

INCH-POUND

MIL-PRF-16173E(SH)
w/INT. AMENDMENT 2
19 October 2017

USED IN LIEU OF
MIL-PRF-16173E(SH)
w/INT. AMENDMENT 1
7 September 2006
MIL-PRF-16173E
6 January 1993

PERFORMANCE SPECIFICATION

CORROSION PREVENTIVE COMPOUND, SOLVENT CUTBACK, COLD-APPLICATION

This specification is approved for interim use by the Naval Sea Systems Command. Other activities in the Department of Defense may use this interim amendment or may continue using MIL-PRF-16173E.

1. SCOPE

1.1 Scope. This specification covers solvent-dispersed corrosion preventive compounds that deposit thin, easily removable films after evaporation of solvent.

1.2 Classification. Corrosion preventive compounds covered by this specification are furnished in the following classes and grades, as specified (see 6.2).

1.2.1 Classes. The classes of the corrosion preventive compounds are designated by 'Class I' (High volatile organic compounds (VOC)) or 'Class II' (Low VOC) as follows:

Class I - High VOC - VOC exceeding 2.8 pounds per gallon (lbs/gal) (340 grams/liter).

Class II - Low VOC - VOC not exceeding 2.8 lbs/gal (340 grams/liter).

1.2.2 Grades. The grades of the corrosion preventive compound are the following:

- | | |
|---------|---|
| Grade 1 | Hard film (175 degrees Fahrenheit (°F) 80 degrees Celsius (°C) minimum flow point of solvent deposited film). |
| Grade 2 | Soft film. |
| Grade 3 | Water displacing, soft film. |
| Grade 4 | Transparent, non-tacky film. |
| Grade 5 | Low pressure steam removable film. |

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 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.daps.dla.mil>.

AMSC N/A

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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.

SPECIFICATIONS

FEDERAL

A-A-1671	-	Tape, Gummed (Paper, Reinforced, Laminated).
O-M-232	-	Methanol (Methyl Alcohol).
P-D-680	-	Dry Cleaning and Degreasing Solvent.
QQ-A-250	-	Aluminum and Aluminum Alloy Plate and Sheet: General Specification for.
QQ-A-250/5	-	Aluminum Alloy Alclad 2024, Plate and Sheet.
QQ-S-700	-	Steel Sheet and Strip, Medium and High Carbon.
RR-S-366	-	Sieve, Test.
TT-E-485	-	Enamel, Semigloss, Rust-Inhibiting.
TT-N-95	-	Naphtha; Aliphatic.
TT-T-291	-	Thinner, Paint, Mineral Spirits, Regular and Odorless.
PPP-C-96	-	Cans, Metal, 28 Gage and Lighter.
PPP-F-320	-	Fiberboard; Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.
PPP-D-729	-	Drums, Shipping and Storage. Steel, 55-Gallon (208 Liters).
PPP-P-704	-	Pails, Metal: (Shipping, Steel, 1 through 12 Gallons).

MILITARY

MIL-L-17331	-	Lubricating Oil, Steam Turbine and Gear, Moderate Service.
MIL-A-18001	-	Anodes, Corrosion Preventive, Zinc; Slab Disc and Rod Shaped.
MIL-L-19140	-	Lumber and Plywood, Fire-Retardant Treated.
MIL-A-22262	-	Abrasive Blasting Media Ship Hull Blast Cleaning.
MIL-I-45208	-	Inspection System Requirements.

STANDARDS

FEDERAL

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

MIL-STD-147	-	Palletized Unit Loads.
MIL-STD-290	-	Packaging of Petroleum and Related Products.

(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, drawing, 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 are those cited in the solicitation.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

40 Code of Federal Regulations (CFR) Ch. 1, Part 60, Appendix A, Method 24 - Determination of Volatile Matter Content, Water Content, Density, Volume Solids and Weight Solids of Surface Coatings.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

Occupational Health and Safety Administration, 29 CFR Parts 1910, 1915, 1917, 1918, 1926, and 1928 - Hazard Communication Act, Final Rule.

(Unless otherwise indicated, copies of other Government documents are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

B 117	-	Standard Method of Salt Spray (Fog) Testing.
B 121	-	Standard Specification for Lead Brass Plate, Sheet, Strip, and Rolled Bar.
D 16	-	Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
D 86	-	Standard Test Method for Distillation of Petroleum Products.
D 93	-	Standard Test Methods for Flash Point by Pensky-Martens Closed Tester.
D 822	-	Standard Practice for Conducting Tests on Paint and Related Coatings and Materials Using Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
D 874	-	Standard Test Method for Sulfated Ash from Lubricating Oils and Additives.
D 937	-	Standard Test Method for Cone Penetration of Petrolatum. (DoD adopted)
D 1748	-	Test Method for Rust Protection by Metal Preservatives in the Humidity Cabinet. (DoD adopted)
D 2369	-	Standard Test Method for Volatile Content of Coatings.
D 3278	-	Standard Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus.
D 3951	-	Standard Practice for Commercial Packaging. (DoD adopted)
D 4057	-	Standard Practice for Manual Sampling of Petroleum and Petroleum Products.
G 23	-	Standard Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing And Materials, 1916 Race Street, Philadelphia, PA 19103-1137.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AMS 4377 - Magnesium Alloy Sheet and Plate 3.0A1-1.OZn (AZ31B-H24) Cold Rolled, Partially Annealed.

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

United Nations (UN)

UN - Performance Oriented Packaging.

(Application for copies should be addressed to Labelmaster, 5724 North Pulaski Road, Chicago, IL 60646.)

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

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specifications, specification sheets or MS standards), 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. REQUIREMENTS

3.1 Qualification. The corrosion preventive compound 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 of award of contract (see 4.3 and 6.4).

3.1.1 Classification. Unless otherwise specified (see 6.2), preservatives shall conform to the classification contained herein (see 1.2). The selection of class and grade of preservatives shall be based on particular application, removal, or use without causing damage to the specific items to which they are applied (see 6.1).

3.2 Material. The corrosion preventive compound shall be composed of a nonvolatile base material dispersed in petroleum solvent in order to form a fluid formulation conforming to this specification. The compound shall be uniform, free from grit, abrasives, water, chlorides, or other impurities.

3.2.1 Toxicity. When evaluated as specified in 4.8, the materials used in the preventive compound unless specific material maximum levels are cited herein shall have no known carcinogenic or potentially carcinogenic materials identified by Occupational Safety and Health Administration (OSHA) regulated carcinogens, or International Agency for Research on Cancer (IARC) latest monographs, or and the latest annual report of the National Toxicology Program (NTP). The manufacturer is responsible for maintaining carcinogenic free materials. The manufacturer shall certify that the preventive compound does not contain the following materials in excess of 0.05 percent by weight of the dry preventive compound asbestos or asbestos-form pigments, benzene, toluene, chlorinated solvents, hydrolyzable chlorine derivatives, lead, chromium, mercury, and nitrosamines. The manufacturer shall also certify that the product unless specific material maximum levels are cited herein does not have known or suspected carcinogens intentionally added to the formulation and when known or suspected carcinogens are/may be present, as a result of being a trace, impurity in another ingredient(s) the concentration of the agent in the final product must not exceed the in excess of 0.05 percent by weight of the dry preventive compound. A certificate of compliance shall be provided with each lot shipped (see 4.1.3 and 6.3). The preventive compound shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this toxic effect shall be referred by the contracting activity to the qualifying activity. The qualifying activity will act as advisor to the contracting activity. The qualifying activity will arrange for review of questions by the appropriate departmental medical service. The contracting activity shall be provided with a copy of Navy Environmental Health Center (NEHC) findings. The NEHC findings shall be included with each unit of issue of material covered by this specification (see 5.6).

3.2.2 Material safety data sheet (MSDS). The contracting activity shall be provided a material safety data sheet at the time of contract award. The MSDS shall be provided in accordance with OSHA section 1910.1200, 29 CFR CH XVII and found as part of FED-STD-313. OSHA section 1910.1200 requires reporting threshold criteria for known or suspected human carcinogens on MSDS 0.1% or greater. The KSDS shall be included with each unit of issue of material covered by the specification (see 5.5 and 6.5).

3.3 Film characteristics. The film characteristics shall be as specified in 3.3.1 and 3.3.2.

3.3.1 Grades 1, 2, 3, 4, and 5. The compounds shall readily wet the surfaces of the test panels and upon evaporation of the solvent the resultant coating shall be continuous. Upon completion of the accelerated weathering (grade 1) and shed storage (grades 2, 3, 4, and 5) tests, the specimens shall show no evidence of cracking. Specimens that show evidence of checking, alligating, or other irregularities shall be evaluated as specified in 4.6.11.7. (Refer to ASTM D 16 for definition of terms.)

3.3.2 Grade 4 only. The compound shall be transparent during the protective life of the coating (see 4.6.16).

3.4 Nonvolatile and volatile organic content (VOC).

3.4.1 Nonvolatile content. The nonvolatile content (percent by weight) for each grade and class of product will be established when qualification tests are conducted. The nonvolatile content of any succeeding lot of product shall be not greater than 5 percent lower nor 10 percent higher than the established value, based on the nonvolatile as received as being 100 percent (see 4.6.5.1).

3.4.2 Volatile organic content (VOC). When tested as specified in 4.6.5.2, the VOC for class I compounds shall exceed 2.8 lbs/gal (340 grams/liter) and class II VOC compounds shall not exceed 2.8 lbs/gal (340 grams/liter).

3.5 Solvent distillation end point. The solvent employed shall possess a maximum distillation end point of 410°F (210°C) (see 4.6.1).

3.6 Discernibility. Grades 1 and 2 shall be permanently discernible on the preserved item and grades 3 and 5 shall be discernible for at least two weeks after application when allowed to stand in a well lighted and ventilated room. The color of the finished compound shall be black or brown. An oil soluble dye may be used.

3.7 Stability. The compound shall flow, be stable and uniform (see 4.6.6). The compound shall show no gelling, solidification, or more than a slight haze or precipitate.

3.7.1 Recovery from low temperature. If after tilting of test tube (see 4.6.6.1), the compound flows and does not show any gelling, solidification, or more than a slight haze or precipitate, the compound meets this requirement. If it is not necessary to shake and invert test tube for a further inspection, the requirement of recovery from low temperature is met if the compound flows and does not show any lumps suggesting permanent solidification or more than a slight haze or precipitate.

3.7.1.1 Confirmatory test for recovery from low temperature. From compounds requiring shaking, the test for recovery from low temperature is confirmed provided the compounds then pass the sprayability test (see 4.6.7).

3.7.2 Uniformity. The compound shall contain no precipitates formation or permanent haziness in the solution. If subsequent exposure of test panels in supernatant solution is required (see 4.6.6.1.2 and 4.6.11.4), an examination of the test panels after removal shall show not more than a trace of corrosion on the leading test surface of the panels for grades 1, 2, and 4 in the salt spray test. For grades 3 and 5, after exposure to the humidity test (see 4.6.11.3), the compound shall pass the test if the test panels do not exhibit more than a trace of corrosion on the leading test surface of the panel.

3.7.3 Storage stability. The compound shall pass the shed storage stability test (see 4.6.6.2) if the compound shows a film thickness not exceeding the requirement shown in table I. Panels that conform to the requirements in table I for the respective grades must also pass the additional exposure tests described in 4.6.6.2.1 for the respective grades. In addition, the compound shall also pass the sprayability test (see 4.6.6.2.2 and 4.6.7).

TABLE I. Requirements applicable to individual grades.

