

INCH-POUND

MIL-PRF-24453B(SH)

13 November 2008

SUPERSEDING

MIL-I-24453A(SH)

11 December 1986

PERFORMANCE SPECIFICATION

INHIBITOR, CORROSION, SOLUBLE OIL

This specification is approved for use by the Naval Sea Systems Command and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a petroleum base soluble oil corrosion inhibitor, compounded with such additives as necessary to minimize rust formation and corrosion in water systems.

1.2 Part or identifying number (PIN). PINs to be used for petroleum based soluble oil corrosion inhibitors acquired to this specification are created as follows:

<u>M</u>	<u>24453</u>	=	<u>X</u>
Prefix for military specification	Specification number		Size (see code below)

Size code	
Size	Code
1 gallon	A
5 gallon	B

Examples:

- a. M24453-A
- b. M24453-B

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification 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 specification, whether or not they are listed.

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>.

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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-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-R-6855 - Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes, General Specification for

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-129 - Military Marking for Shipment and Storage

MIL-STD-1916 - DoD Preferred Methods for Acceptance of Product

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or <http://assist.daps.dla.mil> 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.

BUREAU OF MEDICINE AND SURGERY (BUMED)

BUMEDINST 6270.8 - Procedures for Obtaining Health Hazard Assessments Pertaining to Operational Use of Hazardous Material

(Copies of this document are available from the Bureau of Medicine and Surgery, Department of the Navy, 2300 E Street, NW, Washington DC 20377-5300 or online at <http://navymedicine.med.navy.mil>.)

DEFENSE STANDARDIZATION PROGRAM OFFICE

SD-6 - Provisions Governing Qualification

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

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR, Part 1910.1200 - Hazard Communication Standard

49 CFR, Parts 170-179 - Hazardous Materials Regulations

(Copies of these documents are available from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20401 or online at www.gpoaccess.gov/index.html.)

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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.

ASME INTERNATIONAL

ASME B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay) (DoD adopted)

(Copies of this document are available from ASME International, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900 or online at www.asme.org.)

ASTM INTERNATIONAL

ASTM D92 - Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester (DoD adopted)

ASTM D95 - Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation (DoD adopted)

ASTM D97 - Standard Test Method for Pour Point of Petroleum Products (DoD adopted)

ASTM D1193 - Standard Specification for Reagent Water (DoD adopted)

ASTM E29 - Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD adopted)

(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.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. For purposes of determining conformance with each requirement, an observed value or calculated value shall be rounded off to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding-off procedure given in ASTM E29.

3.2 Qualification. Soluble oil corrosion inhibitors furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.3 Chemical and physical requirements. The soluble oil corrosion inhibitor shall conform to the chemical and physical requirements specified in table I when tested in accordance with the applicable test methods.

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TABLE I. Chemical and physical requirements and test methods.

Property	Requirement	Test method references
Flash point, °C (°F), max	121 (250)	ASTM D92 and 4.5
Pour point, °C (°F), max	-1.1 (30)	ASTM D97 and 4.6
Water content, %, max	5	ASTM D95 and 4.7
Emulsion stability	Pass ^{1/}	4.8
Simulated service tests		4.9
Corrosion rate, still water, average millimeter (mm) per year, max Cast iron Mild steel Cast aluminum, Type 355	0.0102 0.0102 0.076	4.9.4
Corrosion rate, circulating water, average mm per year, max Cast iron Mild steel Cast aluminum, Type 355	0.0102 0.0102 0.076	4.9.4
Rubber swelling	Pass ^{2/}	4.9.5
Deposit formation	Pass ^{3/}	4.9.6
NOTES: ^{1/} The emulsion shall show no separation of free oil from the emulsion after standing for 24 hours. Creaming (separation of a heavy emulsified oil layer at the surface) shall not be considered free oil separation. ^{2/} The edges of the gaskets shall not be excessively swollen nor softened at the conclusion of the test. It shall not be possible to wipe off any rubber with the ball of the finger. ^{3/} The use of the corrosion inhibitor shall not result in deposit formation on metal surfaces.		

