

MILITARY SPECIFICATION

RESIN COMPOUND, THERMOSETTING, ROOM TEMPERATURE
CURING, FOR METAL COATING

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 the requirements for unpigmented, thermosetting, room temperature curing resin with associate curing agents to be used for convolutely, or spirally wound fibrous glass reinforced coatings on steel, aluminum and gun metal for corrosion protection.

1.2 Classification. The resin shall be furnished in the following types, as specified (see 6.2.1).

- Type I - Resin for coating steel.
- Type II - Resin for coating aluminum.
- Type III - Resin for coating gun metal.

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.

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 5523, 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.

SPECIFICATIONS

FEDERAL

- QQ-A-250/9 - Aluminum Alloy 5456, Plate and Sheet.
- QQ-C-390 - Copper Alloy Castings (Including Cast Bar).
- PPP-B-585 - Boxes, Wood, Wirebound.
- PPP-B-591 - Boxes, Shipping, Fiberboard, Wood-Cleated.
- PPP-B-601 - Boxes, Wood, Cleated-Plywood.
- PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.
- PPP-B-636 - Boxes, Shipping, Fiberboard.
- PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple-Wall.
- PPP-B-676 - Boxes Setup.
- PPP-C-96 - Cans, Metal, 28 Gage and Lighter.
- PPP-C-186 - Containers, Packaging and Packing for Drugs, Chemicals, and Pharmaceuticals.
- PPP-P-1892 - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of.

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- MIL-L-10547 - Liners, Case, and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible.
- MIL-S-17726 - Sand, Sandblast.
- MIL-S-22698 - Steel Plate and Shapes, Weldable Ordinary Strength and High Strength: Hull Structure.

STANDARDS

FEDERAL

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

MILITARY

- MIL-STD-105 - Sampling Procedures and Table for Inspection By Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.

2.1.2 Government publication. The following Government publication forms a part of this specification to the extent specified herein. Unless otherwise specified, the issue shall be that in effect on the date of the solicitation.

DEPARTMENT OF TRANSPORTATION (DOT)

Code of Federal Regulations (CFR)

- 49 CFR 71-78 - Interstate Commerce Commission Rules and Regulations for Transportation of Explosives and Other Dangerous Articles.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

(Copies of specifications, standards, and publications 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 nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 1639 - Standard Test Method for Acid Value of Organic Coating Materials. (DoD adopted)
- D 1652 - Standard Test Method for Epoxy Content of Epoxy Resins. (DoD adopted)
- D 1963 - Standard Test Method for Specific Gravity of Drying Oils, Varnishes, Resins, and Related Materials at 25/25°C.
- D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor. (DoD adopted)
- G 62 - Standard Test Methods for Holiday Detection in Pipeline Coatings.

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

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT
National Motor Freight Classification

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., ATA TRAFFIC Dept., 2200 Mill Road, Alexandria, VA 22314.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

- AMS 3824 - Cloth, Type "E" Glass, Finished for Resin Laminates

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

UNIFORM CLASSIFICATION COMMITTEE AGENT

- Uniform Freight Classification Ratings, Rules and Regulations

(Application for copies should be addressed 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 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3 and 6.4).

3.2 Materials. The materials used in the manufacture of the resin and curing agents shall be entirely suitable for the purpose intended. The resin shall be of the epoxy or polyester (including vinyl-ester) thermosetting, room temperature curing type. Curing of the finished surface shall be uninhibited by air. The component materials of the resin shall be not corrosive to the applicable metal.

3.2.1 Toxicity. The material shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.8). 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 activity.

3.2.2 Form. The resin shall be in a form suitable for impregnating glass cloth reinforcement and shall be free from foreign matter. Unless otherwise specified (see 6.2.1), materials supplied shall constitute a resin system which includes the resin and the specific curing agent or agents or fillers required to meet the requirements stated herein. Unless otherwise specified (see 6.2.1), the curing agents shall be packaged in unit quantities as required to react with unit quantities of resin as ordered.

3.2.3 Chemical-type. The manufacturer shall designate the general chemical type of resin (polyester, vinyl-ester or epoxy) on the instruction sheet specified in 3.8 and on the resin container.

3.3 Code number. The manufacturer shall designate each resin system by a code number which shall be used to identify the resin and curing agents as a system. The code number may include trade name if desired. The manufacturer's code number shall appear on the instruction sheet and on the label of the resin container. Any changes in the components or manufacturing procedures shall necessitate resubmission for inspection and a new code number shall be assigned.

3.4 Specific gravity, acid number (polyesters), and epoxide equivalent (epoxies). The specific gravity, acid number (of polyester resins), and epoxide equivalent (of epoxy resins) of the liquid uncatalyzed resin shall be determined in the tests of 4.3. The manufacturer shall provide limiting manufacturing tolerance values within which these properties can be controlled (see 4.3). These values shall be considered requirements of this specification for quality conformance inspection (see 4.4.2).

3.5 Resin system properties. The resin with its specific curing system shall conform to the property values specified in 3.5.1, 3.5.2 and 3.5.3. Properties apply to resin types I, II and III. The resin system shall be capable of curing, with a tack-free surface, within 24 hours at room temperature.

3.5.1 Drainage or minimum viscosity. A 0.030 inch film of catalyzed resin when applied and tested as specified in 4.6.1.1 shall take no less than 5 minutes

to drain a distance of 1 inch. For applications where drainage is not a problem (see 6.2.1), such as covering items that can be rotated, the drainage requirement may be replaced by a minimum viscosity value of 1500 centipoise at 72 degrees Fahrenheit (°F).

3.5.2 Viscosity. The viscosity of the catalyzed resin when measured as specified in 4.6.1.2 shall be no greater than 25,000 centipoises at 50°F.

3.5.3 Gel time. The gel time of the catalyzed resin shall be as specified in table I when measured as specified in 4.6.1.3.

TABLE I. Gel time requirements.

	Temperature	
	73 ± 2°F	90 ± 2°F
Gel time	30 minutes, minimum 6 hours, maximum	18 minutes, minimum

3.6 Resin coating properties. When reinforced with fiberglass (glass reinforced resin) resin coatings on steel, aluminum and gun metal shall conform to the property values specified herein.