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Test method
Flash point, °F (°C) (min)	100 (38)	100 (38)	100 (38)	100 (38)	100 (38)	4.6.2
Penetration of non- volatile fraction (min)	----	200	----	----	----	4.6.4
Miscibility with lubricating oil	----	pass	----	----	----	4.6.9
Removability after Exposure	pass	pass	pass	pass	----	4.6.10.1
Hot water removability, residue, g/sq. ft. (max)	----	----	----	----	0.45	4.6.10.2.2.1
Low pressure steam removability, residue, g/sq. ft. (max)	----	----	----	----	0.15	4.6.10.2.2.2
Protection tests:						
Film thickness, mils (μm) (max)	4.0(100)	2.0(50)	1.0(25)	2.0(50)	1.0(25)	4.6.11.2
Humidity	----	pass	pass	pass	pass	4.6.11.3
Salt spray	pass	pass	----	pass	----	4.6.11.4
Weathering, accelerated, operating hours (min)	pass	----	----	----	----	4.6.11.5
Shed storage (prior to test removability)	----	pass	pass	pass	pass	4.6.11.6
Flow resistance	pass	----	----	pass	----	4.6.15

3.8 Sprayability. The compound shall be sprayable at temperatures of 40°F (5°C) and above (see 4.6.7).

3.9 Corrosion. The compound shall not show evidence of pitting, etching, or darkening. There shall be no weight change in excess of the amount shown below (see 4.6.8.1 and 4.6.8.2).

<u>Metal</u>	<u>Milligrams per square centimeter (max)</u>
Brass	1.0
Cadmium	5.0
Zinc	7.5
Magnesium	0.5
Aluminum	0.2
Steel	0.2
Lead-calcium alloy (applicable to grade 2 only)	5.0

3.10 Sulphated residue. The sulphated residue of each product will be established when qualification tests are conducted. When the established value of the accepted sample is 0 to 0.50 percent, the sulphated residue of any succeeding lot shall be plus or minus 0.05 (absolute value) percent with a zero minimum. When the established value of the accepted sample is 0.51 percent and up, the sulphated residue of any succeeding lot shall be plus or minus 10 percent of the established value (see 4.6.3).

3.11 Requirements applicable to individual grades. When tested as specified in 4.6, the rust preventive compound shall conform to table I.

3.11.1 Low-temperature adhesion (grades 1, 2, and 4). Grade 1 compound shall adhere to metal at 0°F (minus 18°C) and grade 2 and 4 compounds shall adhere to metal at minus 40°F (minus 40°C) (see 4.6.12). There shall be no flaking of the film (see 4.6.12).

3.11.2 Drying (grades 1, 2, 3, and 5). Grade 1 compound shall be dry within 4 hours to permit handling without injury to the coating (see 4.6.13). Films of grades 2, 3, and 5 shall remain soft on drying and exposure (see 4.6.13).

3.11.2.1 Drying (grade 4 only) (tackiness). The coating shall be dry in 4 hours to permit handling without injury to film. After 24 hours, the film shall be tack free (see 4.6.13.1).

3.11.3 Water displacement and water stability (grades 3 and 5). After storage in contact with water and when diluted in a 1 to 1 ratio with paraffin oil, the test panels after contact with grade 3 and 5 compounds shall show no evidence of rust, mottling, or other abnormal surface stains or defects and shall displace water (see 4.6.14).

3.12 Application of preservation coating (except grade 1). Before using, care shall be taken to ensure that the preservative coating selected has uniform consistency. Aliphatic solvent in accordance with P-D-680 or TT-T-291 shall be used, when necessary, to restore consistency. After cleaning and drying the items, the required preservatives shall be applied by one or more of the following procedures that will permit the preservative to coat all required surfaces.

3.12.1 Brushing. Application shall be accomplished by coating the items or surfaces to be preserved by brushing.

3.12.2 Dipping. Application shall be accomplished by the complete submersion of the items in a bath of preservative coating.

3.12.3 Filling or flushing. Application shall be accomplished by completely filling or flushing the items with preservative coating until all interior surfaces are coated. For the items to be left filled, space shall be allowed for thermal expansion and all ports and openings shall be sealed to prevent leakage.

3.12.4 Spraying. Application shall be accomplished by coating item surfaces (interior or exterior, as applicable) with a preservative coating applied as a spray.

3.13 Batch specific VOC certification. Although the NESHAP applies to traditional paints and coatings and this product is not a traditional coating, the NESHAP does apply in as much as it is a liquid product applied for preservation purposes. Manufacturer shall prepare container label instructions for the preventive compound in accordance with the requirements of 29 CFR Parts 1910, 1915, 1917, 1918, 1926, and 1928. Each container must be affixed with a hazardous chemical warning label in accordance with requirements of 29 CFR Part 1910, 1200. To comply with the Environmental Protection Agency (EPA) National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements for shipbuilding and ship repair, the following two statements must appear on each product can label:

- a. A certification that the product in the container meets the NESHAP requirements for shipbuilding and ship repair.
- b. A statement of the ratio of volatile content to solids expressed as grams Of volatile organic hazardous air pollutants (VOHAPS) per liter of solids.

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 (examinations and tests) 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall 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 program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as a part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Inspection system. When specified in the contract or order, an inspection system program plan shall be in accordance with MIL-I-45208 (see 6.3).

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. Qualification inspection shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA) on sample units produced with equipment and procedures normally used in production. Qualification inspection shall consist of the examinations as specified in table II, as applicable.

TABLE II. Test methods (as applicable). 1/ 2/

Test	Test method	ASTM	Requirement	Grade applicability				
				1	2	3	4	5
Solvent Distillation End Point	4.6.1	0 86	3.5	X	X	X	X	X
Flash Point	4.6.2	D 93 or D 3278	Table I	X	X	X	X	X
Sulphated Residue	4.6.3	D 874	3.10	X	X	X	X	X
Penetration	4.6.4	D 937	Table I		X			
Non-volatile Organic Content	4.6.5.1	D 2369	3.4.1	X	X	X	X	X
Volatile Organic Content(VOC)	4.6.5.2	--	3.4.2	X	X	X	X	X
Stability	4.6.6	--	3.7	X	X	X	X	X
-Low Temp. Recovery	4.6.6.1	--	3.7.1	X	X	X	X	X
-Confirmatory Recovery	4.6.6.1.1	--	3.7.1.1	X	X	X	X	X
-Uniformity	4.6.6.1.2	--	3.7.2	X	X	X	X	X
Storage Stability	4.6.6.2	--	3.7.3	X	X	X	X	X
Sprayability	4.6.7	--	3.8	X	X	X	X	X
Corrosion	4.6.8	--	3.9	X	X	X	X	X
-Immersion	4.6.8.1	--	3.9	X	X	X	X	X
-Coating	4.6.8.2	--	3.9	X	X	X	X	X
Miscibility	4.6.9	--	Table I		X			
Removability	4.6.10	--	Table I	X	X	X	X	X
Film Thickness	4.6.11.2	--	Table I	X	X	X	X	X
Humidity	4.6.11.3	D 1748	Table I		X	X	X	X
Salt Spray	4.6.11.4	B 117	Table I	X	X		X	
Accelerated Weathering	4.6.11.5	G 23 or D 822	Table I	X				
Shed Storage (Prior to Removability Test)	4.6.11.6	--	Table I		X	X	X	X
Film Characteristic	4.6.11.7	D 1748	3.3	X	X	X	X	X
Low-temp Adhesion	4.6.12	--	3.11.1	X	X		X	
Drying	4.6.13	--	3.11.2	X	X	X		X
Tackiness	4.6.13.1	--	3.11.2.1				X	
Water displacement and Water Stability	4.6.14	--	3.11.3			X		X
Flow Resistance	4.6.15	--	Table I	X			X	
Transparency	4.6.16	--	3.3.2					

1/ The test methods apply to both classes I and II unless otherwise specified.

2/ Before test methods are conducted, local cognizant industrial hygienists shall review operations, and prescribe; health hazard control measures to limit workers from potentially toxic materials, engineering controls, and personal protective equipment, as well as other control measures.

4.3.1 Qualification sampling. Sampling for qualification shall be two 1-quart samples of solvent and two 1-pound samples of nonvolatile ingredient for each grade and class to be tested.

4.3.2 Loss of qualification. After qualified product list (QPL) approval, any subsequent change in product composition will result in cancellation of QPL listing and the necessity for the manufacturer to apply for requalification.

4.3.3 Certification data/report. When specified in the contract or order, a certification data report shall be prepared.

4.4 Quality conformance inspection. Quality conformance inspection (see 6.3 and appendix) shall consist of all the examinations as specified in table II except for storage stability (see 4.6.6.2), removability (see 4.6.10), accelerated weathering (see 4.6.11.5), and shed storage (prior to removability test) (see 4.6.11.6). Removability after 600 hours exposure (25 days accelerated weathering, see 4.6.11.5), but not shed storage shall be conducted on grade 1 only (See 6.3).

4.4.1 Sampling for quality conformance inspection. As a minimum, the contractor shall randomly select a sample quantity of solvent and finished compound as specified in 4.4.1.2 and test them as specified in 4.4.

4.4.1.1 Lot.

4.4.1.1.1 Corrosion preventive compound. For purposes of quality conformance inspection and test sampling, a lot is defined as all the corrosion preventive compound, 10,000 gallons or less of the same class and grade, manufactured at the same time, using the same production processes and materials, and being offered for delivery at the same time.

4.4.1.1.2 Solvent and nonvolatile materials. Solvent and nonvolatile material from which a lot of compound is manufactured shall be considered a lot for the purpose of inspection.

4.4.1.2 Sampling for test. Sampling for quality conformance shall be in accordance with ASTM D 4057, as specified herein and shall consist of the following:

4.4.1.2.1 Solvents. From each lot of each class and grade a two pint sample of the solvent shall be selected and placed in clean, dry, metal container with the top sealed.

4.4.1.2.2 Finished compound. From each lot, four separate 1-gallon samples of the finished compound shall be selected for quality conformance testing and placed in clean, dry, metal containers with the tops sealed.

4.5 Lot rejection. If one or more defects are found in any sample, the entire lot shall be rejected. The contractor has the option of screening 100 percent of the lot for the defective characteristic(s) or providing a new lot which shall be inspected in accordance with the sampling plan contained herein. The contractor shall maintain for a period of 3 years after contract completion all records of inspections, tests, and any resulting rejections.

4.6 Test methods. Test methods shall be as specified in table II.

4.6.1 Solvent distillation end point. Solvent distillation test procedures shall be in accordance with ASTM D 86.

4.6.2 Flash point. The test for flash point for grade 1, 2, 3, 4, and 5 shall be in accordance with ASTM D 93 or ASTM D 3278. For cut-back asphalts and other viscous materials and suspension of solids, use stirring rate of 250 revolutions per minute (rpm).

4.6.3 Sulfated residue. The sulfated residue shall be tested in accordance with ASTM D 874.

4.6.4 Penetration (grade 2 only). The penetration test shall be in accordance with ASTM D 937.

4.6.5 Nonvolatile content and volatile organic content (VOC).

4.6.5.1 Nonvolatile content. The non-volatile content shall be determined in accordance with ASTM D 2369, except the heating time shall be extended to 3 hours.

4.6.5.2 VOC. The VOC of the corrosion preventive compound solvent cutback, in ready-to-use condition, shall be determined by method 24 of EPA 40 CFR CH 1, Part 60, Appendix A. The VOC shall be as specified in 3.4.2.