3.4 Toxicity. The soluble oil corrosion inhibitor shall have no adverse effect on the health of personnel when used for its intended purpose. The inhibitor shall be assessed by the Navy Environmental Health Center (NAVENVIRHLHCEN) using the administrative Health Hazard Assessment (HHA). A flowchart for this process can be found as enclosure (1) of BUMEDINST 6270.8. The HHA is a review of the inhibitor based on information submitted by the manufacturer, to assess health hazards associated with the handling, application, use, and removal of the product. The inhibitor shall not cause any environmental problems during waste disposal (see 4.10 and 6.5).

3.5 Material safety data sheets (MSDS). Material safety data sheets shall be provided when specified (see 6.2 and 6.4).

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Conformance inspection (see 4.3).

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4.2 Qualification inspection and tests. Qualification inspection shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA). Qualification tests shall consist of the tests specified in table I. Application for qualification tests shall be made in accordance with “Provisions Governing Qualification SD-6” (see 6.3).

4.2.1 Sampling for qualification tests. The qualification sample shall consist of two 18.9 liter (L) (5-gallon) containers. The two 18.9 L (5-gallon) containers shall be sealed, labeled, and forwarded to a testing laboratory satisfactory to NAVSEA.

4.3 Conformance inspection. Conformance inspection shall include the examination of 4.3.2.

4.3.1 Lot. Inhibitors manufactured as one batch shall be considered a lot for purposes of inspection.

4.3.2 Examination of filled containers. A random sample of filled containers shall be selected from each lot in accordance with MIL-STD-1916 at verification level I, sampling by attributes, using the sampling procedure (normal, tightened, or reduced) specified in the contract (see 6.2), to verify compliance with all requirements of this specification regarding fill, closure, marking, and other requirements of this specification not involving tests. Containers shall be examined for defects of the container and the closure, for evidence of leakage, and for unsatisfactory markings. Each sample filled container shall also be weighed to determine the amount of the contents.

4.4 Test procedures. The corrosion inhibitors shall be tested as specified in 4.5 through 4.9.

4.4.1 Synthetic seawater. One L of synthetic seawater, for use in the procedures in 4.8 and 4.9, shall be prepared by mixing the components listed in table II in reagent water meeting the requirements of ASTM D1193 Type II. This prepared synthetic seawater has a chloride content of approximately 20,000 parts per million (ppm).

TABLE II. Synthetic seawater.

Component	Grams per liter
Magnesium chloride (MgCl ₂ ·6H ₂ O)	11.0
Anhydrous calcium chloride (CaCl ₂)	1.2
Anhydrous sodium sulfate (Na ₂ SO ₄)	4.0
Sodium chloride (NaCl)	25.0

4.5 Flash point. The flash point of the soluble oil shall be determined in accordance with ASTM D92 (see table I). The value shall be recorded.

4.6 Pour point. The pour point of the soluble oil shall be determined in accordance with ASTM D97 (see table I). The value shall be recorded.

4.7 Water content. The water content of the soluble oil shall be determined in accordance with ASTM D95 (see table I). The value shall be recorded.

4.8 Emulsification. Fifty milliliters (mL) of synthetic seawater, prepared as indicated in 4.4.1, shall be diluted to 1 L using reagent water meeting the requirements of ASTM D1193 Type II. This diluted solution has a chloride concentration of approximately 1,000 ppm. Ninety-eight mL of this diluted solution shall be mixed with 2 mL of the soluble oil in a clear plastic 118 mL (4-ounce) oil sample bottle and shaken vigorously for 1 minute to form an oil-in-water emulsion. The emulsion shall be allowed to stand at room temperature (25±5 °C) without agitation for 24 hours and then shall be inspected for evidence of separation (see table I). A suitable constant temperature bath shall be used, if necessary, to maintain the above temperature range.

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4.9 Simulated service tests.