3.6.1 Impact strength. The impact strength of glass reinforced resin coatings on steel, aluminum and gun metal shall be as specified in table II when applied and tested as specified in 4.6.2.1.

TABLE II. Impact strength requirements.

Resin type	Metal ^{1/}	Impact strength, ft-lb (minimum) at standard conditions ^{2/}
I	Steel	0.3
II	Aluminum	2.0
III	Gun metal	10.0

^{1/} Metal specimens shall conform to the following specifications:

<u>Metal</u>	<u>Type</u>	<u>Specifications</u>
Steel	Type II	MIL-S-22698
Aluminum	Temper H321	QQ-A-250/9
Gun metal		QQ-C-390

^{2/} See 4.5.1.

3.6.2 Peel strength. The peel strength of glass reinforced resin coatings on metal substrates shall be as shown in table III when applied and tested as specified in 4.6.2.2.

TABLE III. Peel strength requirements.

Resin type	Metal ^{1/}	Minimum value, (pounds) after 14 days immersion in salt water ^{2/}	Maximum allowable percent decrease after immersion from value obtained after 48 hour cure at standard conditions ^{3/}
I	Steel	14	30 percent
II	Aluminum	14	30 percent
III	Gun metal	14	30 percent

^{1/} See 3.6.1, Note ^{1/}

^{2/} See 4.5.2

^{3/} Percent decrease = $\frac{\text{Dry value} - \text{Wet value}}{\text{Dry value}} \times 100$

3.6.2.1 Porosity. When tested as specified in 4.6.2.1.3, no pinholes shall be detected on the 1-1/2 by 1 inch test area of peel strength specimens (prepared as specified in 4.6.2.2) before and after immersion in salt water.

3.6.2.2 Corrosion. There shall be no evidence of corrosion as determined in 4.7 on the 1-1/2 by 3-1/2 inch bond test area of steel, aluminum and gun metal specimens after the 14 day immersion period in salt water.

3.6.2.3 Barcol hardness. When tested as specified in 4.6.2.1.5, the average Barcol hardness shall not differ from the manufacturer's recommended value by more than 10 percent greater or 5 percent less. If these limits are exceeded, the manufacturer shall provide data to resolve the issue and to demonstrate that his recommended hardness is accurate and adequate.

3.7 Storage life. The storage life at standard conditions (see 4.5.1) of the uncatalyzed resin and related catalyst or hardener shall be at least 6 months. After storage in commercial containers other than glass, for this period, the resin system, when catalyzed, shall meet all of the requirements of this specification.

3.8 Instruction sheet. The manufacturer shall provide an instruction sheet for each resin and curing agent system. The instruction sheet shall contain the following information:

- (a) Chemical type of resin, type number (I, II or III), and manufacturer's code number (see 3.2.2).
- (b) Maximum usable storage life of the resin (uncatalyzed), and gel time or pot life of the catalyzed resin at various temperatures, required percentage and type of curing agent or agents, and minimum and maximum percent of curing agents allowed.
- (c) Recommended mixing and reinforcement impregnating procedures.
- (d) Curing characteristics of the system, including minimum curing temperature, curing times at minimum temperature and at elevated ambient temperature (90 to 100°F) and Barcol hardness of the adequately cured system.

- (e) Any other pertinent information on storage and handling of the resin, cautions on toxicity and precautions to be taken in handling the resin and curing agents.
- (f) The instruction sheet shall pertain only to a single resin system.

3.9 Material safety data sheet. The contracting activity shall be provided a material safety data sheet (MSDS) at the time of contract award. The MSDS is form OSHA-20 and found as part of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification.

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 program. The absence of any inspection requirements in the specification shall 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) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4)

4.3 First article inspection. First article inspection shall consist of tests specified in 4.6.1 through 4.6.2.2.5. The following items shall be submitted for first article inspection:

- (a) A 2-quart sample of resin system (with curing agents) for conformance to 3.2 and 3.2.1.
- (b) Limiting manufacturing tolerance values for specific gravity, acid number (for polyesters), and epoxide equivalent (for epoxies) as specified in 3.4.
- (c) Test evidence of conformance to 3.7.
- (d) An instruction sheet as specified in 3.8.

4.3.1 First article test report. The contractor shall provide first article test reports in accordance with the data ordering document (see 6.2.2).

4.4 Quality conformance inspection.4.4.1 Sampling.

4.4.1.1 Lot. All material offered for delivery at one time shall be considered a lot for the purpose of examination and tests.

4.4.1.2 Sampling for quality conformance inspection. Two resin containers shall be selected at random. From each of the two containers a 1-quart specimen shall be taken. Based on the manufacturer's recommendations, the amount of curing agents required for reaction with the 1-quart resin samples shall be determined, and the required quantity of curing agents selected at random.

4.4.1.3 Sampling for examination of filled containers. A random sample of filled resin containers shall be selected in accordance with MIL-STD-105 at inspection level I and acceptable quality level of 2.5 percent defective for major defects and 5.0 percent defective for minor defects for the examination specified in 4.4.3.

4.4.2 Quality conformance inspection. The resin and curing agents samples, taken as specified in 4.4.1.2, shall be subjected to the tests specified in 4.6.1.1 through 4.6.1.6. If either of the samples fail any of the tests, it shall be cause for rejection of the lot.

4.4.3 Examination of filled containers. Each filled resin container in the sample selected in accordance with 4.4.1.3 shall be examined for defects in compliance with table IV. Any container in the sample having one or more defects or which is under required fill shall be rejected, and if the number of defective containers in any sample exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, it shall be cause for rejection of the lot represented by the sample.

TABLE IV. Classification of defects.

Categories	Defects
Critical: 1	None defined.
Major: 101	Type not as specified, (oblong, square or round).
102	Gauge steel not within requirements.
103	Size (capacity) not as specified.
104	Container not coated or coating nonconforming, (internal and external as applicable).
105	Means of closure not as required; closure (cover) leaks, (container inverted); gasket when applicable, missing, damaged or nonconforming.
106	Seam improperly formed, soldered or welded.
107	Seam leaks.
108	Not the required volume (fill).
109	Marking (as to content) not as specified, missing or illegible.

