLUSTRATION 2A - SINGLE CONDUCTOR CABLE
- FOR RECEPTACLE ONLY -
FIGURE 2E16

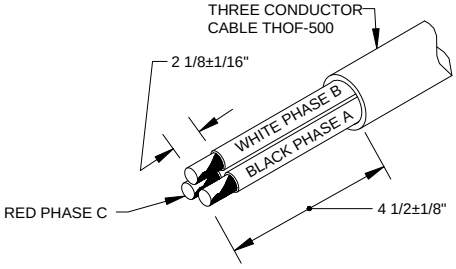


ILLUSTRATION 2B - 3 CONDUCTOR CABLE

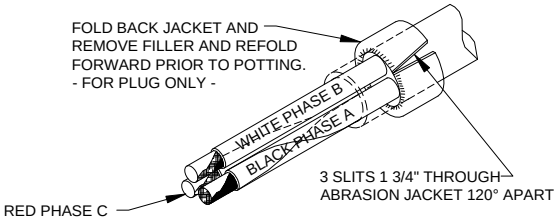


FIGURE 2C: TO BE USED WHEN CABLE LAY IS OUT OF PHASE WITH BUS BAR ORIENTATION. (ILLUS. 3)

ILLUSTRATION 2C - 3 CONDUCTOR CABLE

Step 2 – Cable end preparation:

Remove abrasion jacket and insulation as shown in illustrations 2A, 2B, or 2C as applicable.

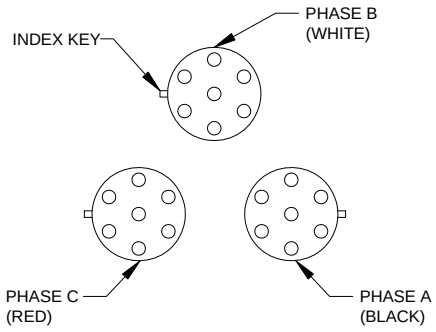


ILLUSTRATION 3 - FRONT VIEW BUS LUG AND CABLE CONDUCTOR ORIENTATION

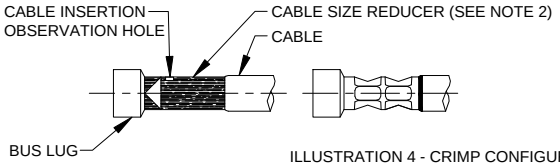


ILLUSTRATION 4 - CRIMP CONFIGURATION

Step 3 – Cable termination:

Prior to crimping, position bus lugs on conductors as shown in illustration 3. Note position of index keys. Insert cable into bus lugs and crimp as shown in illustration 4. Crimp using Thomas & Betts (T&B) hydraulic power crimp and die set, or equivalent.

FIGURE 2E15. Termination and potting ship-or-shore power plug MIL-C-24368/1.

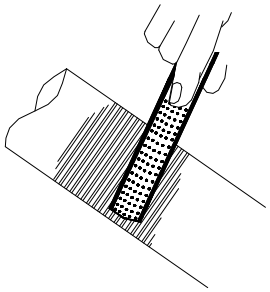


ILLUSTRATION 5 - CABLE INSULATION SCRAPING

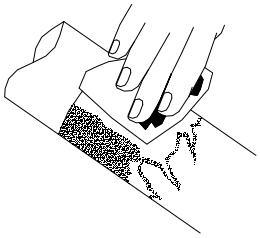


ILLUSTRATION 6 - CABLE INSULATION CLEANING

Step 4 – Cable scraping and cleaning:

Thoroughly scrape and roughen the outside insulation at the conductors and cable jacket with a scraper. Coarse file or emery cloth for a length to be potted to ensure adhesion with the potting compound. Abrade the rear face of the insert (bus lug side) and the inside surface of the plug in the same manner. Clean abraded area with a lint-free cloth wetted with acetone or methyl ethyl ketone, and allow to dry.
Note: Avoid touching or handling of roughened area to eliminate any contamination of surface.