4.6.6 Stability. The compound stability shall be as specified in 4.6.6.1 through 4.6.6.1.2.

4.6.6.1 Recovery from low temperature. Fifty milliliters (mL) of the compound, in a cork stoppered test tube 8 inches by 1 inch, shall be elevated $130 \pm 2^\circ\text{F}$ (55°C), and maintained at that temperature for 8 hours. At the end of this period the tube and its contents shall be transferred immediately to a suitable cold chamber maintained at minus $40 \pm 2^\circ\text{F}$ (minus 40°C) and allowed to remain at that temperature for 16 hours, care being taken to avoid physical disturbance of the compound. This cycle shall be performed for a total of four times ending at the expiration of the last exposure at minus $40 \pm 2^\circ\text{F}$ (minus 40°C). The test tube shall be allowed to remain upright at room temperature ($77 \pm 2^\circ\text{F}$) (25°C) for 24 hours. The test tube shall be then tilted through an angle of 180 degrees and held in that position for 5 seconds. Look for evidence of gelling, precipitate, or a slight haze or separation. If present, the tube shall be shaken vigorously (by hand) for 1 minute and the test tube inverted.

4.6.6.1.1 Confirmatory test for recovery from low temperature. Material requiring shaking (see 4.6.6.1) shall be further examined by a sprayability test (see 4.6.7). A 1-quart spray gun can, as used for the sprayability test (see 4.6.7), shall be filled one-half to two-thirds full with the compound and closed with a rubber stopper or other airtight closure. The temperature cycling procedure of 4.6.6.1 shall then be followed. At the expiration of the last exposure at minus $40 \pm 2^\circ\text{F}$ (minus 40°C) the can shall be allowed to remain upright at room temperature ($77 \pm 2^\circ\text{F}$) (25°C) for 24 hours. Standing upright, the can shall be shaken using a platform-type GCA/Precision Scientific Co. shaker, or equivalent. The shaker shall maintain a stroke amplitude of approximately 2-1/2 inches for 1 minute at the rate of 260 strokes per minute. The spray gun can with its contents shall be placed in a cold chamber and held at a temperature of $40 \pm 2^\circ\text{F}$ (5°C) for a period of 24 hours. At the end of this period, while contents are still maintained at this temperature, a determination shall be made of the fluid flow rate from a spray gun as specified in 4.6.7.

4.6.6.1.2 Uniformity. Materials passing the test specified in 4.6.8.1, shall be examined for precipitates and haziness in the solution. If the precipitate cannot be re-dissolved into the compound or the haziness dispelled by shaking, the supernatant liquid shall be tested to determine its ability to protect steel panels in the salt spray test for grades 1, 2, and 4 (see 4.6.11.4). The supernatant liquid shall pass the salt spray protection test. For grades 3 and S, the supernatant liquid must be exposed to the humidity cabinet test (see 4.6.11.3). The panels for the exposure tests shall be coated by dipping them in a small dish filled with the supernatant liquid. It may be necessary to repeat the low temperature cycle using a larger sample in order to obtain sufficient supernatant liquid for testing (grades 2, 3, 4, and 5).

4.6.6.2 Storage stability. A 0.9 gallon sample of the compound in a 1-gallon round metal container shall be stored for a total of 9 months consisting of a 3-month storage period at each of the following temperatures and in the order given: $100 \pm 2^\circ\text{F}$ (38°C), $77 \pm 2^\circ\text{F}$ (25°C), and $40 \pm 2^\circ\text{F}$ (5°C). At the expiration of the storage period, the compound shall be allowed to remain at room temperature ($77 \pm 2^\circ\text{F}$) (25°C) for 24 ± 1 hour, and the container and contents shall then be rolled at approximately 50 rpm for 5 minutes without reversing direction. The compound shall conform to the requirements specified in 3.7.3.

4.6.6.2.1 Exposure tests. Panels which meet the film thickness requirement shown in table I shall also be exposed to the following tests for the respective grades:

Grade 1	600 hours and 1200 hours in the weatherometer.
Grade 2	7 days in the salt spray.
Grades 3 and 5	30 days in the humidity cabinet.
Grade 4	14 days in the salt spray.

4.6.6.2.2 Sprayability. As specified in 4.6.7.

4.6.7 Sprayability. A DeVilbiss Company, M-510-FF pressure type spray gun (see figure 1), or equivalent, shall be filled one-half to two-thirds full with the compound to be tested, placed in a suitable cold chamber, and held at a temperature of $40 \pm 2^\circ\text{F}$ (5°C) for a period of 24 hours (see 6.6). At the end of this period, while still maintained at the temperature, a determination shall be made of the fluid flow rate from the gun, using a pressure of 35 pounds per square inch gauge (lb/in²), on the fluid container. For this determination, the atomizing pressure valve shall be closed, and the needle travel regulator adjusted for maximum travel of the gun's trigger. A small, tared weighing bottle shall be placed in front of the nozzle of the gun in position to catch the stream of fluid which flows from the gun when the trigger is pulled. After a measured time of flow, the weight of fluid in the banker shall be determined, and the flow rate in grams per second calculated. Following this, the atomizing pressure valve shall be opened, the pattern valve turned completely in, the atomizing pressure adjusted to 40 lb/in² gauge maximum, and fluid pressure to a constant 35 lb/in² gauge. The chilled compound shall then be sprayed on a glass plate which is held vertically and is approximately 12 inches away from the nozzle of the gun. The gun shall make one pass over the panel at the rate of one inch per second. The sprayed panel shall be allowed to dry for 24 hours at 40°F (5°C) in a horizontal position. The film shall then be examined for continuity. A material shall be considered sprayable at 40°F (5°C) if it flows at the rate of 1.0 gm. per second and the film on the sprayed glass panel is continuous.

4.6.8 Corrosion. Specimens of the following metals shall be used in this test (suggested specimen size is 1/4 by 7/8 by 2 inches) (see 6.7):

Brass, ASTM B121, (33500)

Zinc Anodes, MIL-A-18001, class 2, type ZPN

Magnesium, SAE AMS 4377,

Aluminum, QQ-A-250 and QQ-A-250/5,

Steel, QQ-S-700, cold rolled, annealed last

Lead-calcium alloy (nominal composition: Lead 98 percent, Tin 1 percent, Calcium 0.5 percent.

4.6.8.1 Immersion. Two sets of seven specimens shall be prepared as specified herein. A small hole near one corner shall be drilled in each specimen of the set for tests of 4.6.8.2. The immersion test shall be conducted as follows: The seven specimens shall be polished to remove pits, burrs, and irregularities from all faces and edges, finishing with a 240-grit polishing medium. The use of a slow speed horizontal metallurgical polishing wheel is convenient, with the final polishing being done with 240-grit aluminum oxide paper or cloth moistened with kerosene to produce a surface finish of 10 to 20 microinches (RMS). The use of iron oxide or so-called wet or dry cloths or wet or dry papers is prohibited. Specimens shall be cleaned by swabbing in hot naphtha with a final rinse in warm anhydrous methanol conforming to grade A of 0-M-232 (95 percent methanol shall be used for the magnesium specimen). The specimens shall be held in a manner to avoid contact with the operator's hands. After weighing, the specimens shall be placed in a 3-inch diameter screw cap ointment or widemouth jar, arranging the specimens in the order as listed above along one diameter of the jar. The specimens shall be stood on one of their narrow ends and separated from each other by glass-rod separators. The specimens shall be covered with enough compound (approximately 300 mL) so that the tops of the specimens are at least 1/4-inch below the surface of the compound. The sealed jar shall then be placed in an oven at $130 \pm 2^\circ\text{F}$ (55°C) for 7 days. Upon completion of the test, the compound and any loose corrosion products shall be removed from the specimens by swabbing with surgical gauze pads moistened with naphtha, then with methanol (95 percent methanol shall be used for the magnesium specimen), and followed by clean solvent rinses. The specimens shall be reweighed and the weight loss or gain calculated in milligrams per square centimeter (mg/cm^2).

4.6.8.2 Coating. The seven specimens polished and cleaned as specified in 4.6.8.1 shall be coated with the compound as specified in 4.6.11.1.3. After a 24 hour drying period the specimens shall be placed in a gravity convection oven maintained at $120 \pm 2^\circ\text{F}$ (49°C) for 7 days. Upon completion of the test, compound and any loose corrosion products shall be removed from the specimens by swabbing with surgical gauze pads moistened with naphtha, then with methanol (95 percent methanol for the magnesium specimen), and followed by clean solvent rinses. Reweigh the specimen and calculate the weight loss or gain in milligrams. Amount of weight change shall be within the limits specified in 3.9. Look for evidence of pitting, darkening, or etching

4.6.9 Miscibility with lubricating oil (grade 2). Five mL of rust preventive coating under test shall be added to 95 mL of lubricating oil in accordance with MIL-L-17331 in a 100 mL, cone-shaped centrifuge tube. The tube shall be stoppered and shaken by hand until the mixture appears uniform. The stopper shall be loosened and the tube placed in a beaker (to keep it upright) and then the beaker placed into an explosion-proof oven at $170 \pm 2^{\circ}\text{F}$ (77°C) for 15 minutes. The tube shall be removed and the content examined for separation or sediment. The contents shall be allowed to cool to room temperature and then be examined again. The tube shall remain at room temperature for an additional 24-hours and then shall be examined again. Look for separation or sediment as evidence of nonmiscibility.

4.6.10 Removability.

4.6.10.1 Grades 1, 2, 3 and 4. The apparatus for determining removability shall be essentially as shown on figure 2. Removability shall be determined on the test specimens that have completed the exposure period for accelerated weathering and shed storage tests. The specimens shall be placed in a position one at a time in the apparatus so that a felt pad wiper saturated with dry cleaning solvent conforming to type 1 of P-D-680, can wipe a streak $4 \pm 1/4$ inches long, in a forward and backward motion, on the center of the specimen. The wiper shall consist of a 2-inch long wick made from an all wool felt (weighing approximately 190 ounces per square yard in a 3/4-inch thickness) which shall be packed tightly into the lower end of a tube (wiper holder) 10 inches long with a 5/16-inch inside diameter, and shall protrude 1/4 to 1/2 inch outside. One or more indentations shall be made approximately 2 inches from the bottom of the wiper holder tube to prevent the wiper from being forced further into the tube. A rim supporting a weight sufficient to increase the weight of the wiper holder assembly to 200 grams shall encircle the holder tube approximately 2 inches from the top. The wiper holder shall fit into a supporting tube 4 inches long with a 7/16-inch inside diameter, which is fixed in position and will act as a sleeve or guide. The wiper holder tube shall be filled with solvent and tightly corked. It shall be uncorked and vented before each run so that the wiper felt is filled with solvent in an amount sufficient to make the run but without allowing the solvent to flow freely over the specimen. The length of the wiping stroke shall be 4 inches and the speed of the machine shall be regulated to 40 ± 5 cycles per minute. A complete wiping cycle shall consist of a stroke of approximately 4 inches in one direction with a return stroke to the starting position. At the completion of the required number of cycles (see table III), the compound under the wiper should be completely removed (as determined visually) over an area 1/4 inch wide and the entire length of the stroke.

TABLE III. Removability after exposure.

Compound (grade)	Cycles (max)
1	30
2	15
3	6
4	15
5

4.6.10.2 Grade 5.

4.6.10.2.1 Preparation of specimens. Steel panels 1/8 x 2 x 2 inches shall be fabricated from open hearth, cold rolled annealed last, high carbon steel conforming to QQ-S-700. The panels shall have a 1/8-inch hole centered 1/8 inch from one edge, as shown on figure 3. Panels shall be finished and cleaned as specified in paragraph 4.6.11.1.2, weighed to the nearest milligrams, and the corrosion preventive compound applied as specified in 4.6.11.1.3. The coated panels shall be aged in a draft-, dust- and fume-free indoor atmosphere for 9 months before performing the hot water and low pressure steam removability tests.