TABLE IV. Classification of defects. - Continued

Categories	Defects
Critical: 1	None defined.
Minor: 201	Not free from dents, scratches, burrs or sharp exposed edges.
202	Evidence of rust or corrosion.
203	Bails improperly attached or missing (when applicable).
204	Diameter of bail wire less than allowable minimum (when applicable).
205	Bail wire hand grip missing, nonconforming, not wood or metal as required (when applicable).

4.5 Test conditions.

4.5.1 Standard conditions. Standard conditions shall be $73 \pm 2^{\circ}\text{F}$ and 50 ± 4 percent relative humidity.

4.5.2 Fourteen day immersion in salt water. Specimens shall be immersed in 10 percent solution by weight of sodium chloride, through which air is bubbled to accelerate corrosion. The apparatus consists essentially of a glass jar with a specimen rack, containing salt solution through which air is bubbled to accelerate corrosion. The glass jar shall be a nominal 4-1/2 gallon container, 12 inches in diameter and 12 inches high. The shelves shall be of 1/4-inch bakelite and have bakelite separators to serve as legs and as spacers. Each shelf shall be perforated with numerous 1/2 inch diameter holes. Air at the rate of 0.3 cubic feet per minute shall be bubbled through a water column approximately 6 inches high and introduced into the solution through a manifold and interlaced ring assembly. The ring assembly shall be made of 1/4-inch diameter plastic tubing and have a total of fifty-one 3/64-inch diameter holes. (It is to be noted that no metal is used in any part of this apparatus.)

4.6 Test procedures.

4.6.1 Resin system tests.

4.6.1.1 Drainage.

4.6.1.1.1 Specimen. The specimen shall be a flat metal plate, 12 by 12 by 1/4 inches. The metal shall be as specified in 3.6.1. One surface of the plate shall be sandblasted as specified in 4.6.2.1.2.

4.6.1.1.2 Procedure. Drainage shall be determined at standard conditions on a 0.030 inch thick layer of catalyzed resin applied to the steel plate. The resin layer shall be 4-1/2 inches wide and approximately 8 inches long. The resin may be applied by any method that will deposit a layer of the specified dimensions. Figure 1 gives details for a suggested applicator of this type. The steel plate shall be placed on a flat surface. A strip of wood shall be clamped along the upper edge of the steel plate. The strip shall serve as a guide for the applicator in depositing a straight film of resin. A line shall be ruled across the plate parallel to the wood strip so that the nearest edge

of the resin film will be 1 inch above the line. The applicator shall be placed on the plate against the wood guide. The resin shall be catalyzed in accordance with the manufacturer's instructions. The resin shall be stirred with a spatula for 1 minute at a rate of approximately 120 turns per minute. If necessary, stirring shall continue until the resin is uniformly mixed. A small quantity of resin shall then be placed in the applicator which shall be slowly pulled along the wood guide to lay down the designated resin layer. One minute after completion of the application of the resin layer, the plate shall be turned 90 degrees so that the resin layer is in a vertical position with the indicating line 1 inch below the bottom edge. At the same time a stop watch shall be started. The portion of the film to be measured shall be a 6-inch length which is 1 inch from both ends of the 8-inch layer. The time for any of the designated portion of the film to drain the 1 inch to the indicating line shall be measured. The determination shall be made in triplicate and the results averaged. A fresh batch of resin shall be catalyzed each time the test is conducted.

4.6.1.2 Viscosity.

4.6.1.2.1 Preparation of specimen. The viscosity of the catalyzed resin shall be determined in a 1-pint can conforming to type V, class 2 of PPP-C-96. The resin and curing agents shall be cooled separately to $50 \pm 1^\circ\text{F}$. For unpromoted polyester resins, the accelerator shall be blended into the resin before cooling. When ready to run the test, the resin and curing agents shall be removed from the cold chamber and placed at standard conditions. The resin shall be catalyzed immediately in accordance with the manufacturer's instructions. The resin shall be stirred with a spatula for 1 minute at a rate of approximately 120 turns per minute. If necessary, stirring shall continue at this rate until the resin is uniformly mixed, but not longer than 2 additional minutes. Care shall be taken to avoid undue entrapment of air while stirring.

4.6.1.2.2 Procedure. After blending the resin and curing agents, the viscosity shall be determined immediately with a Brookfield Synchro-lectric Viscometer, Model RVF, or equivalent, using spindle No. 3. The instrument shall be mounted on a ring stand and the guard arm removed. The instrument shall be lowered into the resin up to the notch on the spindle shaft. The spindle shall be rotated at 2 revolutions per minute for 30 seconds. The clutch lever shall then be pressed down so that the pointer becomes clamped to the dial and the reading shall be taken. Viscosity measurements shall be made in duplicate and the results averaged. A new batch of resin shall be used for each determination.

4.6.1.3 Gel time. Gel time shall be determined on 3.53 ounces (100 grams) of the catalyzed resin in an 8-ounce paper cup. The resin and catalyst (or hardener) shall be brought separately to the test temperature, mixed and placed in the chamber maintained at the ambient test temperature. A wooden tongue depressor shall be used to stir the resin every few minutes. The gel time is determined as the time required for the viscosity to increase to a value such that it is no longer possible to stir or to work the resin. Gel time measurements shall be made in duplicate and the results averaged. Alternatively, commercial instruments for measuring gel time may be used.

4.6.1.4 Specific gravity. The specific gravity of the liquid, uncatalyzed resin at $25/25^\circ\text{C}$ shall be determined in accordance with ASTM D 1963. A single determination shall be made.

4.6.1.5 Acid number. Acid number of the liquid, uncatalyzed polyester resin shall be determined in accordance with ASTM D 1639. Two measurements shall be made and the results averaged.

4.6.1.6 Epoxide equivalent. The epoxide equivalent of the liquid, uncatalyzed epoxy resin shall be determined in accordance with ASTM D 1652. Two measurements shall be made and the results averaged.

