

MIL-A-19521A(SHIPS)
 30 January 1961
 SUSPENDING
 MIL-A-19521(SHIPS)
 25 May 1956
 MIL-P-19415C(SHIPS)
 31 October 1957

MILITARY SPECIFICATION

ANODES, CORROSION PREVENTIVE, ZINC, AND PLUGS, ZINC ANODE RETAINING; DESIGN OF AND INSTALLATION IN SHIPBOARD CONDENSERS AND HEAT EXCHANGERS

1. SCOPE

1.1 Scope. - This specification establishes basic design criteria covering application of zinc corrosion preventive anodes to shipboard condensers and heat exchangers. It also covers fittings to be used as support plugs for types ZRN and ZDM zinc anodes conforming to Specification MIL-A-18001. These support plugs are intended for shipboard service on heat exchangers (see 6.1).

1.2 Classification. - The support plugs for heat exchanger zinc anodes shall be of the following types and classes as specified (see 6.2):

- Type I (for use with ZRN anodes).
- Type II (for use with ZDM anodes).
- Class A - Straight thread O-ring seal.
- Class B - Tapered pipe thread.

2. APPLICABLE DOCUMENTS

2.1 The following specifications and standard, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS

MILITARY

- MIL-R-196 - Repair Parts for Internal Combustion Engines, Packaging of.
- MIL-B-857 - Bolts, Nuts, and Studs.
- MIL-C-15726 - Copper-Nickel Alloy Bars, Plates, Rods, Sheets and Strips.
- MIL-A-18001 - Anodes, Corrosion Preventive, Zinc: Plate, Slab, Disc and Rod Shaped.

STANDARD

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be

obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

NATIONAL BUREAU OF STANDARDS PUBLICATION

Handbook H28 - Screw Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.)

OFFICIAL CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York 16, N. Y.)

AMERICAN SOCIETY FOR TESTING MATERIALS

- B21-58 - Naval Brass, Rod, Bar and Shapes.
- B61-52 - Steam or Valve Bronze Castings.
- B122-55T - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar.
- B143-52 - Tin Bronze and Leaded Tin Bronze Sand Castings.
- B148-52 - Aluminum Bronze Sand Castings.
- B150-58 - Aluminum Bronze Rod, Bar and Shapes.
- B164-58T - Nickel Copper Alloy Rod and Bar.

(Applications for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa.)

3. REQUIREMENTS

3.1 Design. - The design of the cooling water side of condensers and heat exchangers intended for use with salt water as a coolant shall provide for zinc corrosion preventive anodes as a safeguard against galvanic corrosion. The anodes shall be installed in such a way as to permit ready disassembly

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from the unit for examination, cleaning or replacement without removal of the waterbox, or, unless specifically approved by the Bureau of Ships, removal of connected piping. Where more than one anode is required in a compartment, they shall be well distributed around it, if possible. Anodes shall be arranged so as to create a minimum of turbulence in the water flow.

3.1.1 Surface and weight. - Anodes for each water box compartment shall be provided in accordance with both of the following formulae:

Zinc surface for a water box compartment

$$Z=0.078(0.75D^2 + 6Nd^2)$$

Z = zinc surface needed, Square inch
 D = diameter of a circle of area¹ equal to exposed face of tube sheet Inch
 N = number of tube ends exposed in the compartment
 d = inside diameter of the tubes, Inch

Zinc weight for a water box compartment

$$W = 0.046Z$$

W = weight of zinc needed, Pounds
 Z = zinc surface needed, Square inch
 (as computed above)

¹This area shall be calculated as though the sheet had not been drilled for tubes.

3.1.2 Cored slab anodes. - Where space permits, the anodes shall be in the form of slabs conforming to type ZEP of Specification MIL-A-18001; sizes shall be as specified therein. Slabs shall be mounted on removable covers where water boxes are not fitted with a manhole. Where a manhole is provided, the manhole cover and other access opening covers shall be fitted with zincs to the extent necessary to fulfill requirements; where such covers are unable to carry the required amount of zinc, the remainder may be mounted on the interior of the compartment. Slabs shall be mounted on a boss (or bosses) and secured by a 1/2 inch diameter stud (or studs) and two semifinished regular jam nuts per stud conforming to Specification MIL-B-857. The stacking of more than one anode on a support is not acceptable. For illustrations of typical slabs, see figure 1.