4.9.1 Preparation of specimens. A total of 15 corrosion test specimens, each measuring 5.00 centimeters (cm) by 4.44 cm by 0.317 cm (2.00 inches by 1.75 inches by 0.125 inch), shall be cut from the materials given in table III. Mild steel specimens shall be cut from rolled sheet metal; cast iron, and aluminum shall be machined from castings. Each specimen shall be drilled with a hole 0.63 cm (0.25 inch) in diameter. The center of the hole shall be 0.63 cm (0.25 inch) from the end of the long axis and 2.22 cm (0.875 inch) from the end of the short axis. The specimens shall be free of pits, burrs, and irregularities on all faces and edges. The specimen surface shall have a 0.81 micrometer (μm) (32 microinch) or better average roughness in accordance with ASME B46.1. The specimen shall be measured accurately with a vernier caliper and the total surface area calculated. The specimens shall be rinsed with acetone, allowed to dry and stored in a desiccator. The specimens shall be weighed on an analytical balance to the nearest 0.1 milligram (mg), then stored in a desiccator until used.

TABLE III. Test specimen requirements.

Specimen material	No. of specimens for tank cover (still water corrosion samples)	No. of specimens for box cover (circulated water corrosion samples)
0.317 cm (0.125 inch) hot rolled mild steel plate	2	2
0.317 cm (0.125 inch) machined cast iron	2	2
0.317 cm (0.125 inch) machined Type 355 cast aluminum	3	4

4.9.2 Design of corrosion test apparatus. The apparatus (see figure 1) shall consist of a 76 L (20-gallon) tank through a centrifugal pump to an external watertight box through which the contents shall be pumped in a counterclockwise motion, circulating liquid from the bottom to the top of tank. The 76 L (20-gallon) tank shall be fitted with a removable top cover, removable port cover for still water corrosion specimens, gauge glass, thermocouple, thermometer, and a thermostatically controlled stainless steel electric immersion heater. The external watertight box shall be constructed with a removable front cover. The port cover in the tank and the front cover of the box shall be constructed as illustrated on figure 2 with bored lugs through which corrosion specimens shall be supported in the liquid with their long axes horizontal. Both covers shall be made watertight with rubber gaskets. A thermocouple shall be mounted in the line approximately 25 cm (10 inches) above the specimen box. A turbine flowmeter or spool piece replacement for the flowmeter during operation shall be mounted in the line as illustrated on figure 1.

4.9.2.1 Apparatus. All material used in construction of corrosion test apparatus, including tank, specimen box, piping, and valves and fittings shall be constructed of 316 stainless steel.

4.9.2.2 Heater. The heater shall be an electric immersion type fabricated of 316 stainless steel and capable of maintaining 82.2 ± 2.8 °C (180 ± 2.8 °F).

4.9.2.3 Pump. The pump shall be a centrifugal type capable of a discharge of 132 ± 7 L per minute (35 ± 2 gallons per minute). Except for carbon graphite bearings and pump casing gasket, all wetted parts and all rotors shall be manufactured from 316 stainless steel. Pump casing shall be self-venting with a $\frac{1}{8}$ inch National Pipe Thread (NPT) drain connection.

4.9.2.4 Turbine flowmeter. Those parts of turbine flowmeter through which circulated liquid flows shall be fabricated of 316 stainless steel.

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4.9.2.5 Spool piece. The spool piece used as replacement for turbine flowmeter during operation shall be fabricated entirely of 316 stainless steel.

4.9.2.6 Rubber gaskets. The rubber gaskets shall be fabricated from rubber sheet in accordance with Class 2 of MIL-R-6855.

4.9.3 Procedure.

a. The corrosion test apparatus shall be cleaned and flushed to remove residues from previous tests. The two covers shall be removed, wire brushed, and fitted with new synthetic rubber gaskets, in accordance with MIL-R-6855 Class 2, which extend 1.59 to 3.17 mm (0.062 to 0.125 inch) within the mounting flange.

b. The turbine flowmeter shall be assembled in the line and the flow rate adjusted to 132 ± 7 L per minute. The turbine flowmeter shall be replaced by the spool piece after flow rate is adjusted and during operation.

c. The specimens shall be weighed and fastened into the mounting lugs of the covers with stainless steel pins in accordance with table III. Both covers shall be replaced and the cap screw set up tight.

