MIL-I-24453A(SH)
11 December 1986
SUPERSEDING
MIL-I-24453(SHIPS)
1 July 1971
(See 6.7)

MILITARY SPECIFICATION

INHIBITOR, CORROSION, SOLUBLE-OIL

This specification is approved for use within the Naval Sea Systems Command, Department of the Navy, 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.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

PPP-C-96 - Cans, Metal, 28 Gage and Lighter.
PPP-P-704 - Pails, Metal: (Shipping, Steel, 1 Through 12 Gallons).

MILITARY

MIL-R-6855 - Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6850

STANDARDS

FEDERAL

FED-STD-313 - Material Safety Data Sheets, Preparation and the Submission of.

MILITARY

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

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

2.1.2 Other Government documents. The following other Government documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of solicitation.

DEPARTMENT OF LABOR (OSHA)

Code of Federal Regulations (CFR)

29 CFR, Part 1910.1200 - Hazard Communication Standard

DEPARTMENT OF TRANSPORTATION (DOT)

Code of Federal Regulations (CFR)

CFR 49, Parts 170-179 - Hazardous Materials Regulations

(The Code of Federal Regulations (CFR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

(Copies of specifications, standards, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the non-government documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 92 - Standard Test Method for Flash and Fire Points by Cleveland Open Cup. (DoD adopted)

D 95 - Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation. (DoD adopted)

D 97 - Standard Test Method for Pour Point of Petroleum Oils. (DoD adopted)

(Application for copies may be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay). (DoD adopted)

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

UNIFORM CLASSIFICATION COMMITTEE AGENT
Uniform Freight Classification Ratings, Rules and Regulations

(Application for copies should be addressd to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Soluble oil corrosion inhibitors furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).

3.2 Flash point. The open cup flash point shall be not less than 121 degrees Celsius (°C) (250 degrees Fahrenheit (°F)) (see 4.6).

3.3 Pour point. The pour point shall not exceed -1.1°C (30°F) (see 4.7).

3.4 Water content. The water content shall not exceed 5 percent (see 4.8).

3.5 Emulsion stability. An emulsion prepared as shown in 4.9 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.

3.6 Inhibition of corrosion. When tested as specified in 4.10, the corrosion of the test specimens in the tank and in the watertight specimen box shall not exceed an average penetration in millimeters per year (mm per year) of 0.0102 for cast iron, 0.0102 for mild steel, and 0.076 for type 355 cast aluminum.

3.7 Rubber swelling. The edges of the gaskets, fabricated from synthetic rubber comparable to that which is in accordance with class 2 of MIL-R-6855, shall not be excessively swollen nor softened at the conclusion of the test as specified in 4.11. It shall not be possible to wipe off any rubber with the ball of the finger.

3.8 Deposit formation. The use of a corrosion inhibitor shall not result in deposit formation on metal surfaces which will interfere with heat transfer properties (see 4.12).

3.9 Toxicity. This material shall have no adverse effect on the health of personnel when used for its intended purpose. Corrosion inhibitor shall not cause lesions or skin irritation. It shall not emit poisonous, noxious or irritant vapors. It shall not cause death or serious bodily injury if ingested. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service who will act as an advisor to the contracting agency (see 4.13).

3.10 Material safety data sheet. The contracting activity shall be provided a material safety data sheet (MSDS) at the time of contract award. The MSDS shall be provided in accordance with FED-STD-313 and 29 CFR 1910.1200, Hazard Communication. When FED-STD-313 is at variance with the CFR, 29 CFR 1910.1200 shall take precedence, modify and supplement FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.4).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. 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.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality

not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

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

(a) Qualification inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 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 4.6 through 4.12. Application for qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3 and 6.3.1).

4.3.1 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.

4.4 Quality conformance inspection.

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

4.4.2 Examination of filled containers. A random sample of filled containers shall be selected from each lot in accordance with MIL-STD-105 at inspection level I, and acceptable quality level (AQL) of 2.5 percent defective to verify compliance with all requirements of this specification regarding fill, closure, marking and other requirements 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. Any container in the sample having one or more defects or under required fill shall not be offered for delivery. If the number of defective containers in any sample exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, this shall be cause for rejection of the lot represented by the sample.