3.1.2.1 Computing slab surface. - In computing zinc slab surface, the back face of the zinc (adjacent to the surface of the water box) shall not be counted. The surface of the edges of the plate may be counted in designs where the zinc is not recessed to obtain a faired surface along the inside of the compartment. That part of the outer face of the zinc which is covered by the nut shall be disregarded.

3.1.3 Pencil anodes. - On intermediate and small size units where space will not permit the use of slab anodes or where it is necessary to supplement the surface which can be provided by this type, pencil anodes conforming to types ZRN or ZDM of Specification MIL-A-18001 may be used. These pencil anode subassemblies should be inserted through tapped bosses in the wall of the water box.

3.1.3.1 Pencil anode applications for intermediate size units. -

3.1.3.1.1 For submarine applications, the support plugs for pencil anodes shall be 1-5/16-inch thread diameter class A (O-ring) plugs, type I or II.

3.1.3.1.2 For all other applications, the support plugs for pencil anodes shall be the 1-inch class B (iron pipe size (i. p. s.)) plugs, type I or II. (Figure 2a shows the class B type I plug with the corresponding anode.)

3.1.3.1.3 Solid pencils shall be made from 0.840-inch diameter zinc rod, and shall have a 1/2-inch taper pipe thread on one end for assembling to the plug. (For an illustration of this solid pencil anode see figure 2a.) Multiple disc pencils shall use the 1.050-inch diameter type ZDM segmented disc zinc as specified in Specification MIL-A-18001. The number of discs per pencil shall be suited to the installation.

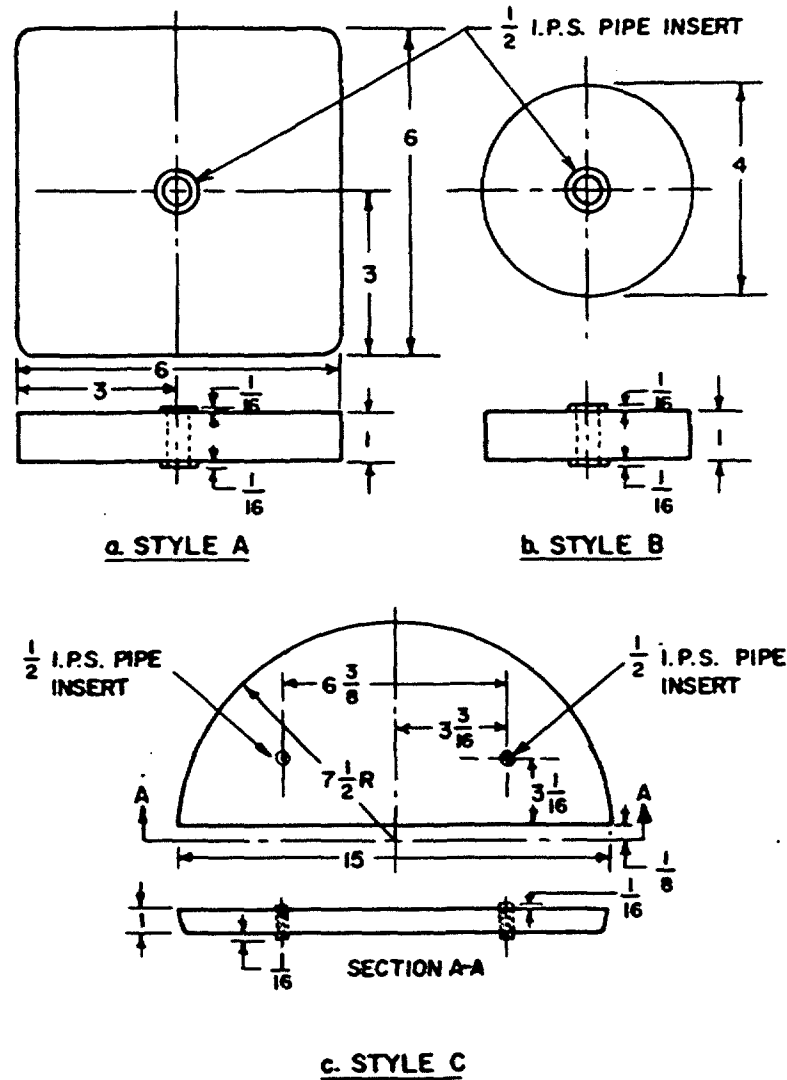
3.1.3.2 Pencil anode applications for small units. - For units having less than 50 square feet of surface per tube bundle, use of a smaller size pencil anode assembly is permitted.