d. Fifty-seven L (15 gallons) of reagent grade water and 571 mL of inhibitor shall be added through the funnel and the circulating pump started at a slow rate of discharge by throttling the discharge valve. Two hundred eighty-eight mL of synthetic seawater prepared in accordance with the formulation shown in table II shall be added to provide 100 ppm of chloride ion in the test water.

e. The heater shall be turned on and the discharge valve opened to maintain discharge of pump at 132 ± 7 L per minute. The temperature of the circulating water shall be raised to $82.2 \text{ }^\circ\text{C}$ ($180 \text{ }^\circ\text{F}$) and maintained at $82.2 \pm 2.8 \text{ }^\circ\text{C}$ ($180 \pm 5 \text{ }^\circ\text{F}$) for 100 hours.

f. After 100 hours continuous operation, the corrosion test apparatus shall be drained and the covers removed for inspection of rubber gaskets (see 4.9.5).

g. The specimens shall be removed separately from the box and port covers, inspected (see 4.9.6), wiped dry, cleaned with a bristle brush, soap, and warm water, and rinsed with warm reagent grade water. They shall be immersed successively into beakers of acetone and hexane and stored in a desiccator until weighed to the nearest 0.1 mg. In all steps after the soap scrubbing, the specimens shall be handled by means of a loop of wire and clean linen toweling. Fingerprints shall be avoided.

4.9.4 Corrosion rate. The corrosion rate in mm per year for each specimen shall be calculated as shown by the formulas in table IV.

TABLE IV. Formulas for calculating corrosion rates.

Special material	Corrosion rate formula
Mild steel	$\frac{\text{Weight loss (g)} \times 122}{\text{Area (cm)}}$
Cast iron	$\frac{\text{Weight loss (g)} \times 122}{\text{Area (cm)}}$
Type 355 cast aluminum	$\frac{\text{Weight loss (g)} \times 323}{\text{Area (cm)}}$

4.9.4.1 Still water corrosion rate. The averages for the two iron, two steel, and three aluminum specimens taken from the port cover shall be taken as the corrosion rates for iron, steel, and aluminum in still water.

4.9.4.2. Circulated water corrosion rate. The averages for the two iron, two steel, and four aluminum specimens taken from the specimen box cover shall be taken as the corrosion rates for iron, steel, and aluminum in circulated water.

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4.9.5 Rubber swelling. The internal edges of the cover gaskets shall be examined for excessive swelling or softening. These edges shall be wiped with the ball of the finger which shall be examined for presence of rubber.

4.9.6 Deposit formation. The specimens as well as the metal surfaces on the corrosion test apparatus shall be examined for the presence of deposits which would interfere with heat transfer properties.

4.10 Toxicity. The soluble oil shall be evaluated by the NAVENVIRHLTHCEN using the administrative HHA. A flowchart for this process can be found as enclosure (1) of BUMEDINST 6270.8. The HHA is a review of the material based on information submitted by the manufacturer, to assess health hazards associated with the handling, application, use, and removal of the product. Sufficient data to permit a HHA of the product shall be provided by the manufacturer/distributor to the NAVENVIRHLTHCEN. To obtain current technical information requirements specified by the NAVENVIRHLTHCEN, see 6.5.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.1.1 Marking. In addition to any special marking required by the contract or order (see 6.2), interior and exterior shipping containers shall be marked with the date (month and year) of manufacture and in accordance with MIL-STD-129, 29 CFR Part 1910.1200 and 49 CFR, Parts 170-179.

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 specification covers petroleum base soluble oil corrosion inhibitors intended to be used with additives, as necessary, to minimize rust formation and corrosion in water systems.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. Size of containers required (see 1.2).
- c. Sampling procedure in accordance with MIL-STD-1916 (see 4.3.2).
- d. Packaging requirements (see 5.1).
- e. Special marking, if required (see 5.1.1).
- f. Material safety data sheets, if required (see 6.4).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 24453 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA05M2, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to commandstandards@navy.mil.

6.4 Material safety data sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313 and 29 CFR, Part 1910.1200. The pertinent Government mailing addresses for submission of data are listed in appendix B of FED-STD-313.