4.5 Test procedures. The corrosion inhibitors shall be tested as specified in 4.6 through 4.12.

4.6 Flash point. The flash point of the compound shall be determined in accordance with ASTM D 92 (see 3.2). The value shall be recorded.

4.7 Pour point. The pour point of the compound shall be determined in accordance with ASTM D 97 (see 3.3). The value shall be recorded.

4.8 Water content. The water content of the compound shall be determined in accordance with ASTM D 95 (see 3.4). The value shall be recorded.

4.9 Emulsification. Synthetic sea water, prepared as indicated in 4.10.4 shall be diluted with distilled water to yield a chloride ion concentration of 1000 parts per million (p/m). Ninety-eight milliliters (mL) of this solution shall be mixed with 2 mL of inhibitor in a 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 $\pm$ 5°C) without agitation for 24 hours and then shall be inspected for evidence of separation. A suitable constant temperature bath shall be used, if necessary, to maintain the above temperature range.

4.10 Inhibition of corrosion.

4.10.1 Preparation of specimens. A total of 15 corrosion test specimens, each measuring 5 centimeters (cm) by 4.44 cm by 0.317 cm (2 by 1-3/4 inches by 1/8 inch), shall be cut from the materials given in table I.

TABLE I. Test specimen requirements.

Specimen material	No. of specimens for tank cover	No. of specimens for box cover
0.317 cm (1/8 inch) hot rolled mild steel plate	2	2
0.317 cm (1/8 inch) machined cast iron	2	2
0.317 cm (1/8 inch) machined type 355 cast aluminum	3	4

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 (1/4 inch) in diameter. The center of the hole shall be 0.63 cm (1/4 inch) from the end of the long axis and 2.22 cm (7/8 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 an 0.81 micrometer (μm) (32 microinch) or better average roughness in accordance with ANSI 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.

4.10.2 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.

4.10.3 Construction of corrosion test apparatus.

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

4.10.3.2 Heater. Heater shall be an electric immersion type fabricated of 316 stainless steel and capable of maintaining 82.2 ± 2.8°C (180 ± 5°F).

4.10.3.3 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 1/8 inch NPT drain connection.

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

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

4.10.3.6 Rubber gaskets. Rubber gaskets shall be fabricated from rubber sheet in accordance with class 2 of MIL-R-6855.

4.10.4 Procedure. 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 (1/16 to 1/8 inch) within the mounting flange. 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. The specimens shall be weighed and fastened into the mounting lugs of the covers with stainless steel pins. Both covers shall be replaced and the cap screw set up tight. Fifty seven liters (15 gal) 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 sea water prepared in accordance with the formulation shown in table II, shall be added to provide 100 p/m of chloride ion in the test water.

TABLE II. Synthetic sea water.

Component	Grams per liter
Magnesium chloride ($MgCl_2.6H_2O$)	11.0
Anhydrous calcium chloride ($CaCl_2$)	1.2
Anhydrous sodium sulfate (Na_2SO_4)	4.0
Sodium chloride (NaCl)	25.0

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°C (180°F) and maintained at 82.2 ± 2.8°C (180 ± 5°F) for 100 hours. After 100 hours continuous operation, the corrosion test apparatus shall be drained and the covers removed for inspection of rubber gaskets. The specimens shall be removed separately from the box and port covers, inspected (see 4.12), wiped dry, cleaned with a bristle brush, soap and warm water, rinsed with warm reagent grade water. They shall be immersed successively into beakers of acetone and petroleum ether 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. The rate of penetration for each specimen shall be calculated as shown by the following formulas:

Special material	Formula	
Cast iron	$\frac{\text{Weight loss (grams)}}{\text{Area (square centimeters)}}$	x 122 = millimeters per year
Mild steel	$\frac{\text{Weight loss (grams)}}{\text{Area (square centimeters)}}$	x 112 = millimeters per year
Type 355 aluminum	$\frac{\text{Weight loss (grams)}}{\text{Area (square centimeters)}}$	x 323 = millimeters per year

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

4.11 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.

4.12 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.