4.6.10.2.2 Removability apparatus. The apparatus for determining the hot water and low pressure steam removability tests shall be as shown on figure 3. The apparatus consists of a rectangular box 17 inches by 2 inches wide by 2-1/4 inches deep with a removable cover and gasket. Welded to a hole in each end of the box are 1-1/2 inch nominal pipe size (NPS) pipe fittings to which are attached a 1-1/2 inch valve and 1-1/2 inch flange. The cover contains lugs for holding nine test panels perpendicular to the cover and at a 45 degree angle to the direction of flow. A pressure gauge and a thermometer shall be fitted in the box.

4.6.10.2.2.1 Hot water removability test (grade 5 only). Eight aged panels shall be secured to the cover of the removability apparatus (see figure 3) with a blank panel to act as a baffle plate, at the bottom, to baffle the inlet flow. The cover shall be attached to the box. The apparatus shall be mounted vertically with the valve at the bottom. The 180°F (83°C) hot water shall be recirculated through the box from the bottom at a rate of 20 gallons per minute for 3 hours. Although the quantity of hot water used for this test is not critical, a 50 gallon reservoir is recommended for convenience. The panels shall be removed, dried, and weighed to the nearest milligram. The amount of corrosion preventive compound remaining shall be calculated as follows:

Residue (g/sq ft) - $16(A - B)$

Where:

A - Final weight of panel in grams.

B - Uncoated weight of panel in grams.

16 - Conversion factor for the total area including the panel thickness.

The level of residue shall not exceed that specified in table I.

4.6.10.2.2.2 Low pressure steam removability (grade 5 only). Eight aged panels shall be secured to the cover of the removability apparatus (see figure 3) with a blank panel at the top. The cover shall be attached to the box. The box shall be mounted vertically with the steam entering from the top. Wet steam at 2S lb/in² shall be piped to a 3/16-inch sharp-edged orifice placed in the flange at the top of the apparatus. The pressure in the apparatus shall be throttled to 15 lb/in² by the valve at the bottom and the steam flowed through for 3 hours. Removed panels shall be dried and weighed to the nearest milligram. The amount of corrosion preventive compound remaining shall be calculated as follows:

Residue (g/sq ft) - $16(A - B)$

Where:

A - Final weight of panel in grams.

B - Uncoated weight of panel in grams.

16 - Conversion factor for the total area including

The level of residue shall not exceed that specified in table I.

4.6.11 Protection tests.

4.6.11.1 Preparation of specimens.

4.6.11.1.1 Panel composition and size. Steel panels shall be fabricated from open hearth, cold finished, dead soft temper, low carbon steel conforming to QQ-S-700. The panels shall be 1/8 by 2 by 4 inches, conforming to the description contained in ASTM D 1748.

4.6.11.1.2 Panel finish and cleaning. The panel test surfaces shall be cleaned and finished as follows:

- (a) After rounding the edges of the panel, reaming out the holes used for suspension, surfaces shall be wiped as clean as possible by use of solvent soaked rags (P-D-680 or TT-N-95).
- (b) The panel shall be scrubbed with a clean cotton or surgical gauze swab in a beaker of hot petroleum naphtha (P-D-680 or TT-N-95).
- (c) The panel shall be rinsed in hot petroleum naphtha.
- (d) The panel shall be rinsed in hot anhydrous methanol (grade A of O-M-232) for at least 10 seconds and allow the panel to dry. If the panels are not processed at once, they shall be preserved in desiccator.
- (e) The panel test surface shall be buffed by means of 240-grit aluminum oxide abrasive with cloth or paper backing so as to produce a surface finish of 10-20 microinches root mean square (rms). The use of iron oxide or so-called wet or dry papers is prohibited. The final abrasion marks shall be in the direction parallel to the length of the panel.

- (f) Superficial dusts from the abrasion operation shall be wiped off, using a clean, dry, absorbent tissue or cloth.
- (g) The abraded face of the panel shall be scrubbed thoroughly with a clean, lint-free cloth until there is not dark stain on a clean section. Three-inch wide surgical gauze held in a blotter holder is convenient for this operation.
- (h) The panel shall be sprayed with hot naphtha using a wash bottle or a spray gun. The panel shall be held in a rack at 20 ± 5 degrees from the vertical. The spray shall be directed vertically down on the panel flushing the test surface progressively downward. The test surface shall be sprayed, then the back face, and finally the test surface again.
- (i) The panel shall be rinsed in fresh boiling anhydrous methanol allowing the panel to be immersed for at least 10 seconds to permit the panel to reach temperature of methanol before withdrawal.
- (j) The panel shall be permitted to dry and preserved in a desiccator, using it on the day of preparation.

4.6.11.1.2.1 Cleaning and finishing precautions: The following precautions shall be observed in carrying out the cleaning and finishing procedure:

- (a) The utensils and cloths used in the preparation of the panels shall be clean and free of contamination. Solvents shall be clean and renewed frequently. Safety equipment and ventilation shall be utilized when using solvents.
- (b) In all stages of treatment beginning with step (a), handling of equipment with bare hands shall be avoided. The panels shall be handled with hooks, forceps, or similar devices. Care shall be taken to prevent contact of the panels with contaminated surfaces during the cleaning procedure.

4.6.11.1.3 Application of corrosion preventive compound. The procedures shall be performed at an ambient temperature controlled at $77 \pm 2^\circ\text{F}$ (25°C) and relative humidity of 50 percent or below. A tightly closed 0.9 full can of the compound shall be rolled at approximately 50 rpm for 5 minutes without reversing direction and the coating chamber filled with the compound. Means shall be taken to assure that the compound is practically free from entrapped air bubbles, and any accumulation of air bubbles shall be skimmed from the surface of the compound prior to immersing the panels. The coating chamber shall be large enough to accommodate simultaneously the protection, film thickness, low temperature adhesion, and drying test panels. The panels shall be coated by suspending them vertically in the chamber containing sufficient compound to immerse the panels completely. The panels shall be allowed to remain immersed for 1 minute and then shall be separated from the compound at a rate of 4 inches per minute. The coated panels shall be dried for 24 ± 1 hours in a draft, dust, and fume-free atmosphere prior to making film thickness measurements or other tests. During this drying period the panels shall be hung vertically by both hooks.

4.6.11.2 Film thickness. The average film thickness produced by the compound shall be determined on a panel prepared as specified in 4.6.11.1.3. The film thickness shall be calculated using the following formula:

$$\text{Film thickness (mils)} = \frac{(1,000 \times W) \times 0.061}{D \times A}$$

Where:

1 mil = 0.001 inch

W = weight of film (grams)

0.061 cubic inch = 1 cubic centimeter

D = density of the film (grams per cubic centimeter (gr/cm^3)). Density is determined on the nonvolatile portion by means of a pycnometer (see 4.6.5).

A = total surface area of the panel (square inches).

4.6.11.3 Humidity test (grades 2, 3, 4, and 5). Three specimens prepared as specified in 4.6.11.1.3, suspended by 18-8 corrosion resisting steel or nickel-copper alloy metal hooks, shall be exposed for a minimum of 30 days in a humidity cabinet constructed and operated in accordance with ASTM D 1748. At the completion of the exposure period the compound shall be considered as having passed this test if after removal from the compound none of the panels show more than a trace of corrosion on the leading test surface of the panel. A trace of corrosion is defined as not greater than three dots of rust, no one of which is larger than 1 millimeter in diameter. Only corrosion within significant areas as outlined in ASTM D 1748 shall be considered.

4.6.11.4 Salt spray test (grades 1, 2, and 4). Three specimens prepared as specified in 4.6.11.1.3 shall be exposed for the specified time (see table IV) in accordance with ASTM B 117. No stop-off material shall be used on the edges. The panels shall be examined at the end of the exposure period and evaluated as specified in 4.6.11.3.

TABLE IV. Salt spray exposure time.

Compound (grade)	Days exposure (min.)
1	14
2	7
3	--
4	14
5	--

4.6.11.5 Accelerated weathering test (grade 1 only). Six specimens prepared as specified in 4.6.11.1.3 shall be exposed to an accelerated weathering test. The apparatus shall conform to and shall be operated as specified in method ASTM G 23 and ASTM D 822 except that the water temperature shall be maintained at 70 ± 10°F (22°C) and the pH of the water shall be 5 to 9. At the end of 600 hours of exposure, removability as specified in 4.6.10 shall be determined on three panels. Upon completion of the removability test, the panels shall be evaluated for resistance to accelerated weathering as specified in 4.6.11.3. At the end of 1200 hours of exposure, the remaining 3 panels shall be examined for evidence of rust break through on the surface of the coating. Following this examination, removability shall be determined as specified in 4.6.10.

4.6.11.6 Shed storage (prior to removability test) (grade 2, 3, 4, and 5). Three specimens prepared as specified in 4.6.11.1.3 shall be subjected to the shed exposure test for the time specified in table V. The exterior construction of the shed shall be shown on figure 4. The interior of the shed box shall be as shown on figure 5 having 12 rows of wooden platforms to support the panels during exposure. As shown on figure 5, the panels rest in a groove cut in each of the platforms and shall lean at an angle of 15 degrees from the vertical against the back of the platform. A copper pan containing water 4 inches deep, covers the floor of the box. The panels shall be held 4 inches above the surface of the water. The sheds need not face in any particular direction. At the end of the exposure period, the panels shall be tested for removability of the film as specified in 4.6.10 (removability test is not applicable to grade 5), and protection shall be evaluated as in 4.6.11.3. The shed exposure tests shall be conducted by an activity acceptable to the Naval Sea Systems Command.

TABLE V. Shed storage test exposure time.

Compound (grade)	Time (yrs.) (min.)
2	1
3	1/2
4	1
5	1/2

4.6.11.7 Film characteristic (grades 1, 2, 3, 4, and 5). Specimens prepared as specified in 4.6.11.1.3 shall be examined to determine whether the coating is continuous. Upon completion of the accelerated weathering (grade 1) and shed storage (grades 2, 3, 4, and 5) tests. Specimens that exhibit cracking is evidence of failure. Upon removal from the compound specimens that exhibit checking, alligatoring, or other irregularities are considered satisfactory if there is no etching, pitting, or other evidence of corrosion on the significant areas of the panel in accordance with ASTM D 1748.

4.6.12 Low-temperature adhesion (grades 1, 2, and 4). One specimen each for grades 1, 2, and 4 shall be prepared, coated, and dried as specified in 4.6.11.1.3, after which the specimen shall be cooled to a temperature of $0 \pm 2^\circ\text{F}$ (minus 18°C) for grade 1 and to a temperature of $\text{minus } 40 \pm 2^\circ\text{F}$ (minus 40°C) for grades 2 and 4, and maintained at that temperature for 1 hour. While the specimens are at this temperature, four parallel scratches approximately 1/8-inch apart and 1 inch long shall be made on the film with the low-temperature scratch tool (see figure 6). Four similar scratches shall be made in a direction perpendicular to that of the first four. Look for unacceptable adhesion characterized by flaking of the film within the areas bounded by the scratches. Chipping of the coating extending more than 1/32-inch from either side of the scratch marks shall be considered flaking.

4.6.13 Drying (grades 1, 2, 3, and 5). The coating on a test panel prepared as specified in 4.6.11.1.3 shall be allowed to drain and dry in a vertical position at room temperature $77 \pm 2^\circ\text{F}$ (25°C) for 4 hours for grades 2, 3, and 5. At the end of the specified times, grade 1 coating shall be examined to determine whether it can be handled without injury to the film. Grades 2, 3, and 5 films shall be examined for softness.

4.6.13.1 Drying (grades 4 only) tackiness. The apparatus used for the tackiness test is shown in figure 7.. The procedure shall be conducted at $77 \pm 2^\circ\text{F}$ (25°C) and the relative humidity shall not exceed 50 percent.