3.1.3.2.1 For submarine applications, the support plugs for pencil anodes shall be 1-1/16-inch thread diameter class A (O-ring) plugs, type I or II. (Figure 2b shows the class A type II plug with the corresponding anode.)

3.1.3.2.2 For all other applications, the supports for pencil anodes shall be the 3/4-inch class B (i. p. s.) plugs, type I or II.

3.1.3.2.3 Solid pencils shall be made from 0.675-inch diameter zinc rod, and shall have a 3/8-inch taper pipe thread on one end for assembling to the plug. Multiple disc pencils shall use the 0.825-inch diameter type ZDM segmented disc zincs as specified in Specification MIL-A-18001. The number of discs per pencil shall be suited to the installation. (For an illustration of this multiple disc anode see figure 2b.)

3.1.3.3 Length and thread form of solid anodes. - Lengths of all solid pencils shall be multiples of 1/2 inch. Solid pencil anode threads shall be American National taper pipe thread form in accordance with Handbook H28.



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Figure 1 - Typical type ZEP heat exchanger slabs.

3.1.3.4 Computing pencil surface. -

3.1.3.4.1 Solid pencils. - The ends of solid pencils shall be disregarded. The cylindrical surface of a solid pencil for a distance of 1/2 inch from the threaded end shall be disregarded.

3.1.3.4.2 Segmented disc pencils. - In computing surface of the segmented disc pencils, only the cylindrical surface shall be used.

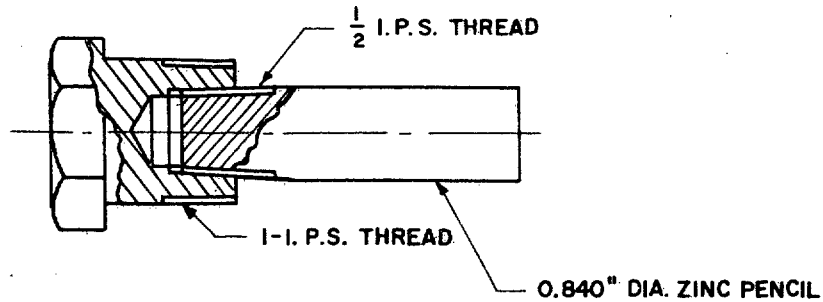
3.2 Design requirements for zinc support plugs. -

3.2.1 Materials. -

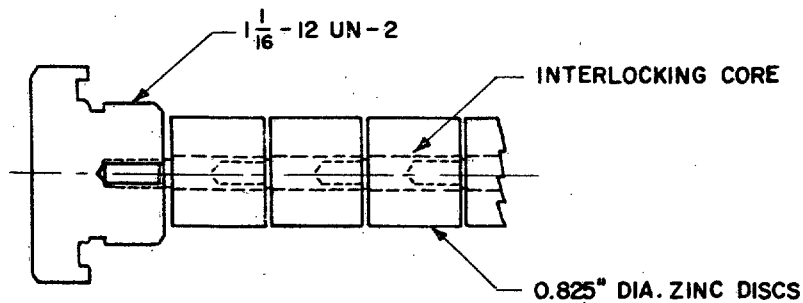
3.2.1.1 Materials for class A zinc support plugs shall be in accordance with table I.