4.13 Toxicity. The contractor shall have the toxicological formulations and associated information available for review by NAVSEA, or to an activity acceptable to that Command, in detail sufficient to permit an accurate evaluation of toxic hazards arising from use of the product. The hazards to be evaluated are those by skin contact, by ingestion, and by breathing vapors emitted from the product upon warming (up to 200°F). Inquiries pertinent to this effect shall be referred by NAVSEA to NAVMEDCOM which will act as an advisor to NAVSEA.

4.14 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.5.)

5.1 Preservation-packaging, packing, and marking.

5.1.1 Preservation-packaging. Preservation-packaging shall be level A or C, as specified (see 6.2).

5.1.1.1 Level A. Corrosion inhibitor shall be furnished in 4 L (1-gallon) and 19 L (5-gallon) containers as specified (see 6.2).

5.1.1.1.1 Four liter (1-gal) cans. Four liter (1-gal) cans shall be in conformance with the requirements of type V, class 4 of PPP-C-96. Inner seals shall be furnished. Plan B exterior coating shall be required.

5.1.1.1.2 Nineteen liter (5-gal) drums. Nineteen liter (5-gal) drums shall be in conformance with the requirements of type I, class 3 of PPP-P-704. Screw cap closures and inner seals shall be furnished (type I only). Exterior coating of the drums shall be required. Wire handles or balls shall be treated to resist corrosion.

5.1.1.2 Level C. Preservation-packaging shall be sufficient to afford adequate protection against deterioration and physical damage during shipment from the supply source to the first receiving activity for immediate use. This level may conform to the contractor's commercial practice when such meet the requirements of this level.

5.1.2 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

5.1.2.1 Levels A and B. Four liter (1-gal) cans shall be packed for levels A or B as specified (see 6.2) in containers in accordance with the appendix of PPP-C-96. Nineteen liter (5-gal) containers will require no further packing.

5.1.2.2 Level C. Corrosion inhibitor preserved-packaged for levels A or C, as specified (see 6.2) shall be packed in containers of the type, size, and kind commonly used for the purpose in a manner which will ensure acceptance and safe delivery at destination. Shipping containers shall comply to the Uniform Freight Classification Rules or other regulations as applicable to the mode of transportation.

5.1.3 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 CFR 49, Parts 170-179.

6. NOTES

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 Ordering data. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Level of preservation-packaging and packing required (see 5.1.1 and 5.1.2).
(c) Size of containers required (see 5.1.1.1).
(d) Special marking, if required (see 5.1.3).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in Qualified Products List QPL-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 purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3.1).

6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

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.

6.5 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.6 Subject term (key word) listing.

Corrosion
Inhibitor
Petroleum
Rust
Soluble-oil
Water systems

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

Preparing activity:
Navy - SH
(Project 6850-N801)