4.6.13.1.1 Apparatus (grade 4 only). The apparatus shall be as follows:

- (a) Bottom (coated) specimen -- (see figure 7). A 3 by 6 by 1/4 inch steel panel, ground flat on each 3 by 6 inch side, with a beveled edge and hook. The unbeveled side shall be finished to 10 to 20 rms by polishing as specified in 4.6.11.1.2(e).
- (b) Top (uncoated) specimen -- (see figure 7). A 2 by 3 by 1/4 inch steel panel, ground flat on one side. Panel weight approximately 190 grams and finished on polished side to 5 to 10 rms by polishing with 210 emery paper. The panel shall be fitted with a removable pulley hook to be affixed to the unpolished side.
- (c) Pulley -- (see figure 7). A 3-inch diameter pulley is mounted on a ball bearing supported shaft so that it is free to turn. The pulley shall be balanced and the diameter oriented vertically. The pulley groove must be sufficiently wide so that wire, does not touch the pulley tips.

4.6.13.1.2 Procedure. The procedure shall be as follow:

- (a) By means of the thin, relatively inelastic 0.012-inch diameter chrome-alloy resistance wire (25 pound test), equal weights shall be hung to either side of the pulley. The additional weight is required on one side to overcome the pulley inertia, and cause it to turn (this additional weight should not exceed 10 grams if the pulley is properly prepared) shall be determined. Record this additional weight as W_1 .
- (b) The weight necessary to lift the top panel by one edge at the lifting hook shall be determined and recorded as W_2 .
- (c) The weight pan, supporting wires and damping spring scale (see figure 7) shall be weighed and recorded as W_3 .
- (d) The lower panel shall be coated as specified in 4.6.11.1.3. The coated panel shall be allowed to drain and dry vertically at 77°F (25°C). After 4 hours the coating should be sufficiently dry to permit handling without injury to the film. It shall be allowed to dry for an additional 20 hours.
- (e) The top panel shall be thoroughly degreased and placed polished surface down in the center of the lower coated panel.
- (f) The top panel pulley hook shall be lined up beneath the pulley to insure a vertical pull. (A plumb bob can be used to locate the hook in line with the vertical pull.)

- (g) A 1600 gram weight as shown on figure 7, shall be placed on top of the top panel. Using the pulley wire attached to the hook, the opposite side of the pulley shall be loaded with the damping spring scale and the scale pan containing sufficient weights to provide a net upward force on the upper test panel of 600 grams. (To calculate the weight to be placed in the scale pan, the following shall be done: Scale pan load = 600 grams + $W_1 + W_2 + W_3$). The weights shall be carefully added to the scale pan to avoid oscillation, swing, or jarring.
- (h) After a 5 minute loading period, the 1600 gram loading weight shall be removed and the timing for the top panel break-away initiated.
- (i) A compound is considered as having passed this test if break-away occurs before 5 seconds have elapsed. Four determinations shall be made and passing values shall be obtained in at least three instances.

4.6.14 Water displacement and water stability (grades 3 and 5).

4.6.14.1 Preparation of test panels prior to abrasive blasting. Test panels approximately 2 by 3 by 1/16 inch with well rounded edges shall be prepared from open hearth, high carbon steel. The surfaces shall be uniformly abraded by abrasive blasting with sharp garnet conforming to MIL-A-22262. The garnet shall pass the following fineness requirements (see RR-S-366):

	Percent
Through No. 10 U.S. standard sieve, minimum	100
Retain on No. 20 U.S. standard sieve, maximum	10
Through No. 30 U.S. standard sieve, maximum	10

Badly rusted panels shall not be used, and any oil or inorganic residue on the panels shall be removed with hot naphtha and hot methyl alcohol rinses prior to abrasive blasting.

4.6.14.2 Preparation of test after abrasive blasting. After each panel is abrasive blasted, it shall be immediately placed in a container of commercial anhydrous methyl alcohol conforming to grade A of O-M-232. Just prior to the final cleaning procedure, the methyl alcohol and panels shall be heated so that upon withdrawal, each panel will be well above the dew point of the room. The panels shall be cleaned by spraying with naphtha, rinsing in hot naphtha and rinsing in hot methyl alcohol. Immediately after cleaning, the panels shall be stored in a calcium chloride desiccator and shall be used the same way as prepared. The panels shall be handled with forceps or other instruments at all times during and after the abrasive blasting operation to avoid fingerprint corrosion.

4.6.14.3 Preparation of compound. Fifty cubic centimeters (cc) of the compound shall be placed in a 125-cc Erlenmeyer flask, 5 cc of distilled water shall be added and the mixture thoroughly shaken. The stoppered flask shall be stored overnight at $130 \pm 2^\circ\text{F}$ (55°C) and cooled to $77 \pm 2^\circ\text{F}$ (25°C) for testing.

4.6.14.4 Water displacement procedures. Each of three panels prepared as specified in 4.6.14.1 and 4.6.14.2, shall be dipped in distilled water momentarily and drained in a vertical position for not greater than 5 seconds, with the bottom edge in contact with absorbent paper. The panel shall be immersed horizontally and without agitation for 15 seconds in a petri or evaporating dish containing the compound previously prepared as specified in 4.6.14.3. After draining momentarily, the panel shall be placed in a static humidity cabinet (for example, a desiccator body containing some distilled water) for 1 hour at $77 \pm 2^\circ\text{F}$ (25°C). At the end of 1 hour of testing and after removal of the compounds, the panels shall be examined for evidence of rust, mottling, or other abnormal surface stains and defects.

4.6.14.5 Dilution. At a 1:1 ratio, the compound shall be diluted with paraffin base oil (a neutral noninhibited petroleum oil of 90-100 standard saybolt universal viscosity at 100°F (38°C)) and the water displacement test shall be performed as specified in 4.6.14.4. The test results shall be evaluated as specified in 4.6.14.4.

4.6.15 Flow resistance (grades 1 and 4). A steel panel as specified in 4.6.11.1.1 shall be finished and cleaned according to the procedure of 4.6.11.1.2. A line shall be scribed parallel to and 7/8-inch from the bottom long edge of the panel as shown on item (a) of figure 8. A 1-inch wide strip of cellulose adhesive tape in accordance with type II, class 2, style 8, A-A-1671 shall be applied to the bottom half of the panel on both sides (see item (b) of figure 8). The panel shall then be coated as specified in 4.6.11.1.3. After the 24-hour drying period, the tape shall be carefully removed. The bottom edge of the 1-inch strip of coating should then be parallel to the long edge of the panel and at right angles to the panel surface. The line previously scribed on the panel should now be 1/8 inch below and parallel to the bottom edge of the film (see item (c) of figure 8). The panel shall then be suspended vertically, with the uncoated area downward for 4 hours in a forced convection oven maintained at $175 \pm 2^\circ\text{F}$ (80°C). The panel shall be removed from the oven and allowed to cool to room temperature. The position of the edge of the coating relative to the reference line scribed on the panel shall be observed. Observe any movement of the coating toward the reference line through heating as evidence of failure.

4.6.16 Transparency (grade 4 only). On the panels to be used for shed exposure tests (see 4.6.11.1.1) five markings no more than 3/16-inch high shall be scratched on the reverse (nonevaluated) side. These markings may be the numbers or letters normally used in identifying the panel. A well-sharpened scratch-awl should be adequate for marking. Look for markings legibility after the 4-hour drying period and after the shed exposure test.

4.7 Inspection of packaging. Sample packs, and the inspection of packaging, and marking for shipment, stowage, and storage shall be in accordance with the requirements of section 5 and the documents specified therein. Suggested packing and marking requirements are contained in Tables VI and VII.

4.8 Toxicity. To determine conformance to requirements of 3.2.1, the manufacturer of the material shall disclose the formulation of his product to the Navy Environmental Health Center, Code 34, 2510 Walmer Avenue, Norfolk, VA 23513-2617. The disclosure of proprietary information, which shall be held in confidence shall include: the name, formula, CAS number, and approximate percentage by weight and volume of each ingredient in the product (totalling 100 percent); the results of any toxicological testing of the product; identification of its pyrolysis products; and any other information as may be needed to permit an accurate appraisal of any toxicity problem or issues associated with the handling, storage, application, use, removal, disposal, or combustion of the material. In addition, the manufacturer shall provide a current MSDS for each ingredient used in the formulation. Within 30 days prior to data submission, the manufacturer shall contact the supplier of each ingredient, and confirm each NSDS submitted is current. The manufacturer must provide certification of compliance that materials submitted meet the specific maximum carcinogens. The manufacturer must provide all technical documentation to support the certificate of compliance. Information submitted shall be clearly marked or identified to show it is being provided in connection with qualification under MIL-C-16173.

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.

6. NOTES

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

6.1 Intended use. The corrosion preventive compound covered by this specification is intended for the following uses:

Grade 1: Hard film.

- (a) For protection of metals when exposed for extended periods to outdoor weather conditions.
- (b) For general purpose preservation, indoor or outdoor, with or without cover, for domestic and overseas shipment where a dry-touch film is required.

Grade 2: Soft film.

- (a) For extended indoor protection of interior or exterior surfaces of machinery, instruments, bearings or materials with or without use of supplementary barrier materials.
- (b) For outdoor protection of material for limited periods where metal temperatures do not reach levels that produce prohibitive flow of the corrosion preventive film.

Grade 3: Soft film - water displacing.

- (a) For use where water or saline solution must be displaced from corrodible surfaces and the corrosion prevented or arrested.
- (b) For protection of metallic surfaces of machinery interior instruments, or parts under cover for limited periods.
- (c) For the protection of critical bare steel or phosphated surfaces for extended periods when packaged with suitable barrier materials.

Note: Use grade 5 on metal(s) which may be attacked by an alkaline treatment during the preservative removal stage. The chemical "bell-out" is alkaline and its use should be avoided with such materials as aluminum and magnesium alloys.

Grade 4: Soft film - water displacing.

- (a) For general purpose indoor and limited outdoor preservation of corrodible metals with or without an overwrap and where handling, stacking and counting requires a tack-free coating.
- (b) For storage protection of precision parts, machine tools, pistons, valves, and where a transparent coating is required in addition to properties indicated in item (a) above.
- (c) For protection of machinery and parts designated for export and where salt spray contamination is likely to occur.
- (d) Where there is not requirement for miscibility with lubricating oil and where ease of removal with stoddard's solvent (P-D-680) is important.

Grade 5: Oily film - low pressure steam removable.

- (a) For use in place of grade 3 corrosion preventive compound where chemical boil-out cannot be used for removal (see grade 3).

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of this specification.
- (b) Class and grade required (see 1.2).
- (c) The specific issue of individual documents referenced (see 2.1.1 and 2.2).
- (d) When classification is other than as specified (see 3.1.1).
- (e) When POP criteria is not required (see 5.1.1).
- (f) When fire-retardant lumber and plywood is not required (see 5.1.2(a)).
- (g) Class of fire-retardant fiberboard required (see 5.1.2(b)).
- (h) Level of preservation and level of packing required (see 5.2 and 5.3).
- (i) Unit pack required (see 5.2.1).
- (j) Type drum required (see 5.2.2.3).
- (k) When pails or drums shall be over packed or palletized (see 5.3.1.2, 5.3.1.3, 5.3.2.2, 5.3.2.3, 5.3.3.2 and 5.3.3.3).
- (l) Special marking (a) required (see 5.4.1).

6.2.1 Special instructions for ordering data. The material should be purchased by volume, the unit being a U.S. gallon at 60°F (16°C).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DIDS) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DIDS are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 24.475-1 exempts the requirement for a DD Form 1423.

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
3.2.1, 4.1.3, 4.4, and appendix	DI-MISC-80678	Certification/ data report	10.3.2 does not apply
4.1.2	DI-QCIC-81110	Inspection and test plan	- - - -
4.4	DI-NDTI-80809	Test/inspection reports	- - - -

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 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. 16173 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 05Q22, Department of the Navy, 2531 National Center Bldg 3, Washington, DC 20362-5160 and information pertaining to qualification of products may be obtained from that activity.