4.6.2 Resin coating tests.

4.6.2.1 Impact strength.

4.6.2.1.1 Specimen. The metal substrate shall be a flat plate, 12 by 12 by 1/4 inches, and shall have four drilled specified holes as shown on figure 2. One specimen, of the appropriate metal specified in 3.6.1, shall be prepared for this test. The reinforcement shall be glass tape or glass cloth, 12 by 12 inches, having a compatible finish and conforming to style 7500 of AMS 3824. Two plies of reinforcement shall be required for each specimen.

4.6.2.1.2 Preparation of surface. The surface to be coated shall be prepared by sandblasting. The sand shall conform to MIL-S-17726, class 3, and shall be free from rust, clay, dirt and other impurities. An air pressure of not less than 75 pounds per square inch (lb/in²) shall be used. The nozzle shall be passed over the surface to be sandblasted slowly and evenly so that all areas of the specimen are sandblasted. After sandblasting, the surface shall be uniform in appearance and free from rust, scale and oil. Prior to coating (see 4.6.2.1.3), dust and sand from the sandblasting operation shall be removed from the surface by a blast of clean compressed air. Care shall be taken to avoid spotting the coating surface with finger marks or other stains.

4.6.2.1.3 Application of coating. The holes in the metal plate shall be covered with small pieces of pressure-sensitive tape. The resin shall be catalyzed according to the manufacturer's instructions, and one coat shall be applied with a brush to the sandblasted surface. One ply of reinforcement shall be placed on the plate and a second coat of resin shall be brushed onto the glass. The second ply of reinforcement shall be placed on the layup so that the warp yarns will be perpendicular to the warp yarns of the first ply. The third coat of resin shall then be applied to the reinforcement. After the reinforcement has wetted out, a polyvinyl alcohol film shall be placed over the layup. The excess resin and entrapped air shall be rolled out with a steel rod 15 inches long by 1-1/2 inches in diameter, weighing approximately 7.5 pounds. The rod shall be rolled over the plate several times. Only the weight of the rod shall be employed in this operation and no additional hand pressure shall be applied. A protective sheet of plastic or metal, 12 by 12 by 1/4 inches, shall be placed on the layup and 15 pounds of weight (including the weight of the cover sheet) shall be distributed evenly on the specimen. After 24 hours, the weights, protective sheet and polyvinyl alcohol film shall be removed from the coating. The specimen shall remain at standard conditions for an additional 24 hours and shall then be tested. The coating shall be tested for pinholes with a high frequency, high voltage spark tester. The apparatus shall be capable of producing a spark of approximately 10,000 volts, self limited to a low current. A suitable spark tester is shown in ASTM G 62. The test shall be made by passing the sparking electrode of the apparatus over, but not in contact with, the covered surface. Care shall be taken to

keep the electrode in motion so that the coating shall not become overheated and burn through. Pinholes may be present in the coating because of air bubbles which have resulted from air feedback before resin gelation. If such pinholes are detected in the vicinity of the four impact areas (that is, the centers of the four 4- by 4-inch quarters of the specimen), impact tests shall not be conducted on this specimen. A second specimen shall be prepared and additional weights may be placed on the layup to prevent the formation of air bubbles. The specimen may be prepared under a vacuum bag to exclude air. When a satisfactory coating is prepared, the coating over the holes in the metal plate shall be drilled through and the specimen shall be tested as specified in 4.6.2.1.4.

4.6.2.1.4 Testing of coating. An 18 by 18 by 2 inch steel base plate shall be secured to the floor by means of four bolts at the corners. Four 1/2-inch diameter holes shall be located and drilled and tapped into the base plate to accommodate the test specimen (see figure 2). The specimen shall be secured to the base plate with four 1/2- by 1-inch bolts and washers. The bolts shall be tightened with a wrench so that they are equally tight. The test shall be conducted by dropping steel balls on the specimen from an electromagnet. The magnet, provided with a centering tip, shall be positioned over the specimen so that the distance from the magnet to the surface of the specimen will be 5 feet. The magnet shall also be positioned so that the ball, when released from the magnet, will strike the specimen in the center of a 4- by 4-inch quarter as shown on figure 2. The electromagnet shall be fixed in this position. A 1/2-inch diameter steel ball shall be dropped on the specimen and the impact area shall be tested for pinholes. A pinhole is evidenced by a bright spark which is distinct from the dull purple corona emanating from the tip of the spark tester when no pinholes are present. Steel balls increasing in diameter in 1/8-inch increments shall be dropped on the specimen until failure occurs. The impact energy shall be calculated in foot pounds by multiplying the weight of the ball, in pounds, by the distance, 5 feet. The three other quarters of the specimen shall be subjected to impact tests specified herein. The impact strength for the coating shall be reported as the average value for the four quarters.

4.6.2.1.5 Barcol hardness. After testing for impact resistance, the coating on the metal plate shall be checked for Barcol hardness in accordance with ASTM D 2583. Hardness readings shall be taken in areas not directly impacted.

4.6.2.2 Peel strength.

4.6.2.2.1 Specimen. The dimensions of the metal substrate shall be 4 by 4 by 1/4 inches. Ten specimens, of the appropriate metal listed in 3.6.1, shall be prepared for this test. Five specimens shall be tested at standard conditions and five shall be tested after the salt water exposure of 4.5.2. The reinforcement shall be glass tape, 2 inches wide and 10 inches long, having a compatible finish and conforming to style 7500 of AMS 3824. Two plies of tape are required for each specimen.

4.6.2.2.2 Preparation of surface. The surfaces of the metal specimens to be coated shall be sandblasted as specified in 4.6.2.1.2.