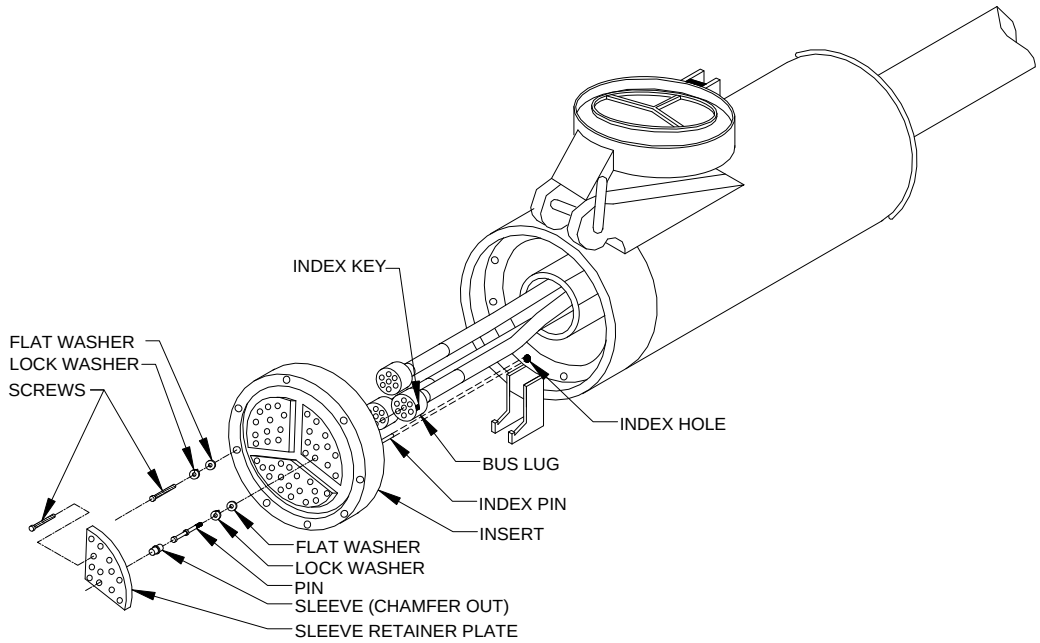


ILLUSTRATION 7 - PLUG ASSEMBLY

Step 5 – Potting:

Slide plug housing over cable and assemble as follows (see illustration 7):

a. Position insert on the bus lugs so index keys fit in their respective slots.
b. Apply a light coat of non-insulated lubricant (not silicone grease) to the threads of the 21 pins and install through the insert so lugs and insert are “locked” together. Lockwashers and flat washers are used with each pin. Flat washers are installed next to the insert.
   NOTE: Do not over-tighten pins (30 inch-pounds maximum) as they are copper.
c. Install 21 sleeves, chamfer facing out, by snapping them onto the ball-tipped pins (see note 4).
d. Install sleeve retainer plates (4 screws each).
e. Attach insert to plug housing with eight screws, the index pin, and hole pattern. Assure proper position. Assure that the eight screws are tight prior to potting.

FIGURE 2E15. Termination and potting ship-or-shore power plug MIL-C-24368/1 - Continued.

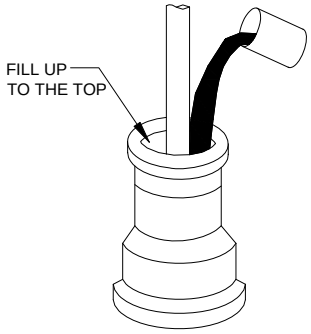


ILLUSTRATION 8

f. Set plug on end and secure the cable to a suitable overhead support. Position plug so that the cable is centered in hole at rear of the housing (illustration 8).
g. Weigh out the specified ratio of the stycast 2741 potting compound and the catalyst 16 hardener and mix thoroughly (see note 3). Pour the mixed compound slowly from one side of the plug housing until the void area is filled. Allow the compound to cure eight hours at room temperature.
h. Assemble.

Step 6 – The plug is now ready for use.

NOTES:

1. When the plug MIL-C-24368/1 is furnished without cable, it shall be prepared for use as shown hereon.
2. Unless otherwise specified in the contract or order, bus lugs are furnished for 500 MCM cable. Cable size reducers, Part M24368/4-033 of MIL-C-24368/4, shall be used if 400 MCM cable is used.
3. Potting compound shall be 100 parts by weight of stycast 2741 cured with 50 parts by weight of catalyst 16 as manufactured by Emerson Cuming, Inc., Canton, Massachusetts 02021. No other compound shall be used without prior approval of NAVSEA. To fill the plug, ¾ of a gallon (5 pounds) is required.
   NOTE: Verify that manufacturer's potting compound expiration date is still current.
4. **Caution:** If sleeve chamfer is not facing out, a hazardous condition will exist.

FIGURE 2E15. Termination and potting ship-or-shore power plug MIL-C-24368/1 - Continued.