6.4.1 Qualification agreements. Qualification approval, certificates of compliance, or any other agreements regarding this specification are valid for the original contractor only and should be considered non-transferable and nonnegotiable without written Government approval.

6.4.2 Qualification re-inspection. The Government reserves the right to reinspect or retest materials acquired under this specification for compliance conformance.

6.5 Materials Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.6 Spray gun. The spray gun used in the sprayability tests is manufactured by the DeVilbiss Company, Toledo, OH and should be identified as follows:

Gun:	MBC-510-FF
Needle fluid:	MBC-444-FF
Air cap:	AV 1239-704
Reservoir:	Screwtop type, 1 quart capacity
Fluid tip end gasket:	TGC-545
	AV-601-FF

6.7 Metal specimens. Specimens of the metals used in corrosion tests may be obtained from the Metaspec Company, P.O. Box 28125, San Antonio, TX (see 4.6.8).

6.8 Shed exposure tests. The shed exposure tests may be conducted at any location approved in writing by the Naval Sea Systems Command.

6.9 International Interest. Certain provisions of this specification (identified by paragraph number of similar manner, if appropriate) are the subject of international standardization agreement STANAG No. 1135. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization office to change the agreement or make other appropriate accommodations.

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6.10 Specification revision. MIL-C-16173E, class 1 is now equivalent to previous MIL-C-16173D with the exception of toxicological prohibitions. MIL-C-16173E, class II is a new class which was established to allow acquisition of lower VOC compounds with toxicological prohibitions.

6.10.1 Packaging recommendations. Suggested packaging and marking requirements are contained in Tables VI and VII. See paragraph 5.1 for packaging.

TABLE VI. Packaging.

Packaging	Recommended requirements for direct Government acquisitions
Containers	<p>(1) The products should be specified to be furnished in cans capable of holding 0.47 liters (L) (1 pint), 0.945L (1 quart), 3.78L (1 gallon) and 18.9L (5 gallons).</p> <p>(2) Multiple Friction plug containers should be in accordance with PPP-C-96, type V, class 2. Interior coatings should be as specified therein. Exterior coatings, including side seam stripping, should be as specified therein for plan B. Wire handles as specified therein should be provided for the 1-gallon container. Closure of the properly filled and sealed cans should be as specified in the appendix thereto.</p> <p>(3) All containers should comply with the requirements of the Uniform Freight Classifications (UFC), the National Motor Freight Classification (NMFC), and the applicable requirements of the Code of Federal Regulations 49CFR178, Department of Transportation (DOT).</p> <p>(4) Unit of procurement: The products covered by this specification should be purchased by volume. The unit of procurement should be in multiples of 1 L or 1 U.S. liquid gallon at 15.5 °C (60 °F).</p>
Commercial packaging	<p>(1) Commercial packaging should be to ASTM D3951.</p> <p>(2) All containers should comply with the requirements of the Uniform Freight Classifications (UFC), the National Motor Freight Classification (NMFC), and the applicable requirements of the Code of Federal Regulations 49 CFR 178, Department of Transportation (DOT).</p>
Packing	<p>Packing should be specified as follows:</p> <p>(1) Overseas delivery packing. Intermediate containers of like size containers of product should be ASTM D6251 packed in close-fitting wood boxes. Box closure and strapping should be as specified in the applicable box specification or the appendix thereto except that strapping should be flat and the finish B.</p> <p>(2) Domestic delivery (Level B) packing. Level B packing should be as for level A, except that boxes should be domestic type or class and the strapping should be finish A or B.</p> <p>(3) Commercial packing. The product, in the unit can and intermediate containers should, as applicable, be packed in multiples of like sizes in accordance with UFC, NMFC and 49 CFR 178 requirements.</p>
Palletization	Intermediate containers should be palletized in accordance with MIL-HDBK-774. Only one size unit or intermediate container should be placed on a pallet.
Intermediate containers	Products should be packaged in intermediate containers as kits. Intermediate containers should be close fitting corrugated fiberboard boxes in accordance with UFC, NMFC and 49 CFR 178 requirements. Fiberboard used in the construction of interior (unit and intermediate) and exterior containers, including interior packaging forms, should conform to the ASTM D4727/D4727M, classes should be domestic fire-retardant or weather resistant fire-retardant (see 6.2).
Packing for acquisitions involving direct delivery to Navy ships or installations	<p>Treated lumber and plywood. All lumber and plywood, including laminated veneer materials, used in shipping container and pallet construction, member, blocking, bracing, and reinforcing must be fire-retardant treated material in accordance with MIL-L-19140 as follows:</p> <p>(a) General use, weather resistant: MIL-L-19140, type II, Category I.</p> <p>(b) General use, non-weather resistant: MIL-L-19140, type I, Category I.</p>

TABLE VI. Packaging - Continued.

Packaging	Recommended requirements for direct Government acquisitions
Material safety data sheets (MSDS) and product / procedure data sheets	A copy of the MSDS and company product data/procedure sheets should be attached to the shipping document for each destination (see 3.5).
VOC certification sheets	VOC certification sheets for each batch of coating will be provided when requested by the procuring activity.

TABLE VII. Marking.

Marking type	Recommended Marking
Bar codes	Marking should include bar codes
Hazardous warnings	<p>(a) Labels should be in accordance with 29 CFR Parts 1910, 1915, 1917, 1918, 1926 and 1928, as well as PPP-P-1892.</p> <p>(b) All individual containers should have the following marking: "CAUTION: This product contains volatile solvents, with probable hazardous vapors. Use with adequate ventilation. Avoid prolonged breathing of vapors or spray mists. The solvents are highly flammable, avoid open flame and smoking."</p> <p>(c) Each component container, shipping container, and palletized load should be marked with the appropriate hazardous symbol.</p> <p>(d) Unit containers should be marked: "This product is Asbestos, Lead, Chromium, Cadmium free, except for possible trace levels."</p>
Volatile organic content (VOC)	"Contains (insert VOC content) grams per liter (insert VOC content in lb/gal) of volatile organic content per 40 CFR CH. 1, Part 60, Appendix A (EPA) Method 24.
Marking type	Recommended Marking
Hazardous air pollutants	"Contains (insert HAP content here in g/L and lb/gal) solids (non-volatiles) per 40 CFR 63."
Shelf life	Each unit container, intermediate container where applicable, and shipping container should be marked as follows: "Date of first re-inspection (insert here date 2 years after date of manufacture)."

6.11 Subject term (key word) listing.

Adhesion, low-temperature preservative
Miscibility, preservative
Nonvolatile preservative
Preservative, removal
Removable film preservative
Salt spray preventive
Shed storage, preservative
Sprayability
Sulfated residue
Weathering, accelerated

6.12 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

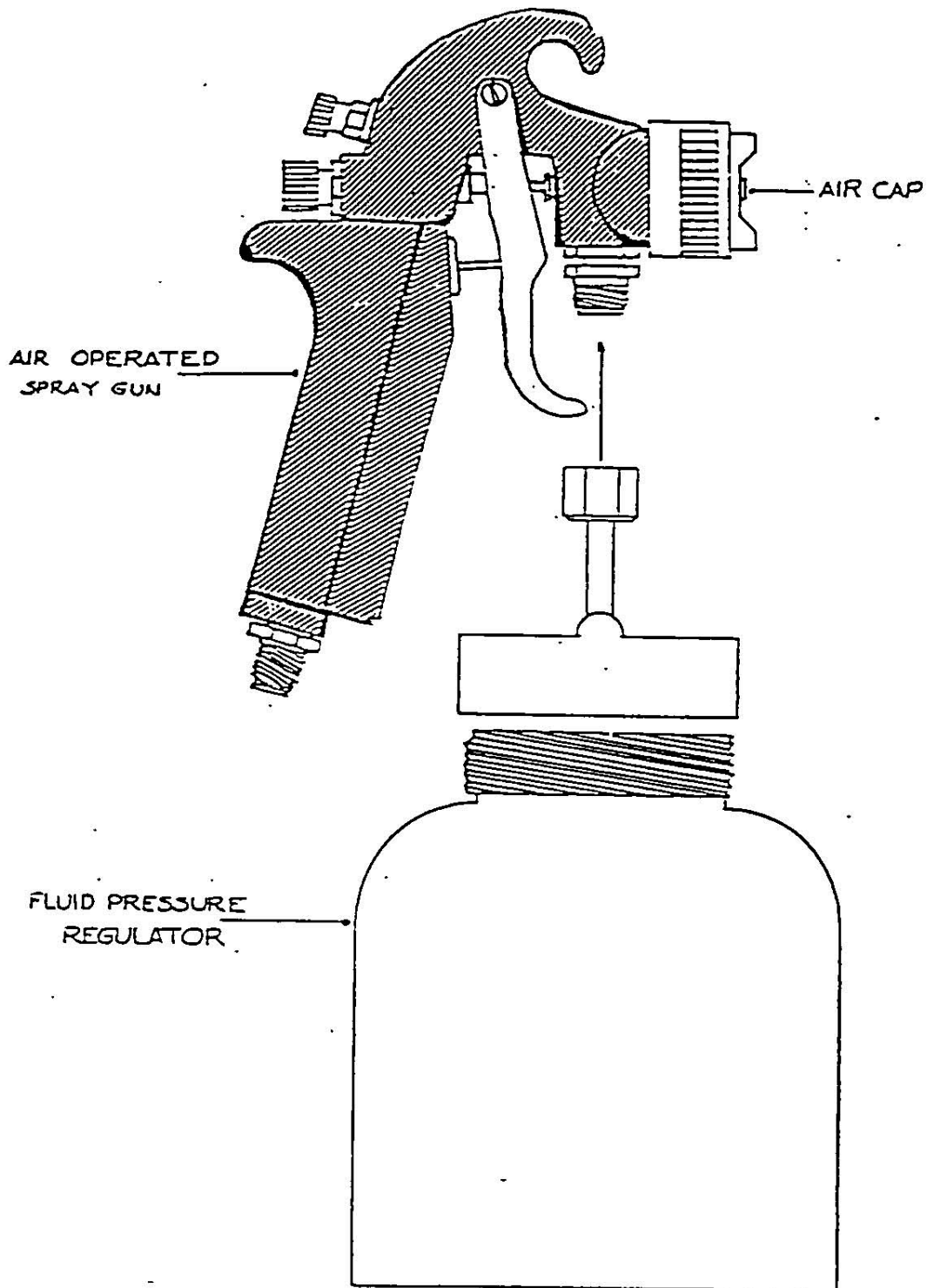


FIGURE 1. Sprayability test apparatus and setup.