3.2.1.2 Materials for class B zinc support plugs shall be in accordance with table II.

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a. TYPE ZRN ANODE WITH TYPE I CLASS B PLUG



b. TYPE ZDM ANODE WITH TYPE II, CLASS A PLUG

SH 5229

Figure 2 - Typical pencil anode assemblies.

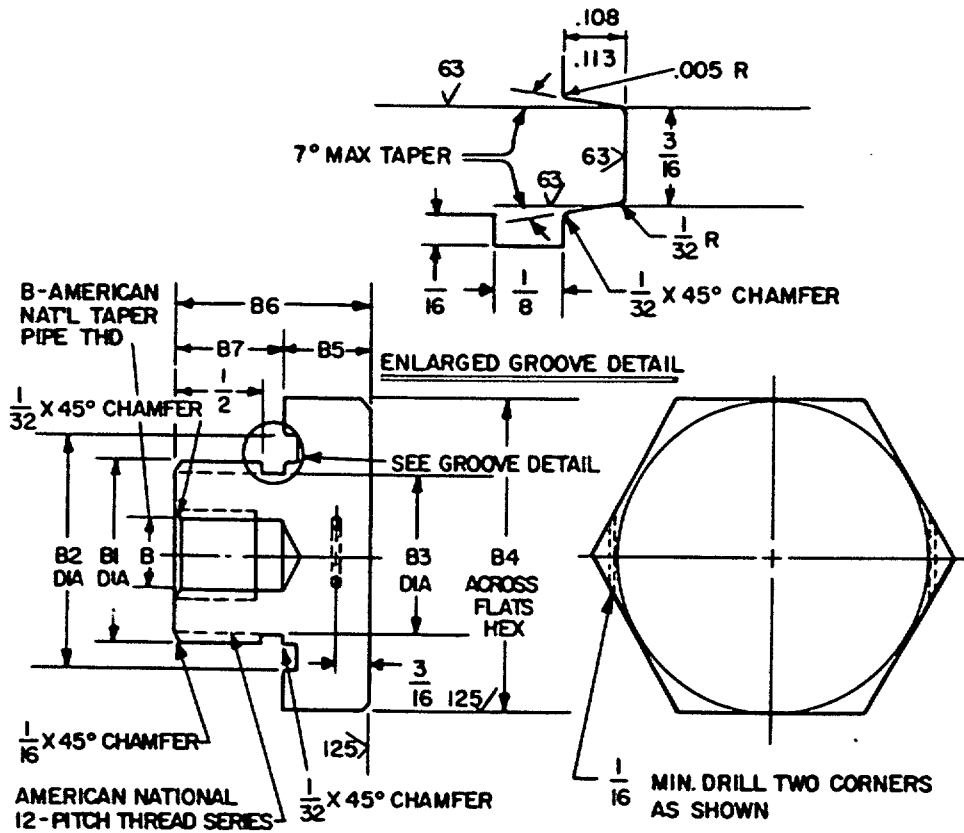
Table I - Class A material.

| Material | Specification |
|---|--|
| Copper-nickel alloy, alloy 5 (70-30); Nickel-copper alloy; or Aluminum bronze, wrought, alloy 3, stress relieved | ASTM B122-55T ASTM B164-58T ASTM B150-58 |

3.2.2 Sizes, dimensions and tolerances. - Plugs shall conform to the sizes, dimensions, and tolerances specified hereinafter and as shown in figures 3, 4, 5, and 6.

Table II - Class B material.

| Material | Specification |
|--|--|
| Copper-nickel alloy, alloy 5 (70-30); Copper-nickel alloy, composition 90-30; Gun metal, alloy 1B; Valve bronze; Aluminum bronze, wrought, alloy 3, stress relieved; Aluminum bronze, cast, alloy 9C; or Naval brass, wrought | ASTM B122-55T MIL-C-15726 ASTM B143-52 ASTM B61-52 ASTM B150-58 ASTM B148-52 ASTM B21-58 |



| SOLID ZINC PENCIL | | B | B1 | B2 | B3 | B4 | B5 | B6 | B7 |
|-------------------|-------|-----|---------------|-------|-------|-------|-----|-----|-----|
| IPS | OD | | | | | | | | |
| 3/8 | 0.675 | 3/8 | 1/16 -12 UN-2 | 7/16 | 15/16 | 11/16 | 1/2 | 1/8 | 5/8 |
| 1/2 | 0.840 | 1/2 | 5/16 -12 UN-2 | 11/16 | 3/16 | 15/16 | 1/2 | 3/8 | 7/8 |