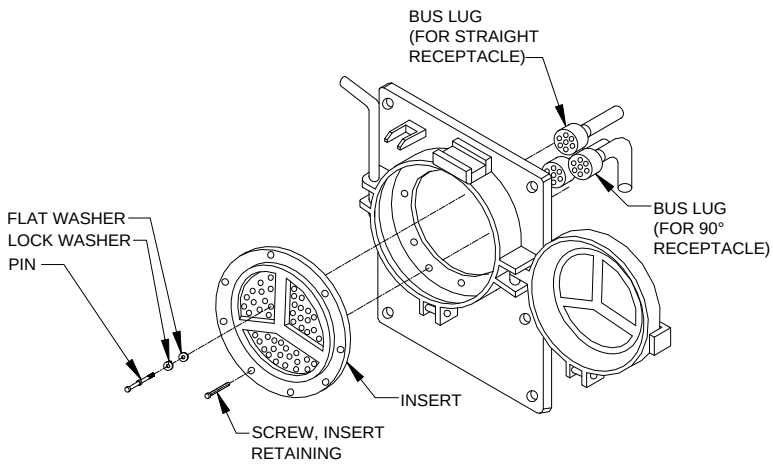


ILLUSTRATION 1 - RECEPTACLE ASSEMBLY

Step 1:

If receptacle is received partially assembled, remove insert retaining screws and remove insert by pushing from rear. If crimping of cable to bus lugs cannot be done while bus lugs are still assembled in the insert, remove them by removing the pins.

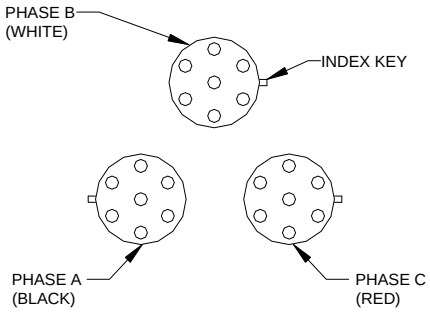


ILLUSTRATION 2A - FRONT VIEW BUS BAR AND CONDUCTOR ORIENTATION

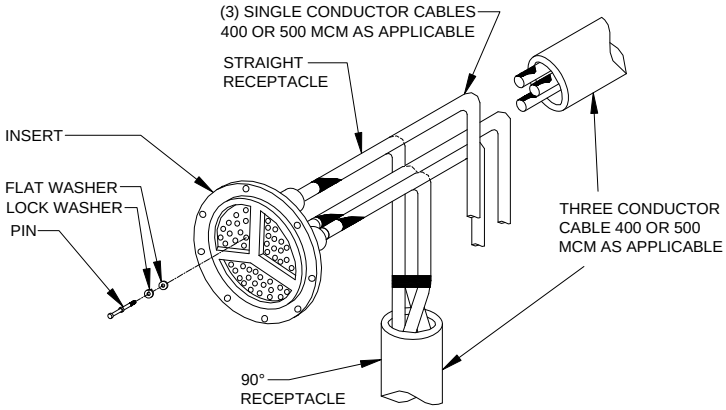


ILLUSTRATION 2B - INSERT AND CABLE ASSEMBLY

Step 2:

Prepare and terminate cable same as steps 2, 3 (modified as shown hereon), and 4 of figure 2E15. Prior to crimping, position bus lugs on conductors as shown in illustration 2A. Note position of index keys. Position insert on the bus lugs so index keys fit in their respective slots. Apply a light coat of non-insulating lubricant (not silicone grease) to threads of the 21 pins and install through the insert so lugs and insert are "locked" together as shown in illustration 2B. If cable is long or installed in ship, slide mounting plate over cable first.
NOTE: Do not over-tighten pins (30 inch-pounds maximum) as they are copper.

FIGURE 2E16. Termination and potting ship-or-shore power receptacle MIL-C-24368/2.

