

MIL-A-87135(USAF)  
16 February 1979

MILITARY SPECIFICATION

ADHESIVES, NON-CONDUCTIVE, FOR ELECTRONICS APPLICATION

This specification is approved for use by The Air Force Materials Laboratory, Department of the Air Force, and is available for use by all Departments and Agencies of the Department of Defense

1 SCOPE

1.1 Scope. This specification establishes requirements for a moderately fast curing adhesive used for bonding components to printed-wiring assemblies to prevent vibration damage

2 APPLICABLE DOCUMENTS.

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

SPECIFICATIONS

MILITARY

- MIL-P-13949 - Plastic Sheet, Laminated, Metal-Clad (For Printed Wiring), General Specification for
- MIL-P-27538 - Plastic Sheet, FEP-Fluorocarbon (Unfilled), Copper Clad (For Printed Wiring).
- MIL-R-39017/5 - Resistors, Fixed, Film, (Insulated), Established Reliability Style RLR05
- MIL-C-45662 - Calibration System Requirements.
- MIL-I-46058 - Insulating Compound, Electrical (For Coating Printed Circuit Assemblies).

STANDARDS

FEDERAL

- FED TEST METHOD STD NO 141 - Paint, Varnish, Lacquer, and Related Materials, Methods of Inspection, Sampling, and Testing

(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 the date of invitation for bids or request for proposal, shall apply

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 257 - Tests for D-C Resistance or Conductance of Insulating Materials.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to The Air Force Materials Laboratory, MXA, Wright-Patterson AFB, OH 45433 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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- D 1002 - Strength Properties of Adhesives in Shear by Tension Loading
- D 1338 - Working Life of Liquid or Paste Adhesives by Consistency and Bond Strength
- D 3482 - Recommended Practice for Determining Electrolytic Corrosion of Copper by Adhesives

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

### 3 REQUIREMENTS

3.1 Adhesive materials The adhesive materials shall be such that they shall have no adverse effects upon the materials used in the substrate or components attached thereon, and shall be formulated from resins, elastomers, plasticizers, catalysts, and other ingredients which meet the requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

3.2 Compatibility The adhesive materials shall be suitable for application and use in printed-wiring assemblies to prevent vibration damage, and shall be compatible with materials used therein (see 6.2). When tested as specified in 4.6.1, the adhesives shall be smooth, homogeneous, and free from bubbles, pinholes, spots, blistering, wrinkling, cracking, softening, and peeling.

3.3 Working life and temperature When adhesives are prepared in accordance with the contractor's recommendations and tested as specified in 4.6.2, the working life shall be the time at the temperature recommended by the contractor (see 6.2). Unless otherwise specified (see 6.2), the working life shall be a minimum of 10 minutes at  $23^{\circ} \pm 1^{\circ}\text{C}$ .

3.4 Overlap shear strength When adhesives are tested as specified in 4.6.3, the overlap shear strength shall be a minimum of  $10,300 \text{ dyne/cm}^2$  (1500 psi) at  $24^{\circ} \pm 3^{\circ}\text{C}$  ( $75^{\circ} \pm 5^{\circ}\text{F}$ ), and a minimum of  $1030 \text{ dyne/cm}^2$  (150 psi) at  $104^{\circ} \pm 3^{\circ}\text{C}$  ( $220^{\circ} \pm 5^{\circ}\text{F}$ ).

3.5 Reworkability When tested as specified in 4.6.4, adhesives shall be capable of being easily removed. There shall be no structural damage to the base material, such as removal of any of the substrate material or delamination of the substrate. A small amount of adhesive may remain on substrate after removal. Color change on the substrate (where adhesive has been removed) is permissible.

3.6 Shelf life When adhesives are tested in accordance with 4.6.5, the shelf life is considered to be acceptable if the working life and overlap shear strength meet the requirements of 3.3 and 3.4.

3.7 Volume resistivity When adhesives are tested as specified in 4.6.6, the volume resistivity shall be a minimum of  $10^{10} \text{ ohm-cm}$ .

3.8 Hydrolytic stability When adhesives are tested as specified in 4.6.7, there shall be no evidence of softening, chalking, blistering, cracking, tackiness, loss of adhesion, or reversion to liquid state.

3.9 Corrosion When adhesives are tested as specified in 4.6.8, they shall be found not to corrode, soften, deteriorate, or otherwise adversely interact with the materials specified. They shall be non-corrosive to copper under all conditions of use.

3.10 Caution label Contractors shall include a warning or caution on the label of containers of material which may have a toxic effect on using personnel. The label, (see 5.2), shall include precautions necessary to avoid the materials' toxic effect.

### 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.

4.1.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-C-45662

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

- a. Materials inspection (see 4.3)
- b. Quality conformance inspection (see 4.4).

