

MIL-C-47175A(MI)
10 November 1980
Superseding
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7 June 1974

MILITARY SPECIFICATION
COMPOUND, POLYURETHANE, FOR CONFORMAL COATING OF
ELECTRONIC CIRCUITRY

This specification is approved for use by the US Army Missile Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers polyurethane, solvent-based compounds for use as conformal coatings for printed circuit boards and other electronic circuitry.

1.2 Classification. The polyurethane compounds shall be of the following types (see 6.2).

Type I - one component system, moisture and air curing.

Type II - two component system, catalyst cured.

NOTE: If no type is specified, type I is required.

2. APPLICABLE DOCUMENTS

* 2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

Federal

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Missile Command, ATTN: DRSI4-RSDS, Redstone Arsenal, AL 35898, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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QQ-S-571

Solder, Tin Alloy, Lead-Tin Alloy and Lead Alloy

Military

MIL-E-5272

Environmental Testing, Aeronautical and Associated Equipment, General Specification for

MIL-F-14256

Flux, Soldering, Liquid (Rosin Base)

MIL-P-18177

Plastic Sheet, Laminated, Thermosetting, Glass Fiber Base, Epoxy-Resin

STANDARDS

Federal

FED-STD-141

Paint, Varnish, Lacquer, and Related Materials, Method Of Inspection, Sampling and Testing.

Military

* MIL-STD-1188

Commercial Packaging of Supplies and Equipment

* (Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

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

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3.2.1.1 Composition. The Type I polyurethane material shall consist of a one component, clear, moisture curing resin. The Type II polyurethane material shall consist of two components: a clear resin and a catalyst. Both types shall be suitable for application by brushing, dipping, or spraying.

3.2.1.2 Condition in container. A freshly opened container shall be free of gel particles, dirt, or any other contaminants which would affect the intended purpose of the material.

3.2.2 Color. The material shall be clear, water white or light amber in color, and shall not contain tracer dyes unless so specified (see 6.2).

3.2.3 Viscosity. The viscosity of the as received Type I compound shall not exceed 500 centipoises (cps) and the viscosity of the mixed Type II compound shall not exceed 100 cps when tested at 23 plus or minus one degree Celsius (C) (73 plus or minus 2 degrees Fahrenheit (F)).

3.2.4 Repairability. The cured coating shall be removable by heating with a soldering iron to permit repair work on circuitry.

3.2.5 Storage life. The material as furnished by the manufacturer shall be capable of meeting the requirements specified herein after storage at room temperature in a closed container for not less than 6 months.

3.3 Performance characteristics.

3.3.1 Adhesion. The cured coating shall adhere tightly to the substrate. It shall be difficult to furrow off the coating with the knife. The coating shall not flake, chip, or powder.

3.3.2 Insulation resistance. The insulation resistance of the coating after a 24-hour room temperature cure shall be not less

3.5 Workmanship. The workmanship shall be such as to ensure a product which forms a uniform coating, free from pores, cracks, or other defects which would expose underlying circuitry, and free from dirt, foreign material, or other contaminants.

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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.

4.2 Preproduction inspection. When specified in the contractual document (see 6.2), a sample consisting of 2 one-quart containers of compound manufactured under the same conditions as those proposed for subsequent production, shall be subjected to preproduction inspection. Accomplishment of preproduction inspection shall be as specified herein. Subsequent units will not be considered for acceptance until Government approval of the preproduction sample has been obtained. Units subjected to preproduction inspection shall have successfully passed acceptance inspection. Testing of the preproduction sample, to determine compliance with the characteristics listed in Table I, shall be conducted in accordance with the corresponding test paragraphs.

Table I. Preproduction Inspection

Characteristic	Requirement Paragraph	Test Paragraph
Repairability	3.2.4	4.5.4.4
Storage life	3.2.5	4.5.4.5
Adhesion	3.3.1	4.5.4.6
Pot life	3.3.3	4.5.4.8
Fungus resistance	3.4.1	4.5.4.9

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4.3 Quality conformance inspection.

* 4.3.1 Lot formation. A lot shall consist of all the material manufactured in one continuous operation by the same process by the same manufacturer in accordance with this specification and submitted for inspection at one time.

* 4.3.2 Sampling for Inspection. Sufficient quantities of polyurethane compound to conduct the tests specified herein shall be selected at random from one unit representative of each lot. Each container of polyurethane compound shall be considered as a unit of product. Failure of this sample to comply with the characteristics specified in Table II, Acceptance Inspection, shall be cause for lot rejection.

Table II. Acceptance Inspection

Characteristic	Requirement Paragraph	Test Paragraph
Composition and condition in container	3.2.1	4.5.4.1
Color	3.2.2	4.5.4.2
Viscosity	3.2.3	4.5.4.7
Insulation resistance	3.3.2	4.5.4.7
Workmanship	3.5	4.7
Packaging and packing	5.1	4.6
Marking	5.2	4.6

4.4 Inspection equipment. The inspection equipment for conducting examination and tests shall be as specified in the applicable test methods and procedures paragraphs.

4.5 Test methods and procedures.

4.5.1 Test conditions. Unless otherwise specified herein, the following conditions shall be used as a basis to establish performance requirements.

- a. Temperature, room ambient plus or minus 9 degrees C (plus or minus 16 degrees F).
- b. Altitude, facility ground.
- c. Humidity, facility ambient up to 95 percent relative humidity.