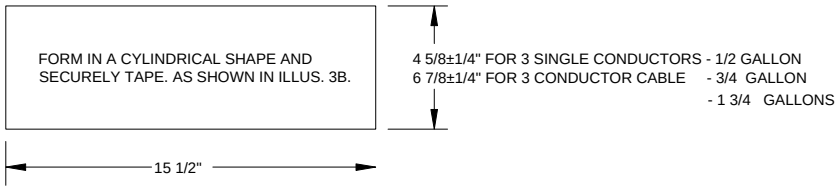


ILLUSTRATION 3A

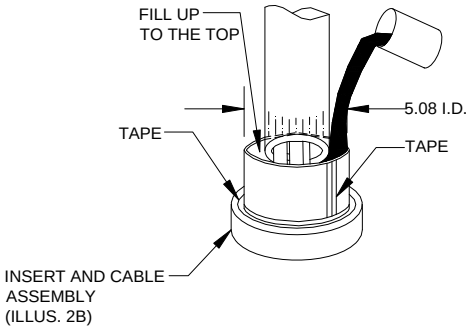


ILLUSTRATION 3B - MOLD FOR STRAIGHT RECEPTACLE

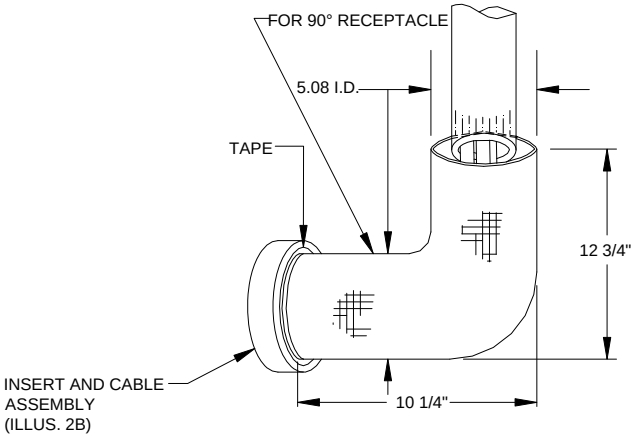


ILLUSTRATION 4 - MOLD FOR 90° RECEPTACLE

FIGURE 2E16. Termination and potting ship-or-shore power receptacle MIL-C-24368/2 - Continued.

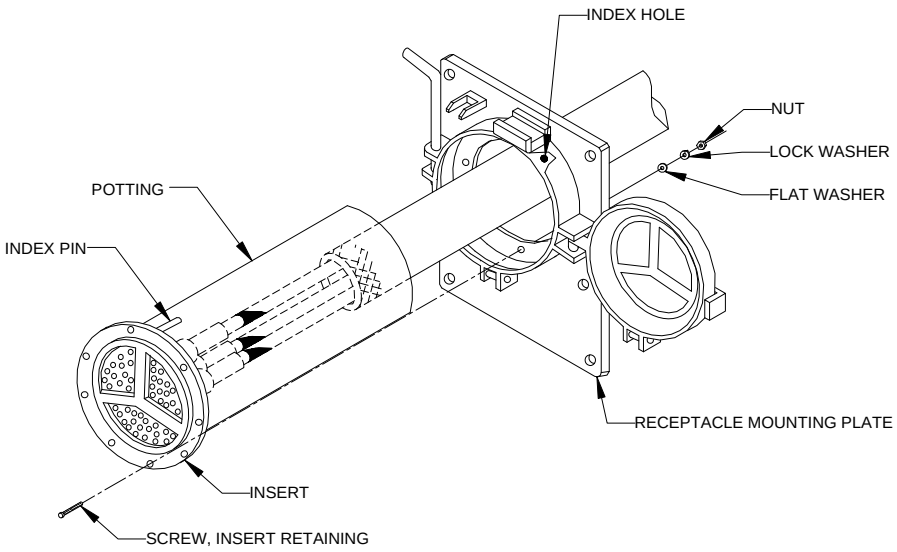


ILLUSTRATION 5 - RECEPTACLE ASSEMBLY

Step 3 – Potting:

a. Fabricate a mold to the dimensions shown in illustrations 3 and 4 from a material such as 0.03 thick plastic sheet. A cellulose acetate material has been shown to be satisfactory. Center and secure mold to insert with tape.
b. Position insert and secure cable to a suitable overhead support. Center cable in mold.
c. Weigh out the specified ratio of the stycast 2741 potting compound and the catalyst 15 hardener and mix thoroughly (see note 3). Pour the mixed compound slowly from one side of the receptacle housing until the void area is filled. Allow the compound to cure eight hours at room temperature.
d. Remove tape holding mold to insert. The mold may be removed if desired.
e. Slide cable through the hole (see illustration 5) in the receptacle mounting plate and attach insert with eight screws and nuts. The index pin and hole pattern will assure proper position.

Step 4 – The receptacle is now ready for use.

NOTES:

1. When the receptacle MIL-C-24368/2 is furnished without cable, it shall be prepared for use as shown hereon.
2. Unless otherwise specified in the contract or order, bus lugs are furnished for 400 MCM cable.
3. Potting compound shall be 100 parts by weight of stycast 2741 cured with 50 parts by weight of catalyst 15 as manufactured by Emerson Cuming, Inc., Canton, Massachusetts 02021. No other compound shall be used without prior approval of NAVSEA. The material required to fill the mold is shown next to illustration 3A.