1. ALL FRACTIONAL DIMENSIONS TO HAVE A TOLERANCE OF $\pm \frac{1}{64}$.
2. DIMENSIONS ARE IN INCHES.

SH 5230

Figure 3 - Class A, type I support plug for ZRN anode.

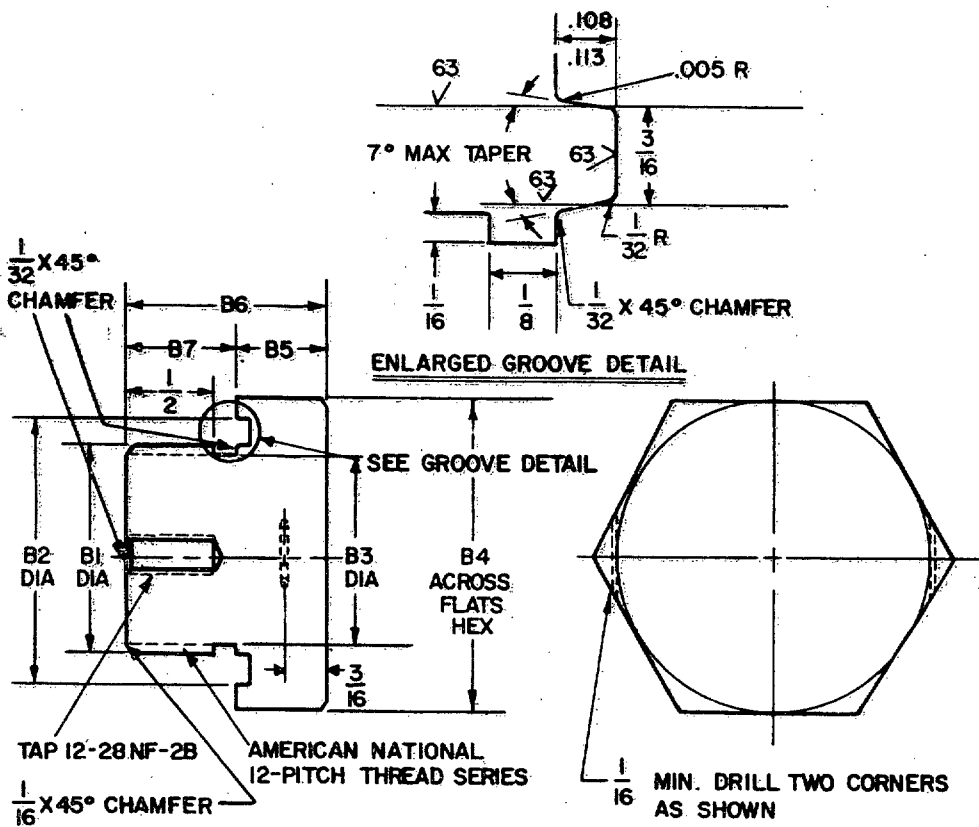
3.2.3 Threads. -

3.2.3.1 Plugs shall be threaded in accordance with Handbook H28.

3.2.3.2 The threads of all plugs shall be sharp and clean and shall be concentric with the axis of the fitting.

3.2.3.3 The internal threads shall be countersunk at the end a distance of not less than one-half the pitch of the thread and at an angle of about 45 degrees with the axis of the thread. For class B plugs the external thread shall also be chamfered a like amount for the purpose of easier entrance in making these joints and for the protection of the threads.