4.6.2.2.3 Application of coating. The bonding area for peel tests shall be 1-1/2 by 3-3/4 inches as shown on figure 3a. This area shall be prepared by masking the area to be bonded with a 1-1/2 by 3-3/4 inch template cut from thin sheet metal or other suitable material and covering all exposed areas of the specimen surface surrounding the template with a thin film of paste wax as shown on figure 3a. Paste wax shall also be applied to the edge of the metal specimens as shown. The separating compound shall not be capable of reacting with the resin. After the wax dries the resin shall be catalyzed and one coat shall be spread over the surface of the specimen with a brush. One ply of glass tape shall be placed on the bond area as shown on figure 3b and a second coat of resin shall be applied. The second ply of tape and a third coat of resin shall then be applied. After the glass tape has wetted out, separating film shall be placed over the layup and excess resin and entrapped air shall be worked out with a rod using light rolling pressure. The specimen shall then be covered with a protective sheet of plastic, 4 by 4 by 1/4 inches and 5 pounds of weights shall be placed on the specimen. The weights shall be centered above the peel test area (see figure 3d) to prevent air feedback during cure. After 24 hours, the weights, cover sheet and film shall be removed from the specimen.

4.6.2.2.4 Preparation of specimen for test. The unreinforced resin flash (see figure 3b) shall be removed from the metal surface by cutting through the resin layer with a sharp instrument along the edge of the glass tape on both sides of the bond and peeling away the resin layers. With a sharp instrument, the coating shall be pried up gently along the edge of the glass tape so that the coating separates from the steel up to the edge of the bond (cross-hatched area shown on figure 3c). The free tape end shall be lifted gently so that the coating separates from the metal up to the beginning of the bond area. This will cause a whitening of the coating in the cross-hatched area shown on figure 3c so that the bond area will be clearly visible. The specimens shall remain at standard conditions for an additional 24 hours and shall then be tested. Specimens shall be tested for pinholes with a spark tester over the 1-1/2 by 3-1/2 inch bond area (see figure 3d) employing the procedure specified in 4.6.2.1.3. If any pinholes are detected because of air bubbles caused by air feedback during resin cure, another specimen shall be prepared. Additional weights shall be used to prevent air bubble formation. Specimens exposed to standard conditions shall then be tested by the procedure in 4.6.2.2.5. Specimens exposed to 10 percent salt water shall be immersed as specified in 4.5.2. Exposed surfaces of steel and gun metal specimens shall be protected against corrosion in the salt water by painting with zinc chromate primer or other suitable material. Care shall be taken not to allow the primer to contact the coating. At the end of the 14-day immersion period, specimens shall be removed from water, dried with a cloth and tested as specified in 4.6.2.2.5.

4.6.2.2.5 Test procedure. Peel strength shall be determined on a tensile testing apparatus with a chart recorder for load and time. A 1-inch peel length shall be marked on the coating as shown on figure 3d. The specimen shall be affixed to the testing apparatus with four C-clamps at the corners of the specimen, or by other suitable means. The two ends of the plies of glass tape shall be affixed to the loading jaws of the apparatus so that an angle of 90 degrees is made with the plane of the coating. Load shall be applied to the specimen at a rate of 0.35 inch of head travel per minute.

The maximum load sustained by the specimen during the 1-inch of peel shall be determined from the chart. An average value shall be calculated for the five specimens of each group.

4.7 Corrosion evaluation. Peel test specimens exposed to salt water (see 4.6.2.2.4) shall be visually inspected for evidence of corrosion before and after peel testing. After peel testing the fiberglass and resin shall be scraped from the bond area to aid inspection. Examination shall note corrosion occurring in the bond area by permeation of the resin or by spreading under the resin covering due to bond inadequacy at the edges. Traces of corrosion at the perimeter of the bond area due to exposed metal and not due to resin inadequacy or bond failure may be ignored.

4.8 Toxicological formulations. The contractor shall have the toxicological formulations and associated information available for review by the contracting activity to evaluate the safety of the material for the proposed use.

4.9 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.)

5.1 Preservation-packaging. Preservation-packaging shall be level A or C, as specified (see 6.2.1).

5.1.1 Level A.

5.1.1.1 Resin. Resin in the quantity specified shall be furnished in metal containers of suitable capacity in accordance with level A of PPP-P-1892.

5.1.1.2 Curing agent. Curing agents of proper type and size and sufficient quantity shall be furnished in metal cans or pails, fiber drums, or polyethylene bottles or jars. There shall be no deleterious effect of the curing agent on the container, or vice versa, and there shall be no loss of material through the container.

5.1.1.2.1 Metal cans. Metal cans shall conform to group C, type A of PPP-C-186. Interior coatings and exterior plan B coating shall conform to PPP-C-96.

5.1.1.2.2 Metal pails. Metal pails shall conform to group E, class 1, type I of PPP-C-186. Interior coatings and exterior plan B coating shall conform to PPP-C-96.

5.1.1.2.3 Plastic containers. Plastic containers shall conform to group A, class 2, styles 1, 2 or 4 of PPP-C-186. Closure A shall be used, except that for volatile materials, vented closures shall be used.

5.1.1.2.4 Fibre drums. Fibre drums shall conform to group E, class 2 of PPP-C-186. Plastic liners shall conform to group F, class 2 of PPP-C-186.

5.1.2 Level C. The resin and curing agent shall be preserved-packaged to afford protection against contamination, corrosion, deterioration and physical damage during shipment from the supply source to the first receiving activity for immediate use. The contractors normal retail or wholesale preservation-packaging methods may be utilized when such meets the requirements of this level.

5.2 Packing. Packing shall be level A, B or C as specified (see 6.2.1).

5.2.1 Level A. Resin and curing agent preserved-packaged as specified in 5.1 shall be packed in containers conforming to any one of the following, with container selection at the option of the contractor:

<u>Specification</u>	<u>Container</u>	<u>Type or class</u>
PPP-B-585	Wood-wirebound	Class 3
PPP-B-591	Fiberboard, wood cleated	Class II
PPP-B-601	Wood, cleated-plywood	Overseas type
PPP-B-621	Wood, nailed and lock corner	Class 2
PPP-B-636	Fiberboard	Weather-resistant
PPP-B-640	Fiberboard-corrugated triple wall	Class 2

Boxes, in accordance with PPP-B-636 shall be restricted to the special requirements and V-grades. Unless otherwise specified (see 6.2.1), shipping containers shall have caseliners conforming to MIL-L-10547 with closure and sealing in accordance with the appendix thereto. Wood and plywood containers shall be closed, strapped or banded in accordance with the applicable container specification or appendix thereto. Fiberboard containers shall be closed, waterproofed and reinforced with tape or non-metallic banding as specified in the appendix to the applicable specification with method V closure applicable to PPP-B-636 containers. Caseliners specified above, may be omitted for fiberboard boxes closed and waterproofed as specified herein. The gross weight of wood or wood cleated boxes shall not exceed 200 pounds. Fiberboard boxes shall not exceed the weight limitations of the applicable box specification.