FIGURE 2E16. Termination and potting ship-or-shore power receptacle MIL-C-24368/2 - Continued.

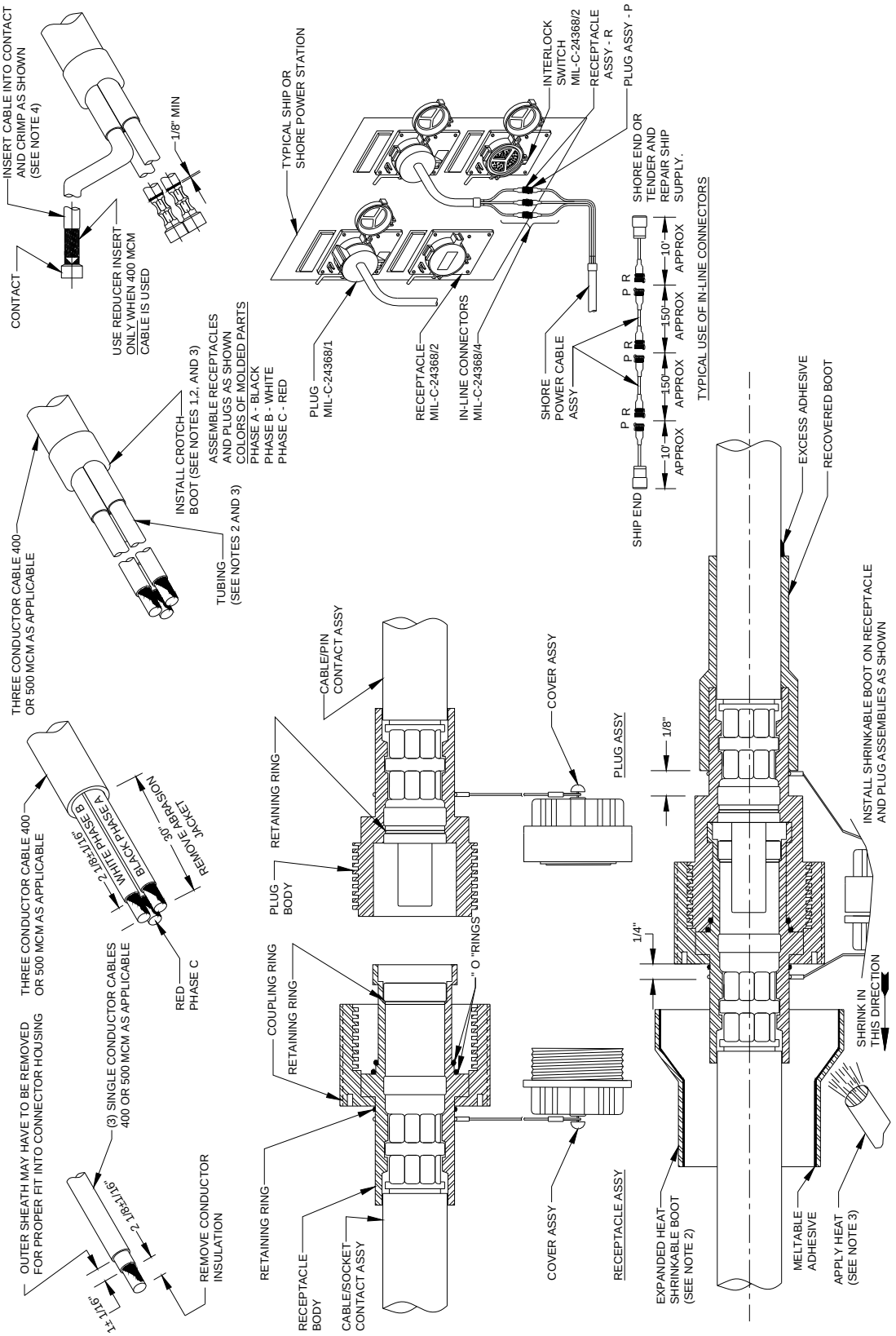


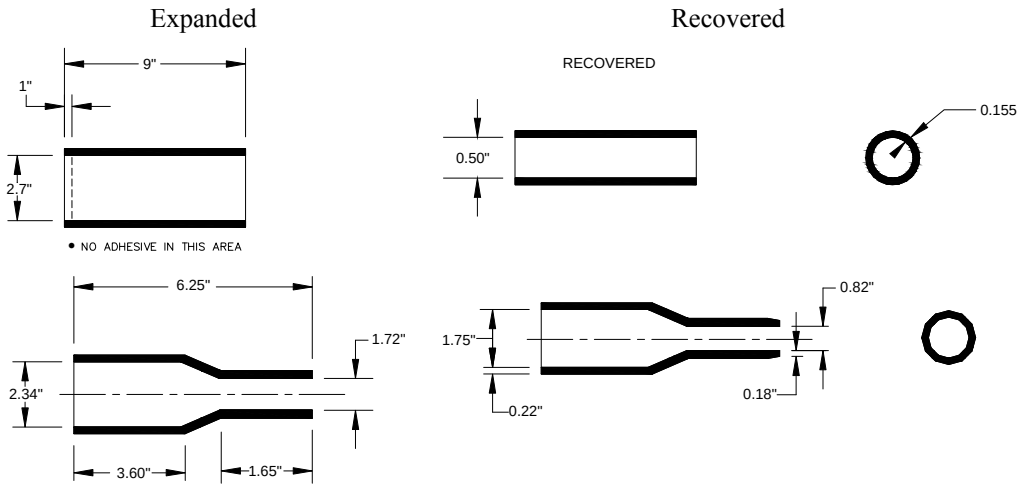
FIGURE 2E17. Alongside power in-line connectors MIL-C-24368/4 (tenders and repair ships).

Notes and installation instructions:

1. Clean cable jacket and conductor insulation. First slide tubing over individual conductors and shrink in place (prior to removal of insulation for crimping). Next slide crotch boot over cable conductors and cable jacket. Press firmly into crotch of conductors and shrink on place (Method 1A-6-1).
2. Shrink on the materials shall be as follows:

2E171-1	Crotch boot	Part 1A62-II of Section 1, Group A
2E171-2	Tubing (27" long)	M23053/15-104-0 of SAE-AMS-DTL-23053/15
2E171-3	Boot	1/
2E171-4	Kit	2/

1/ Boot, Part 2E171-3 shall be either a heavy duty tubing or a molded boot as shown below. Either part shall have adhesive on the internal wall which meets the adhesive requirements described in Section 1, Group A. Material for the tubing shall meet the performance requirements of SAE-AMS-DTL-23053/15 Class 1. Material for the molded boot shall meet the performance requirements of SAE-AS81765/1.



2/ A kit shall contain: 1 crotch boot (2E171-1), 3 tubing (2E171-2), 3 boots (2E171-3), 1 abrasion device, and pertinent installation instructions.

3. Shrink part by applying heat, using a hot air blower or other heat source. Minimum recovery temperature is 350 °F.

   As heat is applied, move heat source back and forth over part to be shrunk. For crotch boot and tubing, shrink from center to ends to avoid trapping air.

   When part has recovered enough to assume the configuration of the item covered and excess adhesive appears at the ends, discontinue heating. Additional heat will not make the part shrink more tightly.
4. Crimp using T&B die no. 94H or equivalent.
5. Shore facilities may utilize available commercial single- or three-phase in-line connectors to facilitate the shore power connection to ship. Type of connectors used shall be determined by the responsible shore facility. For non-MIL-Spec in-line connectors, installation methods shall be in accordance with manufacturer's instructions.

FIGURE 2E17. Alongside power in-line connectors MIL-C-24368/4 (tenders and repair ships) - Continued.