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6.5 Toxicity evaluation. The NAVENVIRHLTHCEN requires sufficient information to permit a HHA of the product. Any questions concerning toxicity and requests for HHA should be addressed to the Commanding Officer, Navy Environmental Health Center, Attn: Hazardous Materials Department, Industrial Hygiene Directorate, 620 John Paul Jones Circle, Suite 1100, Portsmouth, VA 20378-2103. Upon receipt of the HHA, a copy should be provided to Commander, Naval Sea Systems Command, ATTN: SEA 05P25, 1333 Isaac Hull Ave., SE, Stop 5133, Washington Navy Yard DC 20376-5133.

6.6 Subject term (key word) listing.

Petroleum

Rust

Water systems

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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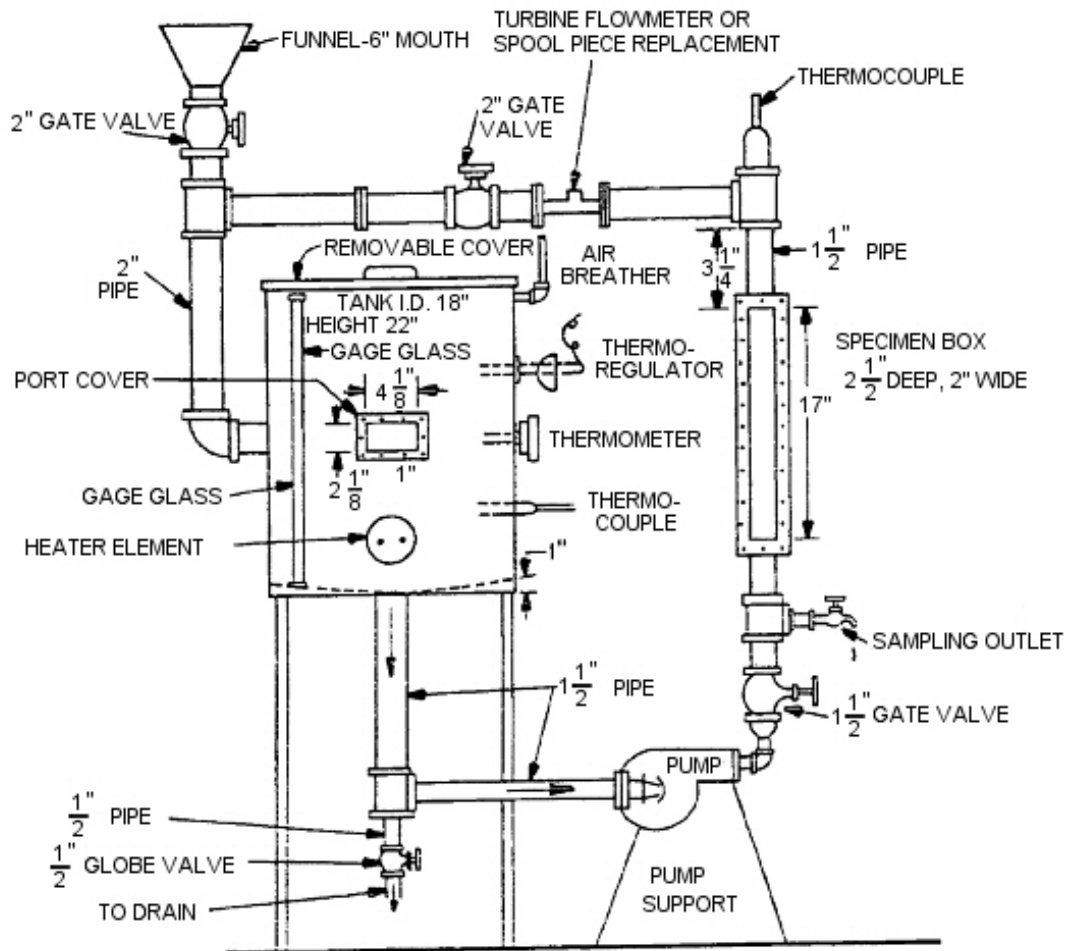


FIGURE 1. Corrosion test apparatus.