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| ZINC COUPON | B1 | B2 | B3 | B4 | B5 | B6 | B7 |
|-------------|--------------------------|-----------------|-----------------|-----------------|---------------|---------------|---------------|
| DIAMETER | EXTERNAL THD. | | | | | | |
| 0.825 | $\frac{1}{16}$ - 12 UN-2 | $\frac{7}{16}$ | $\frac{15}{16}$ | $\frac{11}{16}$ | $\frac{1}{2}$ | $\frac{1}{8}$ | $\frac{5}{8}$ |
| 1.050 | $\frac{5}{16}$ - 12 UN-2 | $\frac{11}{16}$ | $\frac{3}{16}$ | $\frac{15}{16}$ | $\frac{1}{2}$ | $\frac{3}{8}$ | $\frac{7}{8}$ |

1. ALL FRACTIONAL DIMENSIONS TO HAVE A TOLERANCE OF $\pm \frac{1}{64}$.
2. DIMENSIONS ARE IN INCHES.

SH523I

Figure 4 - Class A, type II support plug for ZDM anode.

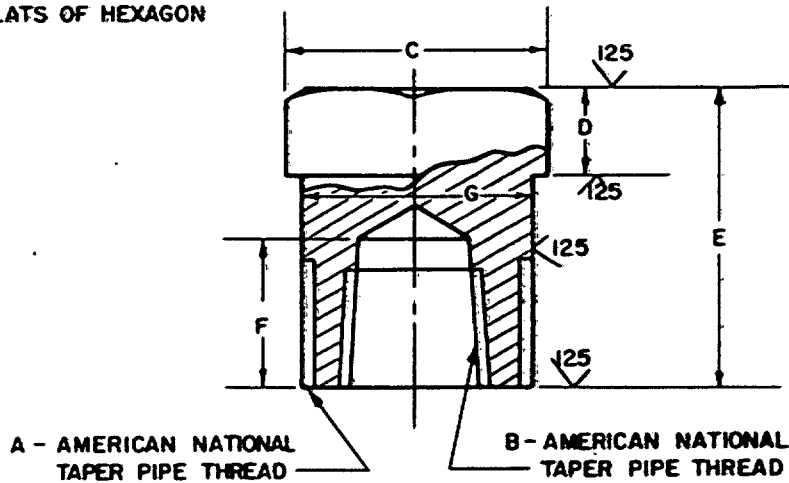
3.3 Detail of heads. - The tops of all plugs shall be flat and chamfered. The angle of chamfer with the top surface shall be 30 degrees and the diameter of the top circle shall be the maximum width across flats, within a tolerance of minus 15 percent.

3.3.1 Class A plugs shall have provision for positive locking by wiring.

3.4 Hydrostatic. - The plugs shall show no evidence of leaking water or sweat at any part of the surface when tested as specified in 4.4.

3.5 Marking. - The size (external thread) and the manufacturer's name or trademark shall be cast, stamped or engraved on the top surface of the head.

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MAXIMUM WIDTH ACROSS
FLATS OF HEXAGON

| NOMINAL PIPE SIZE | A | B | C | D | E | F | G ±.003 | ACTUAL DIA. OF ZINC ANODE |
|-------------------|---------------|---------------|---------------|---------------|---------------|---------------|------------|------------------------------|
| 1 | 1 | $\frac{1}{2}$ | $\frac{1}{2}$ | $\frac{1}{2}$ | $\frac{3}{8}$ | $\frac{7}{8}$ | L315 | 0.840 |
| $\frac{3}{4}$ | $\frac{3}{4}$ | $\frac{3}{8}$ | $\frac{1}{4}$ | $\frac{3}{8}$ | $\frac{1}{8}$ | $\frac{5}{8}$ | L050 | .675 |
| $\frac{1}{2}$ | $\frac{1}{2}$ | $\frac{1}{8}$ | 1 | $\frac{3}{8}$ | 1 | $\frac{1}{2}$ | Q840 | .405 |

1. ALL FRACTIONAL DIMENSIONS TO HAVE A TOLERANCE OF $\pm \frac{1}{64}$.
2. DIMENSIONS ARE IN INCHES.

SH1018C

Figure 5 - Class B, type I support plug for ZRN anode.