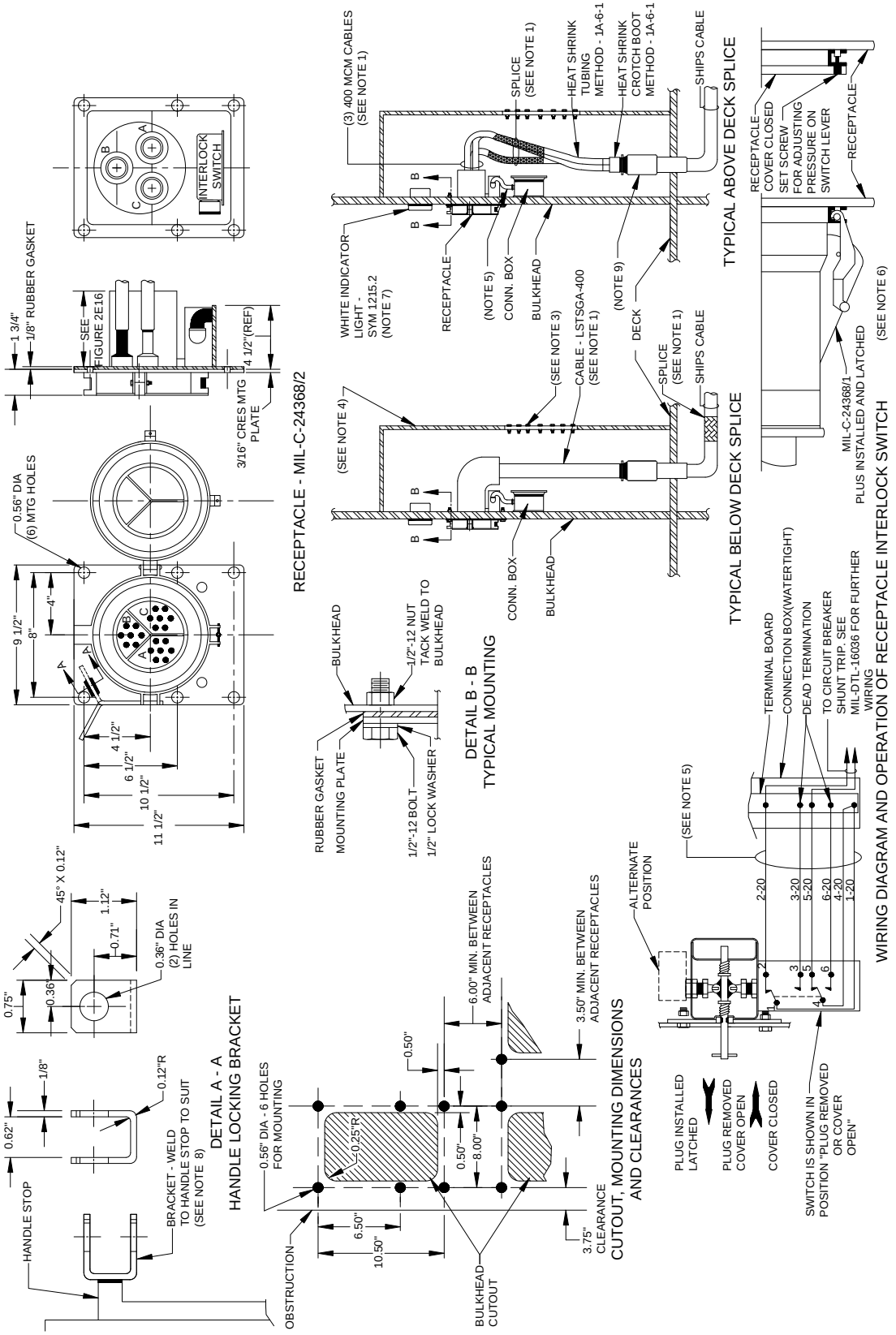


FIGURE 2E18. Installation details for shore power receptacle MIL-C-24368/2.

NOTES:

1. Where receptacles are potted by a manufacturer to a short length of cable, splice shall be in accordance with MIL-STD-2003-1. For greater accessibility, splice may be located below deck. Ship's cable may be terminated and potted directly onto the receptacle as shown on figure 2E16 by the installing activity.
2. For suitable cable support, see MIL-STD-2003-4.
3. Access to terminal, boxes, and receptacles shall be provided.
4. Protective enclosure is required to provide protection and personnel safety and shall be of a tightness required per compartment location. Proper gasketing and drainage for condensation shall be provided for watertight enclosures.
5. Six no. 20 AWG wire leads, 36" long are provided with each switch marked with circuit identification and wire size (1-20, 2-20, etc.). A heat shrinkable tubing (in accordance with SAE-AMS-DTL-23053/4, Class 2) shall be installed over the wire leads between the switch and connection box.
6. Opening of cover or unlatching of plug activates the shunt trip of circuit breaker, opening the breaker to "trip" position. Cover must be closed or plug latched before circuit breaker can be closed.
7. See MIL-DTL-16036 for wiring of the indicator lights. The alternate connection of the indicator lights as shown in MIL-DTL-16036 can be made when crimping the conductors at the cable splice. Flush mounting of indicator lights is preferred for greater protection (see detail "A", figure 2E9).
8. A handle locking bracket shall be installed when receptacles are furnished without brackets.
9. Deck or bulkhead cable penetrations shall be in accordance with MIL-STD-2003-3.

FIGURE 2E18. Installation details for shore power receptacle MIL-C-24368/2 - Continued.