5.2.2 Level B. Resin and curing agent preserved-packaged as specified in 5.1 shall be packed in containers as specified in 5.2.1 except that the containers shall be of the domestic type or class and caseliners are not required. Containers shall be closed, strapped or banded in accordance with the applicable container specification or appendix thereto, with method I closure applicable to PPP-B-636 boxes, utilizing pressure sensitive tape.

5.2.3 Level C. Resin and curing agent preserved-packaged as specified in 5.1 shall be packed in containers acceptable to the common carrier and which will ensure satisfactory condition at the lowest applicable rate. Containers, packing or method of shipment shall comply with Uniform Freight or National Motor Freight Classification Rules or Regulations or other carrier rules as applicable to the mode of transportation.

5.3 Cushioning, dunnage and wrapping materials.

5.3.1 Level A preservation-packaging and levels A and B packing. Use of all types of loose-fill materials for packaging or packing applications such as cushioning, filler or dunnage is prohibited for material destined for shipboard installation and stowage.

5.3.2 Level C preservation-packaging and packing. When loose-fill type materials are used for packaging and packing applications such as cushioning, filler and dunnage, all containers (unit, intermediate and shipping) shall be marked or labelled with the following information.

"CAUTION

Contents cushioned etc., with loose-fill material.
Not to be taken aboard ship.
Remove and discard loose-fill materials before shipboard stowage.
If required, recushion with cellulosic material, bound fiber, fiberboard or transparent flexible material."

5.3.3 Cushioning, filler, dunnage and wrapping materials selected, whenever available, shall exhibit improved performance for resistance to fire.

5.4 Special markings.

5.4.1 Labeling of resin containers. The following information shall be provided on a durable printed label.

"Chemical type of resin, type number (I, II or III), and manufacturers code number.
Storage life at 23°C, 50 percent RH - (number of months).
CAUTION: Do not mix curing agent and resin together until actually ready to use. Use only with curing agent provided.
WARNING: May cause skin irritation.
Vapor harmful.
Avoid exposure to vapor. Use respirator, if adequate ventilation is not available.
Avoid contact with the skin or eyes. Use protective clothing, gloves and goggles.
In case of accidental contact, promptly flush skin or eyes with plenty of water for 15 minutes; for eyes, get medical attention."

5.4.2 Labeling of curing agent container. The following information shall be provided on a durable printed label.

"Type of curing. For resin system (manufacturer's code no.)
Storage life at 23°C, 50 percent RH - (number of months).
CAUTION: Do not mix curing agent and resin together until actually ready for use. Use only with liquid resin provided.

WARNING: May cause skin irritation.
 Vapor harmful.
 Avoid exposure to vapor. Use respirator, if adequate ventilation is not available.
 Avoid contact with the skin or eyes. Use protective clothing, gloves and goggles. In case of accidental contact, promptly flush skin or eyes with plenty of water for 15 minutes; for eyes, get medical attention."

5.5 Special requirements. The packaging and packing of all resins and curing agents which come within the purview of 49 CFR 71-78 Interstate Commerce Commission Regulations for "Transportation of Explosives and Other Dangerous Articles by Freight" shall comply with these regulations in all respects.

6. NOTES

6.1 Intended use. The resin systems covered by this specification are intended for use in convolutely or spirally-wound glass reinforced coatings on metals for protection against the corrosive effects of salt water. In some applications the resin may be used without glass reinforcement. The resins may be used for coating metals in such applications as the following:

Type I (steel)	- Propeller shafting.
Type II (aluminum)	- Aluminum masts.
Type III (gun metal)	- Gun metal sleeves in high pressure propeller shaft seals.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type of resin (see 1.2).
- (c) Size of resin container, and total volume of resin system required.
- (d) When a first article sample is required (see 3.1).
- (e) Curing agents container size if other than required (see 3.2.1).
- (f) If materials to be supplied are other than specified (see 3.2.1).
- (g) If end use permits lower viscosity materials (see 3.5.1).
- (h) Selection of applicable levels of packaging and packing required (see 5.1 and 5.2).
- (i) If shipping containers are to have caseliners (see 5.2.1).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraph.

<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
4.3.1	First article inspection report	DI-T-4902	--

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12L., Vol. I, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 The resin system should be purchased by volume, the unit being a U.S. gallon at 60°F. Unless desired otherwise and so ordered (see 6.2.1), the total quantity (volume) ordered should include the resin and curing agent together as a total system. This is necessary in order to have a specified volume for a specific end use. Since curing agents may vary greatly in the proportions required for a given system, from a few percent of the resin quantity to over 50 percent for others, the total usable mixed volume of resin and curing agent is the important factor.

6.4 First article inspection. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection as to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