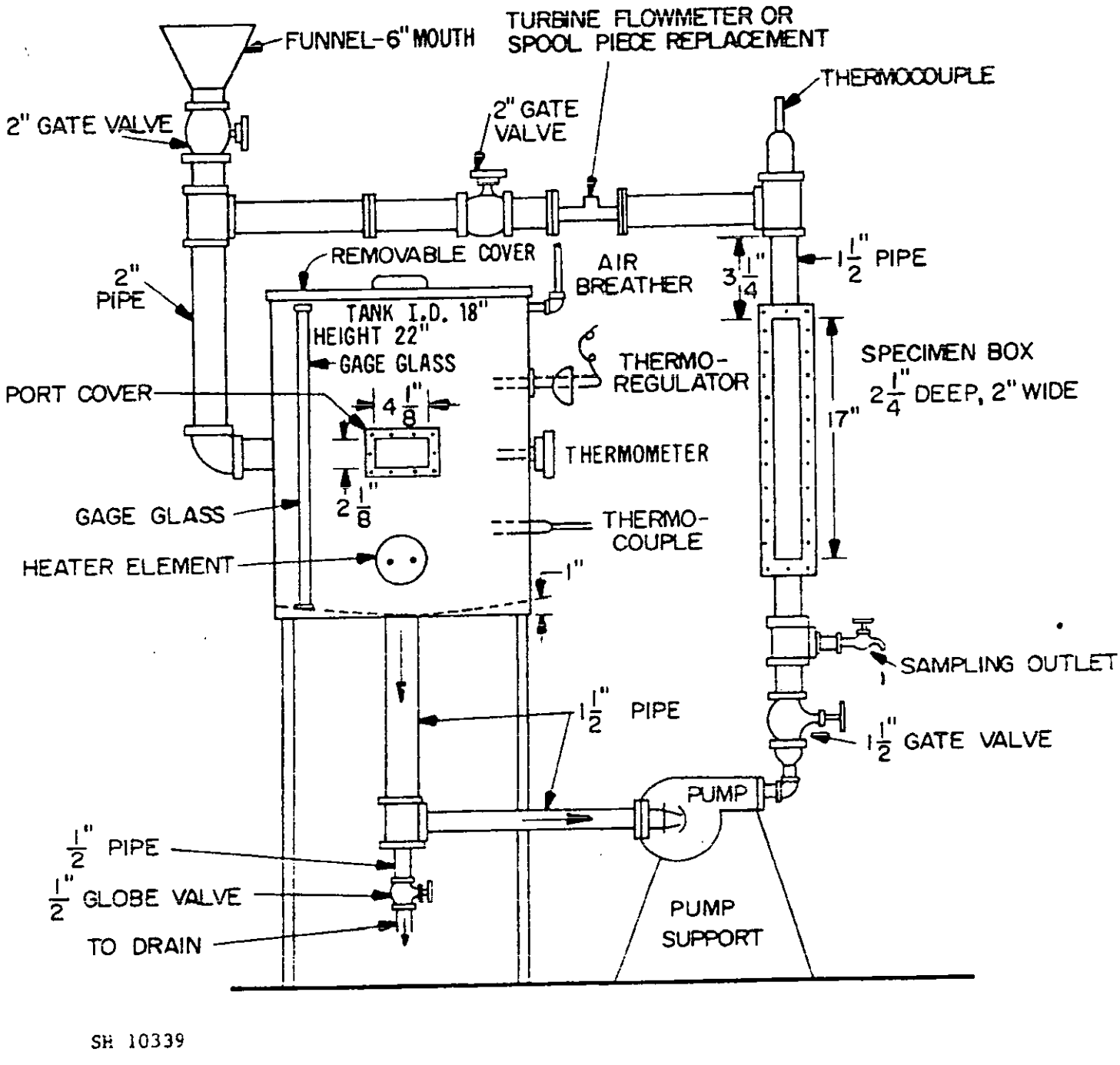
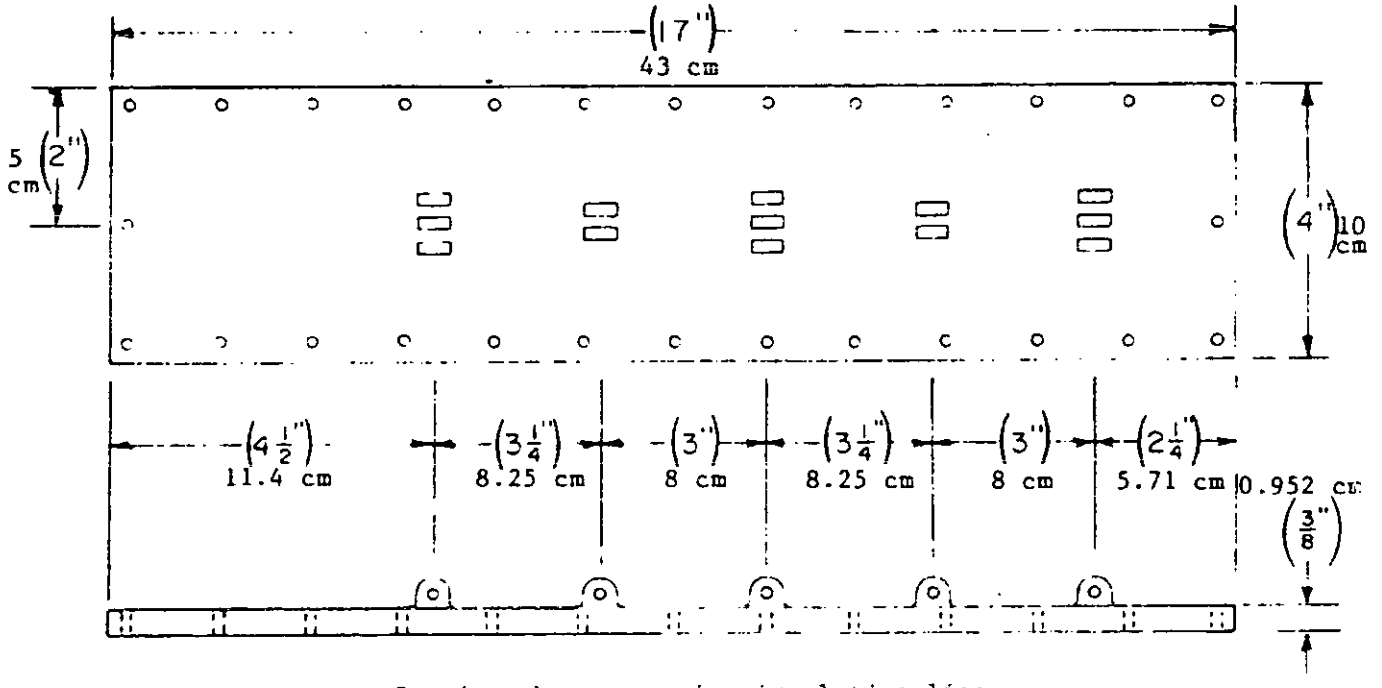
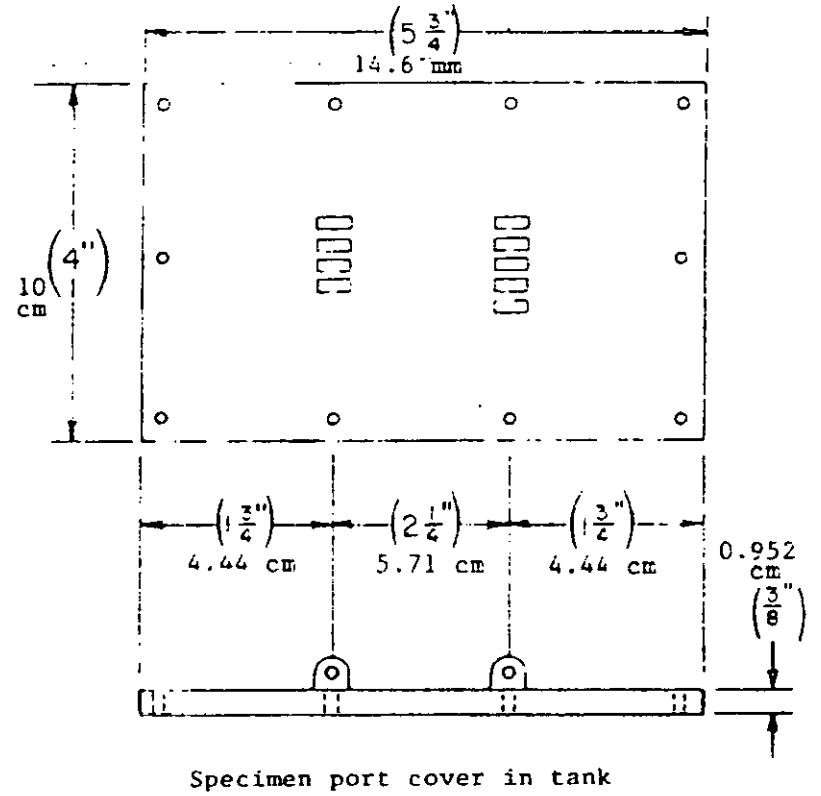


FIGURE 1. Corrosion test apparatus.



Specimen box cover in circulating line



Specimen port cover in tank

SH 10340

FIGURE 2. Specimen covers in corrosion test apparatus.

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NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-I-24453A(SH)	INHIBITOR, CORROSION, SOLUBLE-OIL

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
	☐ USER
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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