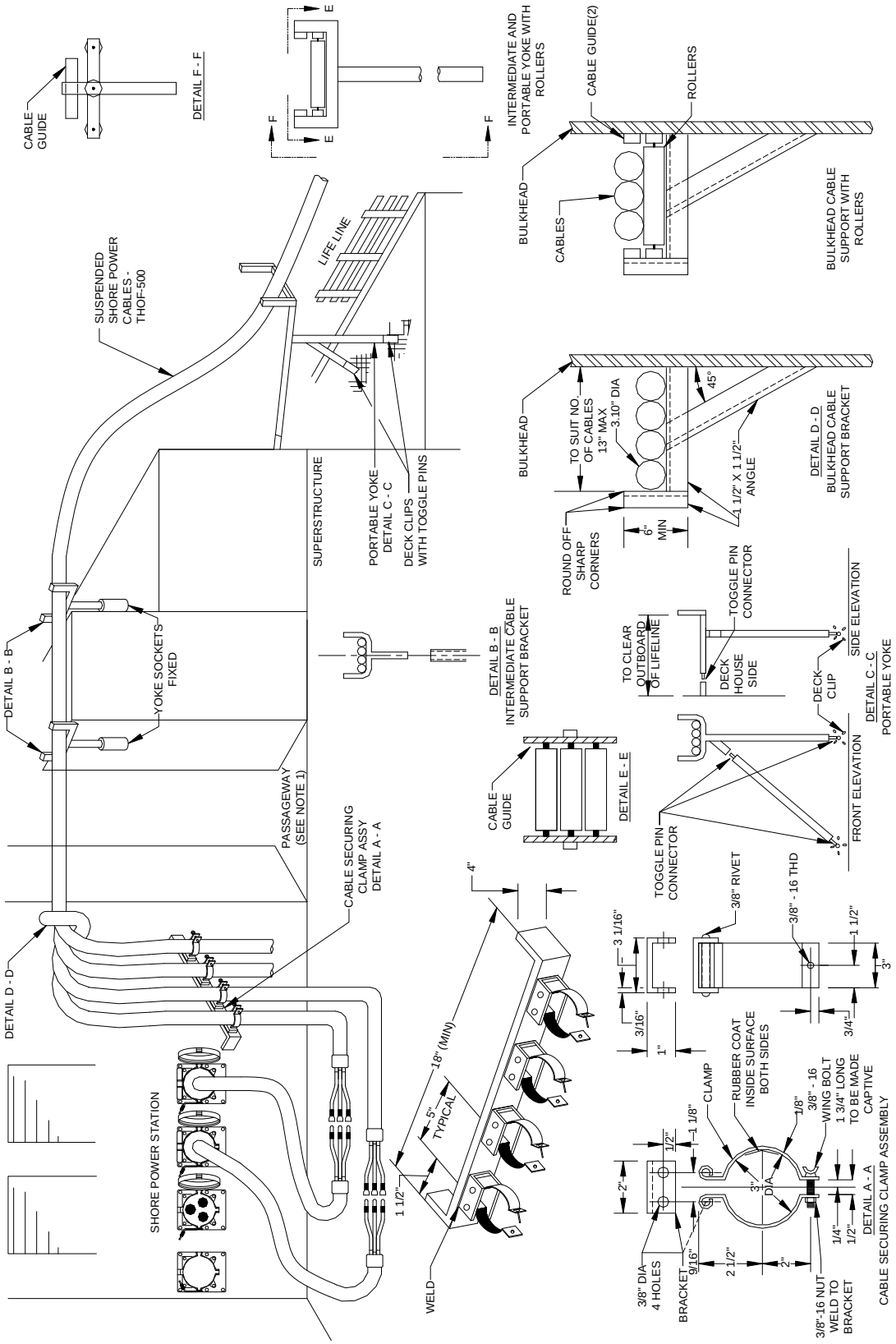


FIGURE 2E19. Typical shore power cable supports.

NOTES:

1. The location of the shore power station shall be determined with respect to the lay of the portable shore power cables over the ship with due consideration given to securing of cables away from personnel traffic on deck.
2. Surface of cable contact to brackets shall be smooth to minimize cable damage.
3. A cable securing clamp assembly in accordance with detail “A-A” shall be installed on a suitable location to provide cable strain relief on the plugs.
4. Rollers may be added to the intermediate bulkhead and portable yokes to improve cable handling capabilities.

FIGURE 2E19. Typical shore power cable supports - Continued.

Preparing activity:
Navy – SH
(Project SESS-2008-003)

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 http://assist.daps.dla.mil.