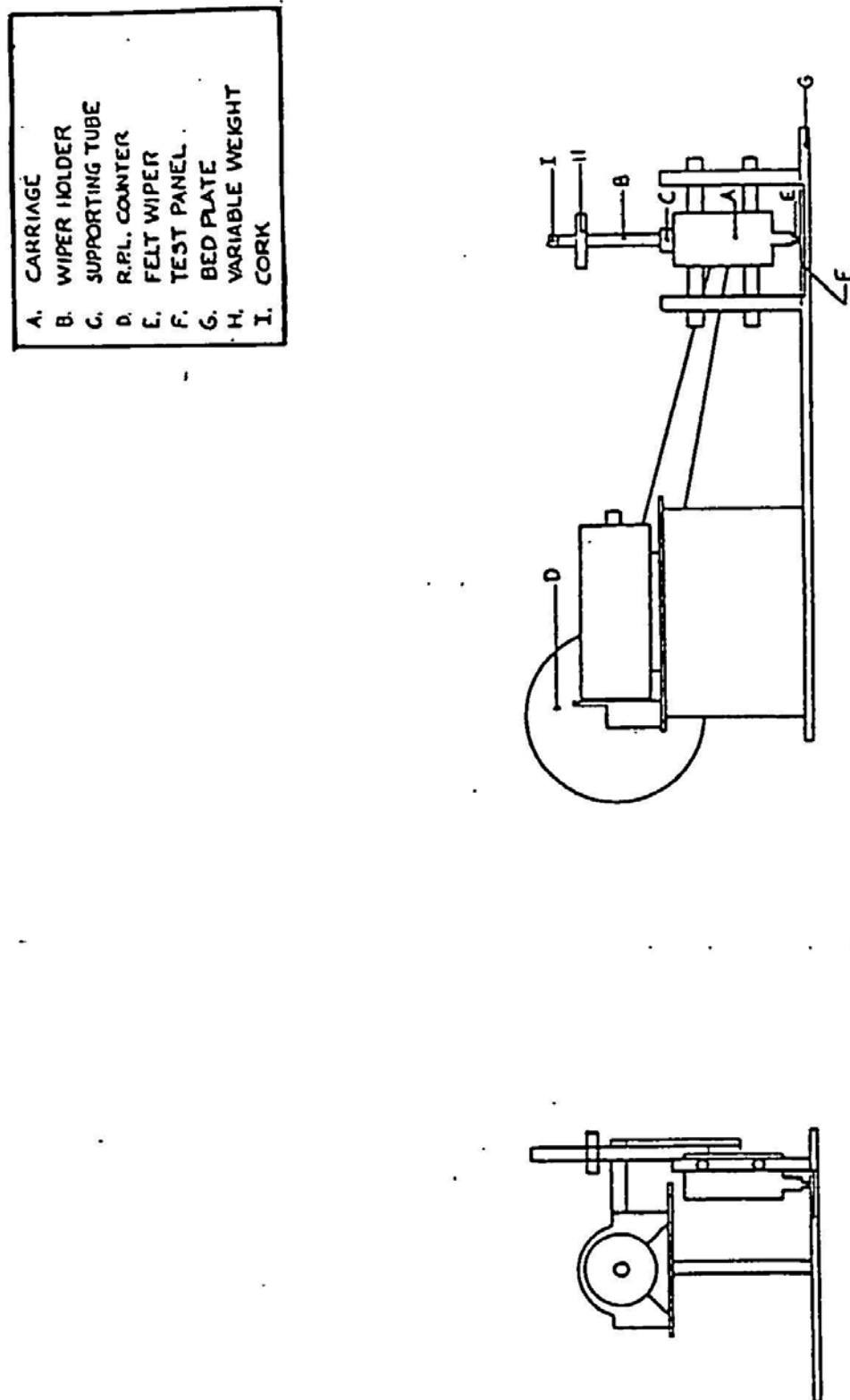


FIGURE 2. Apparatus for determining removability.

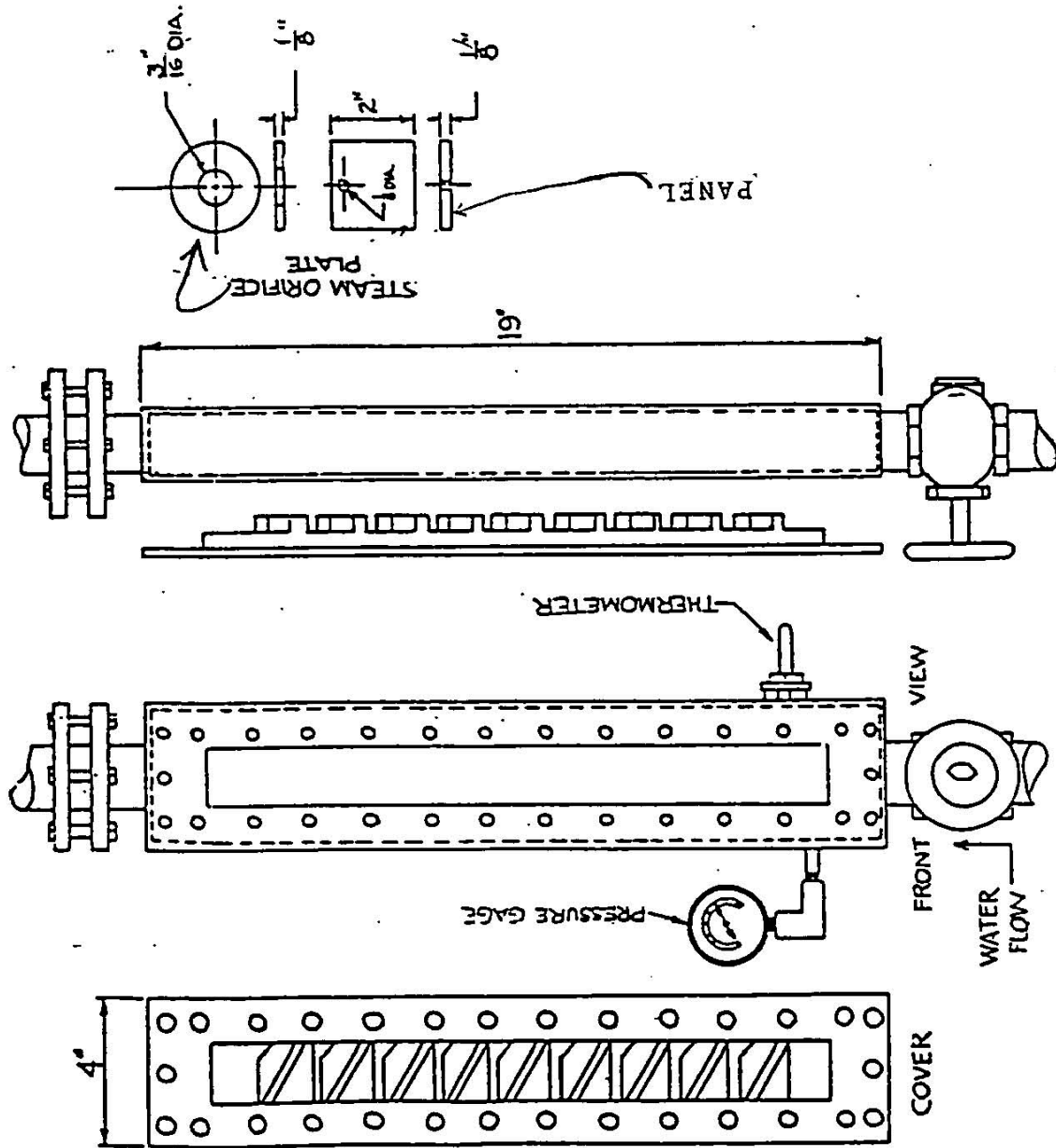


FIGURE 3. Hot water - low pressure steam removability apparatus.

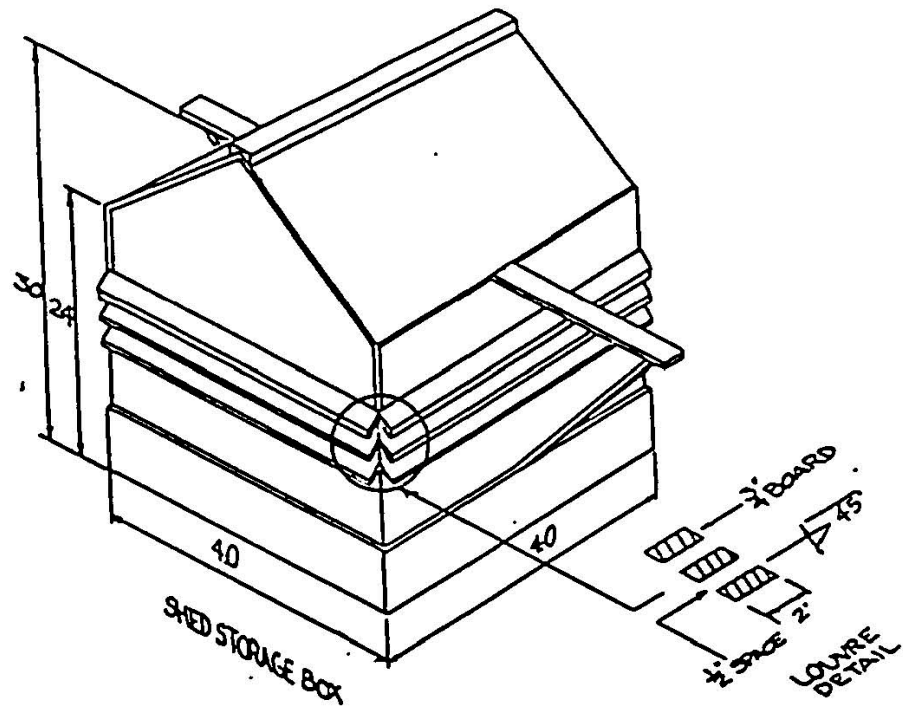


FIGURE 4. Shed storage box.

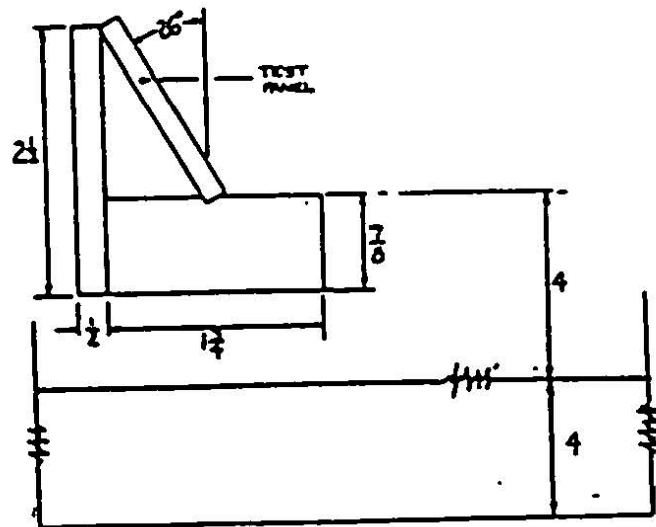


FIGURE 5. Design of panel platform in shed.

