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AEROSPACE MATERIAL SPECIFICATION

AMS 3703

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Revised

ADHESIVE, ELECTRICALLY NON-CONDUCTIVE
Moderately Rapid Cure

1. SCOPE:

1.1 Form: This specification covers an adhesive in the form of a liquid or paste.

1.2 Application: Primarily for use as an adhesive for bonding electrical and electronic components to printed wiring boards to prevent vibration damage.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2825 - Material Safety Data Sheets
AMS 3599 - Plastic Sheet, Copper Faced, Glass Fabric Reinforced Epoxy Resin, Flammability Controlled

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D257 - DC Resistance or Conductance of Insulating Materials
ASTM D1002 - Strength Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal)
ASTM D1338 - Working Life of Liquid or Paste Adhesives by Consistency and Bond Strength
ASTM D3482 - Determining Electrolyte Corrosion of Copper by Adhesives

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Specifications:

MIL-R-39008/4 - Resistor, Fixed, Composition (Insulated), Established Reliability, Style RCR05
MIL-I-46058 - Insulating Compound, Electrical (for Coating Printed Circuit Assemblies)
MIL-R-55182/7 - Resistor, Fixed, Film, Established Reliability, Style RNR50

2.3.2 Military Standards:

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts
MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material: The adhesive shall be formulated from resins, elastomers, catalysts, fillers or thixotropic agents, and other ingredients to produce a product which is non-conductive and useful over a range of -55°C to +125°C (-65°F to +255°F) and meets the requirements of 3.2.

3.2 Properties: Adhesive shall conform to the following requirements; tests shall be performed on the adhesive supplied and in accordance with specified test methods, insofar as practicable:

3.2.1 Shelf Life: Adhesive, stored in waterproof, sealed containers at a temperature not exceeding 30°C (85°F) shall meet the requirements of this specification when tested at any time up to six months from date of receipt by purchaser.

3.2.2 Working Life: Not less than one stirring cycle, determined in accordance with ASTM D1338, Method A.

3.2.3 Tensile Shear: Shall be not less than 1500 psi (10.5 MPa) tested at 24°C ± 3 (75°F ± 5) and not less than 150 psi (1.05 MPa) tested at 105°C ± 3 (220°F ± 5), determined in accordance with ASTM D1002 using steel panels.

3.2.4 Electrolytic Corrosion: Copper wire specimens, tested in accordance with ASTM D3482, shall not exhibit any green corrosion product.

3.2.5 Volume Resistivity: Film specimens cast in polytetrafluoroethylene molds shall exhibit a volume resistivity of not less than 10^{10} ohm-cm, determined in accordance with ASTM D257.

3.2.6 Hydrolytic Stability: Adhesive, tested in accordance with 4.5.1, shall show no evidence of softening, exudate, tackiness, cracking, loss of adhesion, or reversion to liquid state.

3.2.7 Temperature Resistance: Adhesive applied to test specimens prepared in accordance with 4.5.1.1 and exposed to five temperature cycles in accordance with MIL-STD-202, Method 107, Test Condition B, shall show no evidence of cracking, blistering, crazing, or loss of adhesion.

3.2.8 Compatibility: Adhesives shall be compatible with materials and components used in electronic fabricated assemblies and shall not exhibit softening, wrinkling, cracking, or loss of adhesion between the substrate, components, and overcoat when coated with an approved conformal coating and tested in accordance with 4.5.2.

3.2.9 Removal: Adhesive removed from circuit board material specimens in accordance with 4.5.3 shall not cause delamination or removal of any of the substrate material. Color change of the base material where adhesive is removed and small amounts of residual adhesive remaining on the substrate are acceptable.

3.3 Quality: Adhesive, as received by purchaser, shall be uniform in quality, homogeneous, and free from foreign materials and other contaminants detrimental to usage of the adhesive.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the adhesive shall supply all samples for vendor's test and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.6. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the adhesive conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for working life (3.2.2), tensile shear (3.2.3), and volume resistivity (3.2.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of adhesive to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient adhesive shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A lot shall be all adhesive produced from the same batches of raw materials in a single production run under the same fixed conditions and presented for vendor's inspection at one time. An inspection lot shall not exceed 1,000 lb (450 kg) and may be packaged and delivered in smaller quantities under the basic lot approval provided lot identification is maintained.

4.3.1.2 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6 shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Sample adhesive shall be approved by purchaser before adhesive for production use is supplied, unless such approval be waived by purchaser. Results of tests on production adhesive shall be essentially equivalent to those on the approved sample.