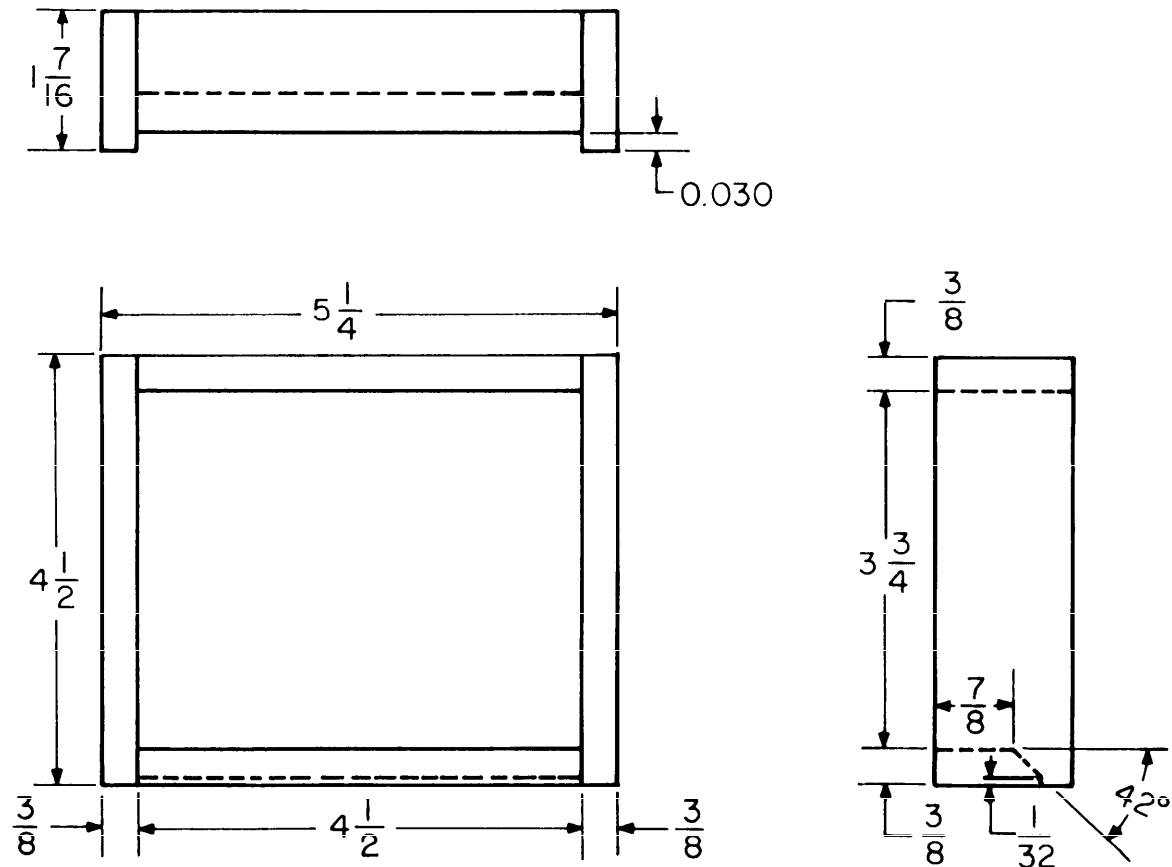
6.5 Material safety data sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in appendix B of FED-STD-313.

6.6 Subject term (key word) listing.

- Aluminum
- Barcol hardness
- Epoxy
- Fiberglass
- Gun metal
- Peel strength
- Resin
- Steel

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.

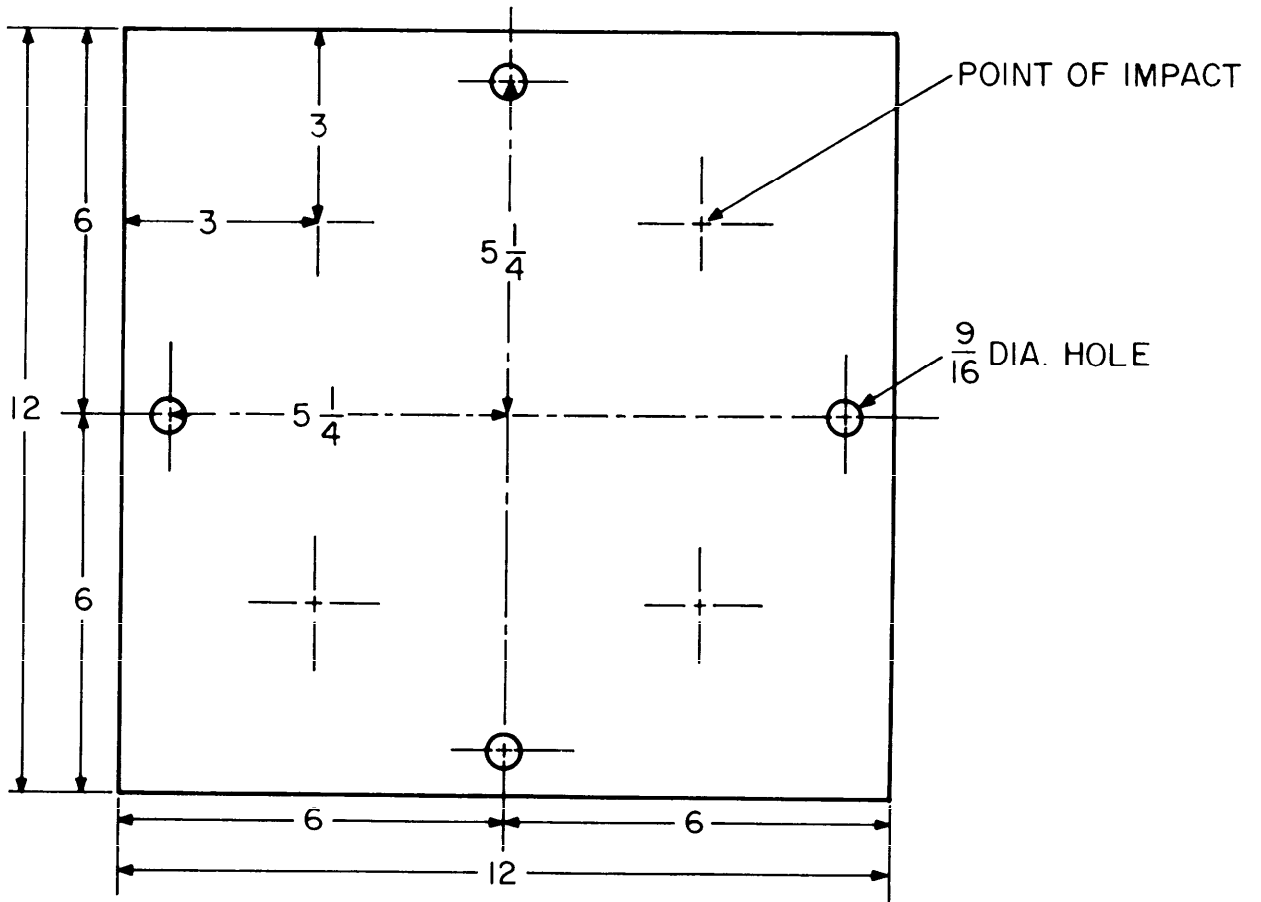
Preparing activity:
Navy - SH
(Project 9330-NB05)



SH 7303

Note: Dimensions shown are in inches.