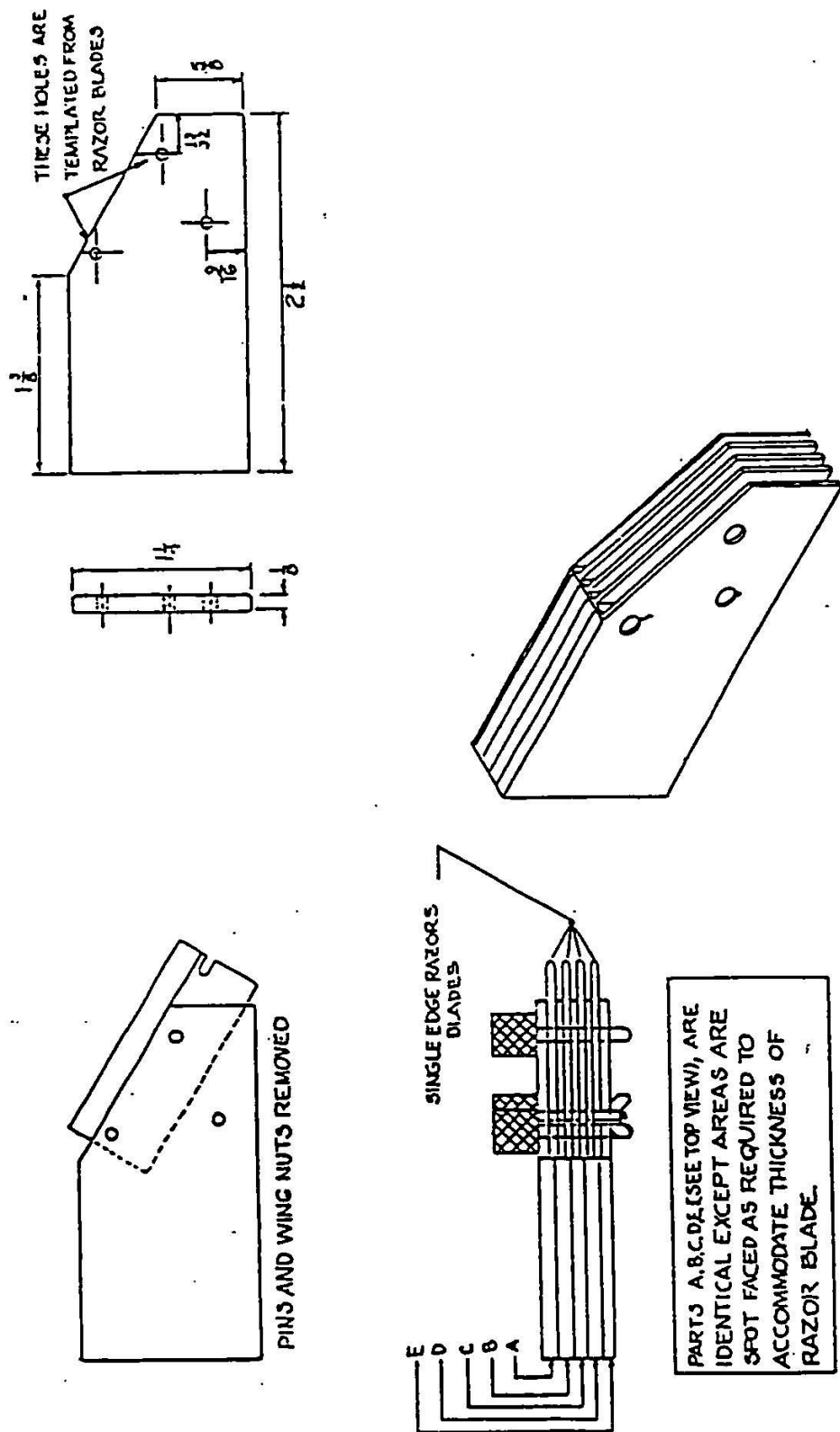


FIGURE 6. Low temperature scratch tool.

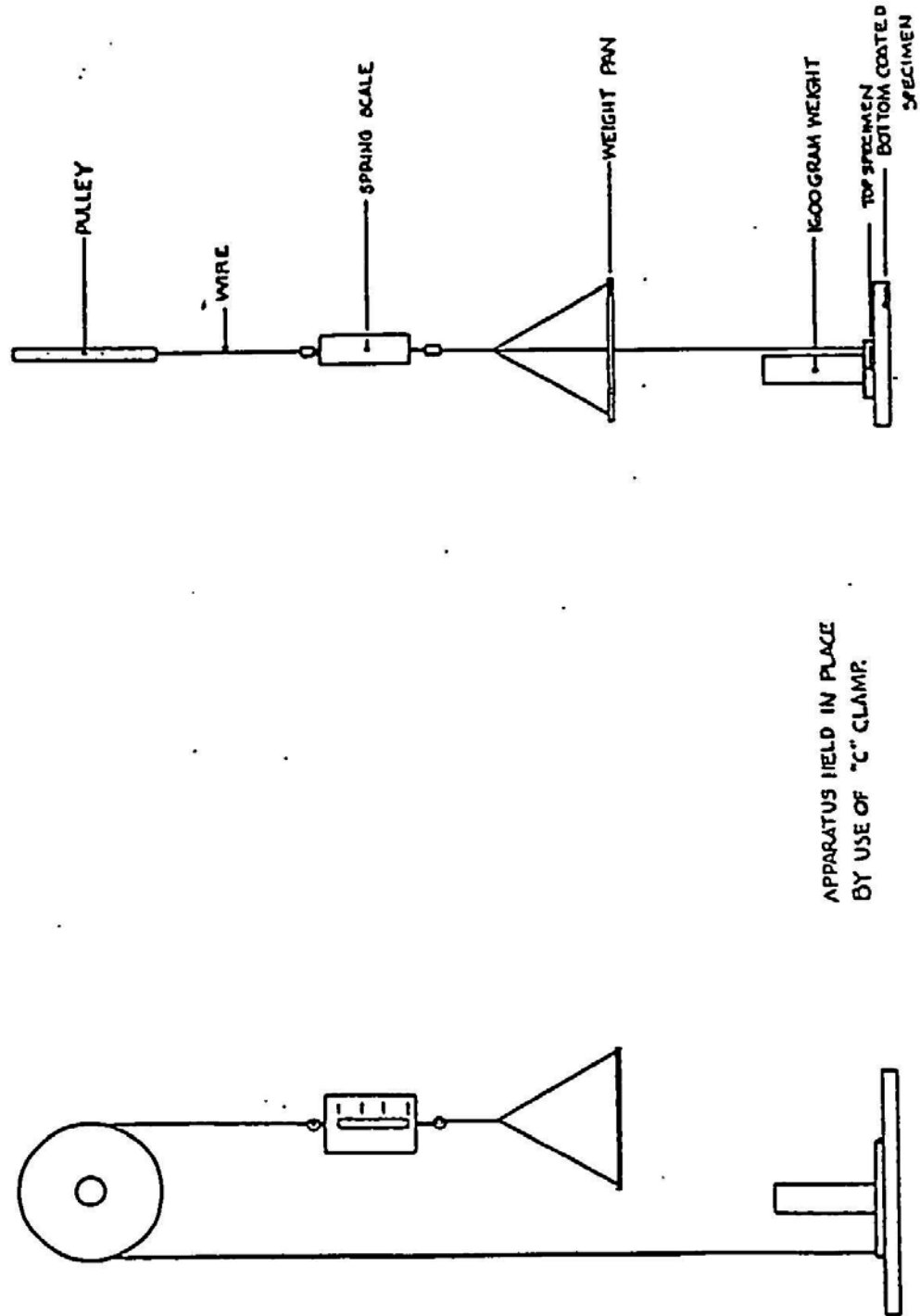


FIGURE 7. Tackiness test apparatus.

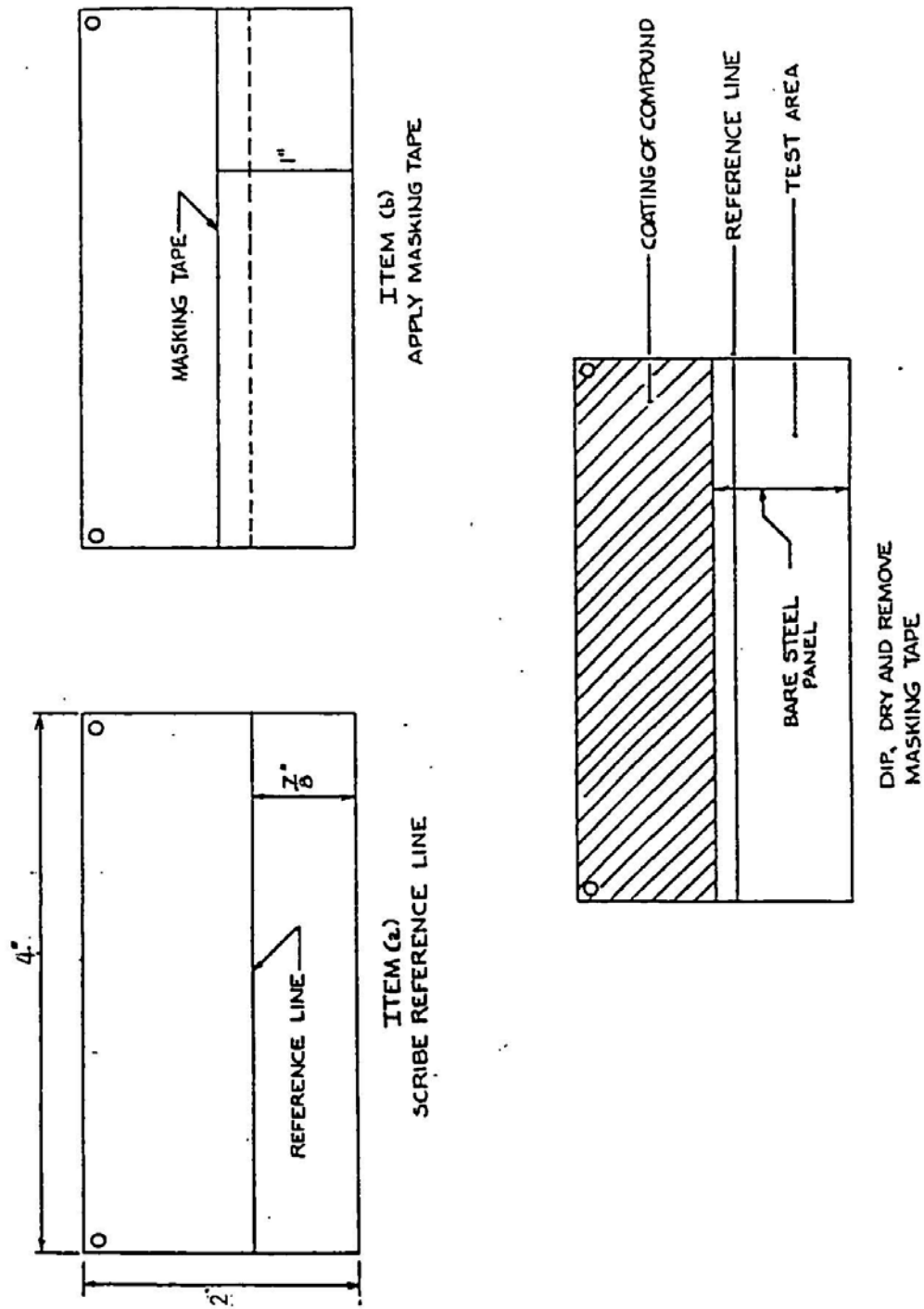


FIGURE 8. Flow resistance test.

APPENDIX

CERTIFICATION/DATA REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included in the certification/data report when specified in the contract or order. This appendix is mandatory only when data item description DI-MISC-80678 is cited on the DO Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. CERTIFICATION CONTENT

30.1 Additional data requirements. In addition to the requirements specified in 4.4, the certification/data report shall include the following information:

- (a) Certification that the submitted preventive compounds does not contain the following materials in excess of 0.05 percent by weight of the dry preventive compound asbestos or asbestos-form pigments, benzene, toluene, chlorinated solvents, hydrolyzable chlorine derivatives, lead, chromium, mercury, and nitrosamines as specified in 3.2.1. The manufacturer shall also certify that the product does not have known or suspected carcinogens intentionally added (based on referenced documents cited in paragraph 3.2.1) to the formulation and when known or suspected carcinogens are/may be present, as a result of being-a trace/impurity in another ingredient(s) the concentration of the agent in the final product does not exceed the in excess of 0.05 percent by weight of the dry preventive compound.
- (b) Certification that the submitted preventive compound has a 1 year storage stability at the time of delivery to the contracting officer as specified in 4.6.6.2.
- (c) Material safety data sheet as specified in 3.2.2., 5.5, and 6.5)
- (d) Test report showing that the submitted material conforms to all requirements of this specification as specified in 4.6.
- (e) For all classes preventive compounds certification that the submitted coating meets the volatile organic content (VOC) requirement of 3.4.2.
- (f) A copy of the NEHC findings in 3.2.1.

CONCLUDING MATERIAL

Preparing activity:
Navy – SH
(Project 8030-2018-005)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.daps.dla.mil>.