4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production adhesive which are essentially the same as those used on the approved sample adhesive. If necessary to make any change in ingredients or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material or processing, or both, and, when requested, sample adhesive. Production adhesive made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Hydrolytic Stability:

4.5.1.1 Preparation of Specimens: Specimens shall be fabricated from AMS 3599 glass epoxy laminate, nominally 0.062 in. (1.55 mm) thick, having a nominal copper thickness of 0.0028 in. (0.070 mm) on one face. The circuit pattern shall be etched in accordance with Fig. 1, using 60 - 40 tin-lead alloy electroplate as a resist. After pattern etch, reflow the tin-lead electroplated surface. Clean the specimen in 1,1,1-trichloroethane at room temperature and air dry. Immerse the specimens for 10 sec in a mixture of 1 part by volume hydrochloric acid to 4 parts by volume distilled water. Rinse in flowing tap water, rinse in flowing distilled water, and dry with filtered air or inert gas. Mount one resistor, each, conforming to MIL-R-55182/7 and MIL-R-39008/4 on the

4.5.1.1 (Continued)

unclad side of the specimen and solder the leads to the pads provided, using tin-lead eutectic solder and water white rosin flux. Apply a uniform fillet of the adhesive to the full length of both sides of each resistor, forming a bond between the resistor and the plastic panel. Cure the adhesive in accordance with manufacturer's instructions and scrub both faces of the specimens in isopropyl alcohol to remove residual flux and other soil. Rinse in clean isopropyl alcohol and dry in a circulating air oven for at least 1 hr at 120°C ± 2 (250°F ± 4). Store in a clean, dry container.

4.5.1.2 Test Procedure: Prepare four specimens as described in 4.5.1.1. One specimen shall be maintained as a control at 25°C ± 1 (77°F ± 2) and 50% ± 4 relative humidity (RH). The three remaining panels shall be subjected to not less than 120 days at 85°C ± 1 (185°F ± 2) and 95% ± 4 RH and examined visually with the unaided eye corrected to 20/20 acuity according to the following schedule. After 28, 56, and 84 days of exposure, respectively, the test specimens shall be returned to room temperature and approximately 50% ± 4 RH and held for approximately 2 hours. The panels shall be examined in respect to the conditions referenced in 3.2.6 and the observations noted. Return the specimens to the humidity chamber and complete the 120 days of exposure. Remove the specimens from the humidity chamber and condition at 25°C ± 1 (77°F ± 2) and 50% ± 4 RH for 7 days ± 0.1. Examine visually with the unaided eye corrected to 20/20 acuity and compare with the control specimen. Report results of observations.

4.5.2 Compatibility: Ten specimens shall be prepared in accordance with 4.5.1.1. The specimens shall be divided into five sets and each set shall be coated with one of the MIL-I-46058 conformal coatings. The coatings shall be applied and cured in accordance with manufacturer's instructions. One panel from each set shall be maintained as a control at 25°C ± 1 (77°F ± 2) and 50% ± 4 RH. The remaining five panels shall be tested in accordance with 4.5.1.2.

4.5.3 Removal:

4.5.3.1 Specimen Preparation: Specimens shall be fabricated in accordance with 4.5.1.1. After pattern etch, clean the specimens in 1,1,1-trichloroethane at room temperature and air dry. Apply a layer of the AMS 3703 adhesive, approximately 1/16 in. (1.5 mm) thick by 1/4 in. (6 mm) wide covering the parallel lines of the test pattern. Cure the adhesive in accordance with manufacturer's instructions. Allow the specimens to stabilize at room temperature for at least 1 hour.

4.5.3.2 Test Procedure: Using a 50 watt heated, chisel head, putty remover, carefully remove the adhesive and examine the underlying surface.

4.6 Reports:

4.6.1 The vendor of adhesive shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the adhesive conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 3703, vendor's compound number, lot number, and quantity.

4.6.1.1 A material safety data sheet conforming to AMS 2825 or equivalent shall be supplied to each purchaser prior to, or concurrent with, the report of preproduction test results or, if preproduction testing be waived by purchaser, concurrent with the first shipment of the adhesive for production use. Each request for modification of adhesive formulation shall be accompanied by a revised data sheet for the proposed formulation.

4.6.2 When assemblies requiring use of this adhesive are supplied, the assembly manufacturer shall inspect each lot of adhesive to determine conformance to the technical requirements of this specification and shall furnish with each shipment a report stating that the adhesive conforms. This report shall include the purchase order number, AMS 3703, assembly number and quantity.

4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the adhesive may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the adhesive represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 Packaging shall be accomplished in such a manner as to ensure that the adhesive, during shipment and storage, will be protected against damage from exposure to moisture, weather, or any other normal hazard.

5.1.2 Each container shall be permanently and legibly marked with not less than the following information:

ADHESIVE, ELECTRICALLY NON-CONDUCTIVE
AMS 3703
PURCHASE ORDER NUMBER _____
MANUFACTURER'S MATERIAL DESIGNATION _____
LOT NUMBER _____
DATE OF MANUFACTURE _____
DIRECTIONS FOR MIXING AND APPLICATION _____
PRECAUTIONS FOR STORAGE _____