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials used in formulating the adhesive are in accordance with 3.1. The basic material and the main subgroup(s) shall be identified for each component and primer (e.g., polyurethanepolyether).

#### 4.4 Quality conformance inspection

4.4.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B.

4.4.1.1 Inspection lot. An inspection lot shall consist of all containers of adhesive materials, produced from the same lot and offered for inspection at one time.

4.4.1.1.1 Lot. A lot is a collection of units of product bearing identification and treated as a unique entity from which a sample is to be drawn and inspected to determine conformance with the acceptability criteria.

4.4.1.1.2 Specimens. The preparation and number of specimens required shall be as specified in 4.5 to 4.5.3, inclusive.

4.4.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table I, in the order shown.

TABLE I. Group A inspection

Inspection	Requirement paragraph	Method paragraph
Working life and temperature - - - -	3.3	4.6.2
Overlap shear strength - - - - -	3.4	4.6.3

4.4.1.2.1 Sampling plan. From each lot, one container of each ingredient necessary to form the compound shall be selected. From each of these containers, a sufficient amount of the ingredients shall be taken for performance of tests shown in table I.

4.4.1.2.2 Failures. If the sample fails any test, this shall be cause for rejection of the lot.

4.4.1.2.3 Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.4.1.3 Group B inspection. Group B inspection shall consist of the inspections specified in table II, in the order shown. The sample specimens shall be prepared from adhesive materials obtained from inspection lots which have passed group A inspection.

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TABLE II Group B inspection

Inspection	Requirement paragraph	Method paragraph
Subgroup I Reworkability - - - - -	3 5	4.6 4
Subgroup II Volume resistivity - -	3 7	4 6 6
Subgroup III Corrosion - - - - -	3 9	4 6 8

4.4.1.3.1 Sampling plan One container of each ingredient necessary to form the compound shall be selected from the first production lot and thence from one production lot in every 50 production lots, or once each 12 months, whichever is less frequent. From each of these containers, a sufficient amount of the ingredients shall be taken for performance of tests shown in table II.

4.4.1.3.2 Failures One or more failures shall be cause for rejection of the lot.

4.4.1.3.3 Rejected lots If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.4.1.3.4 Disposition of sample containers Sample containers which have passed all the group B inspection may be delivered on the contract, if the lot is accepted.

4.4.2 Periodic inspection Periodic inspection shall consist of group C. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.4.2.1.4), delivery of products which have passed groups A and B shall not be delayed pending the results of these periodic inspections.

4.4.2.1 Group C inspection Group C inspection shall consist of the inspections specified in table III, in the order shown. Group C inspection shall be made on sample specimens prepared from specimens obtained from inspection lots which have passed groups A and B inspections.

4.4.2.1.1 Sampling plan One container of each ingredient necessary to form the compound shall be selected once in each 24-month period. From each of these containers a sufficient amount of the ingredients shall be taken for performance of the tests shown in table III.

4.4.2.1.2 Failures If there are one or more failures, the sample shall be considered to have failed.

4.4.2.1.3 Disposition of sample containers Sample containers which have passed all the group C inspection may be delivered on the contract.

TABLE III Group C inspection

Inspection	Requirement paragraph	Method paragraph
Subgroup I Compatibility - - - - -	3.2	4.6 1
Subgroup II Hydrolytic stability - - - - -	3 8	4.6 7
Subgroup III Shelf life - - - - -	3 6	4.6 5
Working life and temperature - -	3 3	4 6.2
Overlap shear strength - - - - -	3 4	4.6 3

4.4.2.1.4 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall notify the procuring activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the procuring activity has been taken. After the units (all inspection, or the inspection which the original sample failed, at the option of the procuring activity) Groups A and B inspection may be reinstated; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the procuring activity.

4.4.3 Inspection of packaging. The sampling and inspection of the preservation-packaging, packing and container marking shall be as specified in the contract (see 6.2).

#### 4.5 Preparation of specimens for test.

4.5.1 Plastic panels. Plastic sections shall be of the type listed in this paragraph and used as base materials in the metal-clad plastic sheets of MIL-P-27538 and MIL-P-13949. Typical resistor components (such as RLR05C1002GM of MIL-R-39017/5) shall be adhesively secured to the plastic panels using the adhesive to be tested in accordance with the procedures recommended by the contractor. The panels shall be cured for the time and temperature recommended by the contractor.

4.5.2 Glass panels. Glass plates shall be clear and prepared in accordance with method 2021 of FED-STD-141. The adhesive shall be prepared in accordance with the contractor's recommendation, applied to one side of the glass, and cured for the time and at the temperature recommended by the contractor.