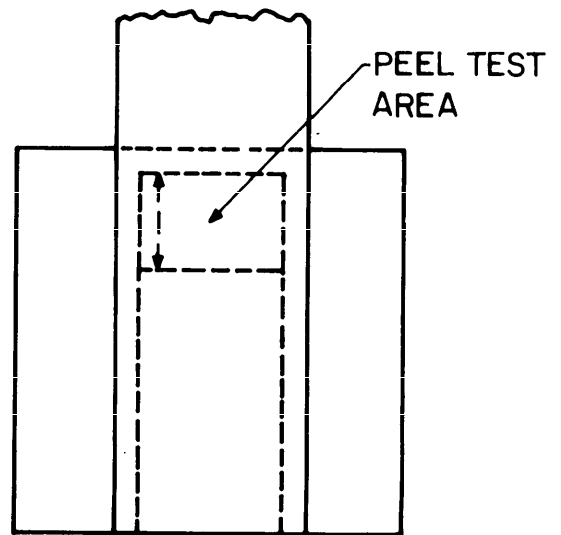
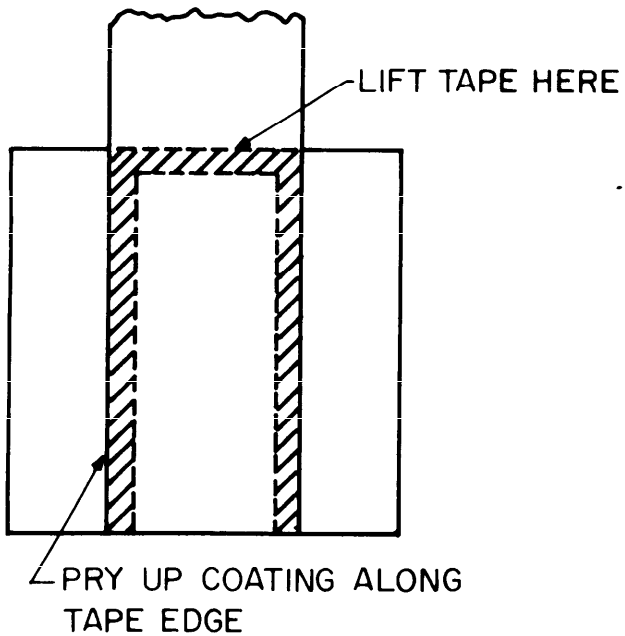
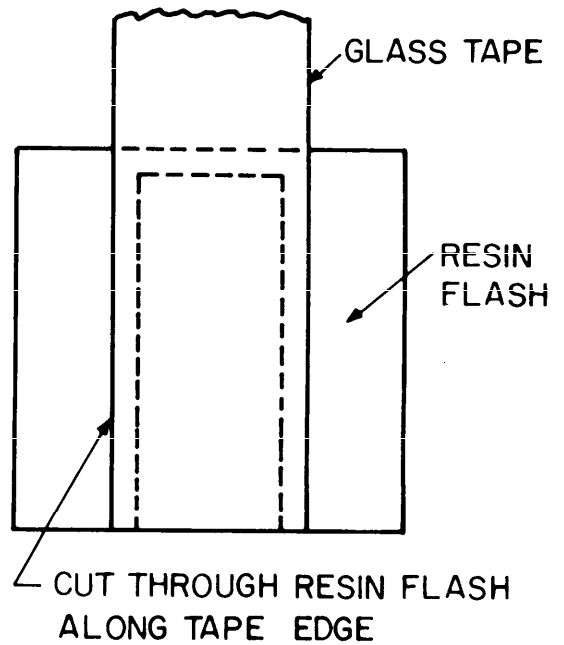
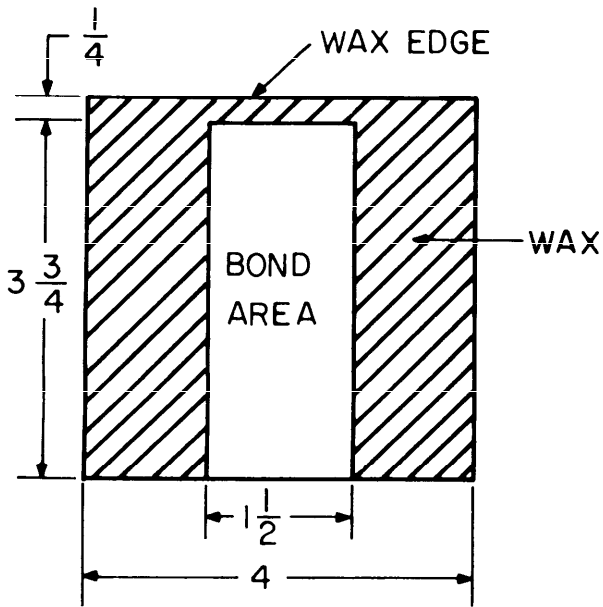
FIGURE 1. Applicator for drainage test.



SH 7304

Note: Dimensions shown are in inches.

FIGURE 2. Impact test plate.



SH 7305

Note: Dimensions shown are in inches.

FIGURE 3. Preparation of peel strength specimens.

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

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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DEPARTMENT OF THE NAVY

COMMANDER
NAVAL SEA SYSTEMS COMMAND (SEA 5523)
DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362



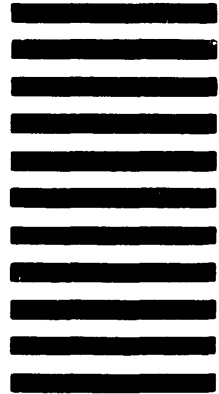
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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-R-23461A		2. DOCUMENT TITLE Resin Compound, Thermosetting, Room Temperature Curing, For Metal Coating	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one) <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____	
b. ADDRESS (Street, City, State, ZIP Code)			
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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