4.5.2 Test sequence. Testing within each classification of inspection (preproduction or acceptance) shall be at the option of the supplier.

4.5.3 Test specimen preparation. Test specimen shall be prepared as follows:

- a. Prepare 2 comb pattern specimens in accordance with figure 1, made from a sheet of copper clad plastic conforming to MIL-P-18177. The comb pattern supplies 2 measurements of insulation resistance, one between terminals A and H; the other between terminals A and C. The pattern lines are 0.025-inch wide, 1.30-inch long, and spaced 0.050-inch.
- b. Solder wire leads to pattern terminals H, A, and C; protect comb pattern from flux and solder splashes while soldering. Use only water-white rosin flux in accordance with MIL-F-14256. Use solder in accordance with QQ-S-571, composition Sn 60, applied with a 25 to 40-watt soldering iron. Do not remove rosin flux after soldering.
- c. Boil in fresh distilled water for at least 10 minutes, using approximately 100 millimeters (ml) of water per comb pattern.

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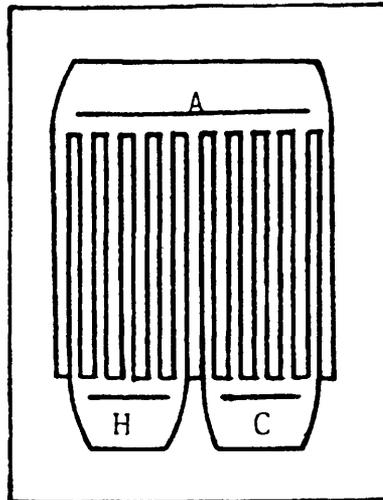


Figure 1. Etched pattern for insulation resistance

- d. Without allowing pattern specimens to dry, immediately rinse in fresh running distilled water.
- e. Oven dry for at least 4 hours at 65 plus or minus 5.5 degrees C (150 plus or minus 10 degrees F). Immediately place in a desiccator and allow to cool.
- f. Apply a coating 0.001 to 0.002-inch thick, and air dry for at least 24 hours.

4.5.4 Tests.

4.5.4.1 Composition and condition in container. The composition shall be certified by the supplier and the condition in container shall be determined visually to establish compliance to 3.2.1.

4.5.4.2 Color. The color of the compound shall be examined visually to determine compliance to 3.2.2.

4.5.4.3 Viscosity. Viscosity shall be determined in accordance with ASTM D 1824 to establish compliance to 3.2.3.

4.5.4.4 Repairability. The comb pattern specimens of 4.5.3 shall be used to test for repairability as follows:

- a. Apply a hot soldering iron to a portion of the coating directly over a soldered joint for approximately one minute.
- b. Remove the coating and visually inspect the area for any residue that could interfere with proper soldering. The coating shall conform to 3.2.4.

4.5.4.5 Storage life. A sufficient amount of material in an original unopened container shall be stored under the conditions specified in 3.2.5. At the end of the storage period, the material shall be subjected to all tests contained herein. The supplier's certification of compliance certifying to the storage life requirements (see 3.2.5) may be accepted during the storage period.

4.5.4.6 Adhesion. The coating shall be tested as follows:

- a. Apply a coating 0.001 to 0.002-inch thick on a clean metal substrate.
- b. Air dry for at least 24 hours at room temperature.
- c. Test in accordance with Method 6304 of FED-STD-141.
- d. Inspect for conformance to 3.3.1.

4.5.4.7 Insulation resistance. The insulation resistance shall be determined as follows:

- a. Condition coated pattern specimens, prepared as specified in 4.5.3, for at least 2 hours in a humidity chamber at 95 percent plus or minus 2 percent relative humidity and 35 plus or minus one degree C (95 plus or minus 2 degrees F).
- b. Determine insulation resistance in accordance with ASTM D 257 after not less than one minute at 500 volts direct current (vdc). Take readings while the patterns are in the chamber. One of the two pattern specimens must show the required reading (see 3.3.2)

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4.5.4.8 Pot life. One half pint of the Type II material shall be mixed and stored under conditions specified in 3.3.3 for at least 3 hours, then visually examined and tested by spraying to establish conformance to 3.3.1.

4.5.4.9 Fungus resistance. Fungus resistance shall be determined on the cured compound in accordance with MIL-E-5272 to determine compliance with 3.4.1.

* 4.6 Packaging and marking. The inspector shall ascertain that the packaging and marking of the material conforms to this specification.

4.7 Workmanship. The coating compound shall be visually examined to determine compliance with workmanship requirements specified in 3.5.

* 5. PACKAGING

* 5.1 Commercial. Preservation, packing, unitization and marking shall be in accordance with MIL-STD-1188.

6. NOTES

6.1 Intended use. The coating compound is intended to provide physical and environmental protection for printed circuit boards operating in the range of minus 54 to plus 100 degrees C (minus 65 to plus 212 degrees F).

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

- a. Title, number, and date of this specification.
- b. Type required (see 1.2 and 3.2.1.1)
- c. Whether preproduction testing is required (see 3.1), and if so, pertinent details.
- d. Size of container.
- e. Requirement for certification of composition (see 4.5.4.1).
- f. Whether tracer dye is required (see 3.2.2), and if so, pertinent details as to color change.

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6.3 Changes to previous issue. The margins of this specification are marked with an astrisk to indicate where changes (additions, modification, corrections, deletions) from the previous issue were made. 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 and relationship to the last previous issue.

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