3.6 **Workmanship.** - The plugs shall be sound, true to form, uniform in texture, and free from porosity, or any other defect which might affect their serviceability. They shall be thoroughly cleaned both inside and outside. All burrs and roughness shall be removed.

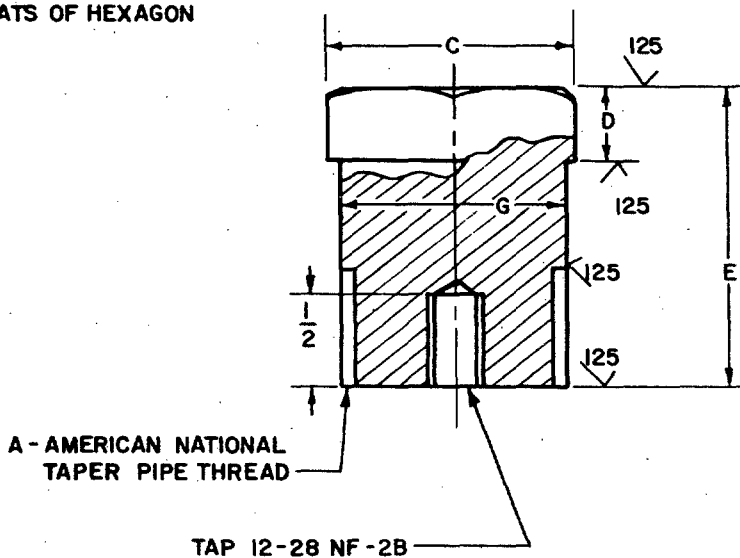
4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for the performance of all inspection requirements as specified

herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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MAXIMUM WIDTH ACROSS
FLATS OF HEXAGON



| NOMINAL PIPE SIZE | A | C | D | E | G ±.003 | ACTUAL DIA. OF ZINC ANODE |
|-------------------|-----|-------|------|-----|------------|---------------------------|
| 1 | 1 | 1 1/2 | 1/2 | 3/8 | 1.315 | 1.050 |
| 3/4 | 3/4 | 1 1/4 | 3/8 | 1/8 | 1.050 | .825 |
| 1/2 | 1/2 | 1 | 3/8 | 1 | .840 | .625 |
| 3/8 | 3/8 | 3/4 | 5/16 | 1 | .675 | .500 |

1. ALL FRACTIONAL DIMENSIONS TO HAVE A TOLERANCE OF $\pm \frac{1}{64}$.
2. DIMENSIONS ARE IN INCHES.

SH 3047B

Figure 6 - Class B, type II support plug for ZDM anode.

4.2 Sampling for acceptance inspection. -

4.2.1 Lot. - All plugs of the same type and size offered for delivery at one time shall be considered a lot for purposes of acceptance inspection.

4.2.2 Sampling for visual examination. - A random sample of plugs shall be selected from each lot of material offered for visual examination in accordance with Standard MIL-STD-105 at inspection level

III. The Acceptable Quality Level shall be 1.5 percent defective. Each sample plug shall be examined in accordance with 4.3.1.

4.2.3 Sampling for dimensional examination and hydrostatic tests. - A random sample of plugs shall be selected from each lot of material offered for dimensional examination and test in accordance with Standard MIL-STD-105 at inspection level I. The Acceptable Quality Level shall be 1.5 percent

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defective. Each sample plug shall be inspected in accordance with 4.3.2 and 4.4.

4.3 Visual and dimensional examination. -

4.3.1 Visual examination. - Each of the sample plugs selected in accordance with 4.2.2 shall be visually examined to verify compliance with the requirements of this specification not involving test. Any plug in the sample containing one or more visual defects shall be rejected, and if the number of defective plugs in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

4.3.2 Dimensional examination. - Each of the sample plugs selected in accordance with 4.2.3 shall be dimensionally examined to verify conformance with dimensional requirements of this specification. Any sample plug which does not meet the dimensional requirements shall be rejected, and if the number of nonconforming plugs in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

4.4 Hydrostatic test. - Each of the sample plugs selected in accordance with 4.2.3 shall be tested as specified in 4.4.1 and 4.4.2. Any sample plug which does not pass the required hydrostatic test shall be rejected, and if the number of nonconforming plugs in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

4.4.1 Class A support plugs shall be subjected to a hydrostatic pressure of 1,500 pounds per square inch gage (p. s. i. g.). This pressure should be held long enough to determine that no leakage occurs.