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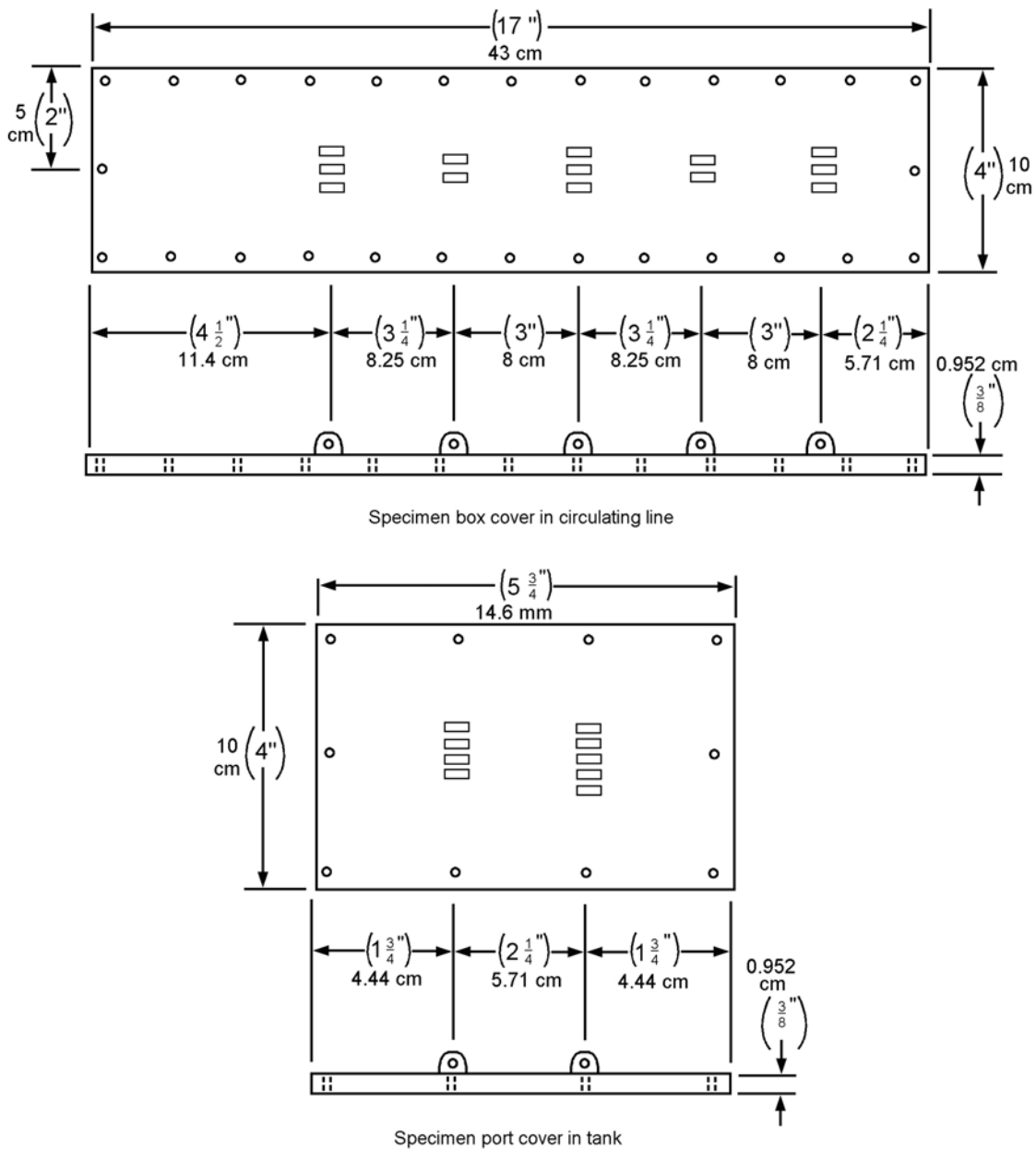


FIGURE 2. Specimen covers in corrosion test apparatus.

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Custodian:
Navy – SH

Preparing activity:
Navy – SH
(Project 6850-2007-010)

Review activity:
DLA – GS

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