#### 4.6 Method of inspection.

4.6.1 Compatibility (see 3.2). Glass panels, two each, shall be covered by one of each of the conformal coatings specified by and conforming to MIL-I-46058. Five plastic panels, one each of the types specified in 4.5.1, shall be prepared. Half of the glass panels (one with each coating) shall be maintained as controls at the conditions specified in 4.6.7, and the remaining panels (plastic and glass) shall be tested at the conditions specified in 4.6.7. When examination of the test panels is made as specified in 4.6.7a and b, the appearance of the panels shall be observed visually with the aid of a 10-power magnification viewer under adequate illumination. Normal or corrected 20/20 vision shall be used to examine for bubbles. The adhesive shall be examined for evidence of pinholes, whitish spots, blistering, wrinkling, cracking, softening, peeling, masking or obliteration of identification markings, discoloration of printed conductors and corrosion.

4.6.2 Working life and temperature (see 3.3). Adhesives shall be tested in accordance with ASTM D-1338, method A. Four specimens shall be tested. The following detail shall apply: Stirring cycles - 1 minimum.

4.6.3 Overlap shear strength (see 3.4). The adhesives shall be tested in accordance with ASTM D-1338, method B, and ASTM D-1002. Four specimens shall be tested.

4.6.4 Reworkability (see 3.5). Adhesives shall be removed using a putty removal head mounted on a 50-watt soldering gun. After careful removal of the adhesive, there shall be no damage to the base material. Five plastic panels (1 of each material in 4.5.1) shall be tested.

4.6.5 Shelf life (see 3.6). The container of adhesives (all components) shall be stored at a temperature of  $25^{\circ} \pm 5^{\circ}\text{C}$  for 6 months. Specimens shall be prepared using this stored material and tested in accordance with 4.6.2 and 4.6.3.

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4.6.6 Volume resistivity (see 3.7) The adhesive shall be tested in accordance with ASTM D-257. The following detail shall apply. Test specimens shall be cast films, prepared in a teflon-lined mold. Four specimens shall be tested.

4.6.7 Hydrolytic stability (see 3.8) One glass compatibility test panel of each type conformal coating shall be maintained as a control at  $25^{\circ}\pm 2^{\circ}\text{C}$  and 50 $\pm$ 4 percent relative humidity. The remaining glass panels and plastic panels shall be subjected to 120 days at  $71^{\circ}\pm 1^{\circ}\text{C}$  and 95  $\pm$ 4 percent relative humidity. Examination of the panels shall be as follows:

- a. After 28, 56, and 84 days, the panels shall be returned to  $25^{\circ}\pm 2^{\circ}\text{C}$  and 50 $\pm$ 4 percent relative humidity and examined for degradation.
- b. After the 120 days aging, the panels shall be held at  $25^{\circ}\pm 2^{\circ}\text{C}$  and 50 $\pm$ 4 percent relative humidity for an additional seven days prior to examination for tackiness in accordance with method 4061 (dry-through for varnish, lacquers, and enamels) of FED-STD-141.

4.6.8 Corrosion (see 3.9) The adhesive shall be tested in accordance with ASTM D-3482.

## 5. PACKAGING

5.1 Preservation-packaging and packing The adhesive shall be packaged and packed in accordance with the contractor's commercial practice in a manner that will afford adequate protection against deterioration and physical damage during shipment. The shipping containers shall conform to the applicable carrier rules and regulations.

5.2 Marking In addition to any special marking required by the contract (see 6.2), each interior and exterior container shall be marked with the following information:

- a. National stock number (if applicable)
- b. Contractor's part number
- c. Item description Adhesive, Electronic, Nonconductive
- d. Quantity and unit of issue
- e. Contract, purchase or delivery order number
- f. Lot number and date of manufacture
- g. Date of packaging 1/
- h. Shelf life expiration date 1/
- i. Caution label, when required (see 3.10)
- j. Gross weight and cube (volume) 2/
- k. Name and address of contractor 2/
- l. Name and address of addressee 2/

## 6. NOTES

6.1 Intended use These adhesives are intended to be used for the bonding of components to printed-wiring assemblies.

6.2 Ordering data Procurement documents should specify the following:

- a. Title, number, and date of this specification
- b. Compatibility required (see 3.2)
- c. Curing time and temperature
- d. Caution label, if required (see 3.10 and 5.2)
- e. Special marking, if required (see 5.2)
- f. Inspection of packaging (see 4.4.3)
- g. Quantity of material required (see 5.1)
- h. Work life and temperature (see 3.3)

1/ - Month and year, e.g., 9/78

2/ - Shipping containers only

6.3 Critical applications When adhesives are to be used in critical applications, the procuring activity should insure that the adhesives meet the necessary special requirements

Custodian  
Air Force - 11

Preparing activity  
Air Force - 11

Review activities  
Air Force - 17  
DLA - ES

Agent  
DLA - ES

(Project 8040-F087)

## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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