4.4.2 Class B support plugs shall be subjected to a hydrostatic pressure of 750 p. s. i. g. This pressure should be held long enough to determine that no leakage occurs.

5. PREPARATION FOR DELIVERY

5.1 Domestic shipment and early material installation and for storage of shipboard repair parts. -

5.1.1 Plugs. -

5.1.1.1 Preservation and packaging. - Preservation and packaging shall be sufficient to afford adequate protection against corrosion, deterioration and physical damage during shipment from the supply source to the using activity and until early installation.

5.1.1.2 Packing. - Packing shall be accomplished in a manner which will insure acceptance by common carrier and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early installation.

The shipping containers or method of packing shall conform to the Uniform Freight Classification Rules and Regulations or other carrier regulations as applicable to the mode of transportation.

5.1.1.3 Marking. - Shipment marking information shall be provided on interior packages and exterior shipping containers in accordance with the contractor's commercial practice. The information shall include nomenclature, Federal stock number or manufacturer's part number, contract or order number, contractor's name and destination.

5.1.2 Shipboard repair parts. - Plugs shall be preserved and packaged Level A, packed Level C and marked Levels A and C respectively, in accordance with the requirements of Specification MIL-R-196.

5.2 Domestic shipment and storage or overseas shipment. - The requirements and levels of preservation, packaging, packing and marking for shipment shall be specified by the procuring activity (see 6.2).

(5.2.1 The following provides various levels of protection during domestic shipment and storage or overseas shipment, which may be required when procurement is made by a Government activity (see 6.2).

5.2.1.1 Preservation, packaging, packing and marking. - Plugs shall be preserved and packaged Level A or C as specified (see 6.2) and marked in accordance with the requirements of Specification MIL-R-196.)

6. NOTES

6.1 Intended use. - These plugs in combination with the appropriate zinc anode are intended for use in corrosion protection (cathodic protection) of heat exchangers and other equipment employing sea water.

6.2 Ordering data. - Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Types required (see 1.2).
- (c) Classes required (see 1.2).
- (d) Sizes required (see 3.2.3).
- (e) Material required, if vendor is not to be permitted to choose among materials authorized for the respective classes.
- (f) Preservation, packaging, packing or marking requirements other than those required by 5.1 (see 5.2).

6.3 Cross reference. - The classification of support plugs given in this specification which are equivalent to those given in Specification MIL-P-19415 are as follows:

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| This specification | MIL-P-19415 |
|---------------------|-------------|
| Type I, class B | Type I |
| Type II, class B | Type III |

Notice. - When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related

Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Preparing activity:
Navy-Bureau of Ships
(Project 5340-N040Sh)

| SPECIFICATION ANALYSIS SHEET | | Form Approved Budget Bureau No. 119-R004 | |
|--|----------------------------|---|--|
| INSTRUCTIONS | | | |
| This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof). | | | |
| SPECIFICATION | | | |
| ORGANIZATION (Of submitter) | | CITY AND STATE | |
| CONTRACT NO. | QUANTITY OF ITEMS PROCURED | DOLLAR AMOUNT \$ | |
| MATERIAL PROCURED UNDER A | | | |
| <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT | | | |
| 1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? | | | |
| A. GIVE PARAGRAPH NUMBER AND WORDING. | | | |
| B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES. | | | |
| 2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID | | | |
| 3. IS THE SPECIFICATION RESTRICTIVE? | | | |
| <input type="checkbox"/> YES <input type="checkbox"/> NO. IF "YES", IN WHAT WAY? | | | |
| 4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity) | | | |
| SUBMITTED BY (Printed or typed name and activity) | | DATE | |

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