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400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 3708

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ADHESIVE, EPOXY PASTE, FOR STRUCTURAL WELDBOND
For 80°C (180°F) Service

1. SCOPE:

1.1 Form: This specification covers a one-part modified epoxy adhesive in the form of paste.

1.2 Application: Primarily for use in structural weldbonding of metallic alloys operating in the range -55° to 80°C (-65° to 180°F).

1.3 Precautions: Adhesive covered by this specification may contain curing agents whose vapors can cause allergic sensitization of personnel. Safety requirements mandate ventilated work areas, protective clothing, and a chemical absorbent face mask.

2. APPLICABLE DOCUMENTS: The following documents form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications and Aerospace Recommended Practices 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 3755/2 - Powder, Fumed Silicon Dioxide, Thickening Efficiency 90
AMS 4037 - Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate), Solution Heat Treated
AMS 4045 - Aluminum Alloy Sheet and Plate, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075; -T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated

2.1.2 Aerospace Recommended Practices:

ARP 1610 - Physical-Chemical Characterization Techniques, Epoxy Adhesive and Prepreg Resin Systems
ARP 1675 - Structural Weldbonding

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

ASTM D1002 - Strength Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal)
ASTM D1876 - Peel Resistance of Adhesives (T-Peel Test)
ASTM D2393 - Viscosity of Epoxy Resins and Related Components
ASTM E537 - Assessing the Thermal Stability of Chemicals by Methods of Differential Thermal Analysis

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-P-17667 - Paper, Wrapping, Chemically Neutral (Non Corrosive)
MIL-T-81533 - Trichloroethane 1,1,1 (Methyl Chloroform) Inhibited, Vapor Degreasing

2.3.2 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material: The product shall be a one-part adhesive system, pigmented to provide corrosion resistance and opacity to X-radiation, with a filler material selected for viscosity and adhesive flow control. The adhesive shall be suitable for structural weldbonding. Weldbond assemblies can be nondestructively examined for bondline voids by X-radiography.

3.2 Properties of Uncured Adhesive: Adhesive, as received, shall conform to the following requirements; tests shall be performed on the adhesive supplied and in accordance with test procedures specified herein:

3.2.1 Composition: Shall be as follows:

Constituent	Weight, %
Base Epoxy Resin (1-part system)	90.0 ± 0.8
Strontium Chromate (pigment)	3.0 ± 0.3
AMS 3755/2 Fumed Silicon Dioxide (filler)	7.0 ± 0.5
Volatiles, max	0.2

3.2.2 Viscosity: Shall be 5000 to 20,000 poises (500 to 2000 Pa·s) at 20°C ± 1 (65°F ± 2), determined in accordance with 4.5.1.

3.2.3 Storage Life: Adhesive, packaged as specified herein, shall meet the requirements of 3.4 after storage at a maximum temperature of -18°C (0°F) for up to three months from date of receipt by purchaser.

3.2.4 Working Life: The maximum allowable adhesive out-time, at various temperatures to ensure weldability, shall be as follows:

Temperature °C	Temperature °F	Out Time Hours
27	80	168
29	85	132
32	90	96
35	95	79
38	100	72

3.3 Curing: The adhesive shall be fully cured when heated to 125°C ± 3 (255°F ± 5) for 60 min. ± 5 in accordance with 4.5.2.

3.4 Properties of Cured Adhesive: Shall be determined on specimens processed as in 4.5.3.

3.4.1 Lap Shear Strength: Shall be not less than 6000 psi (41.5 MPa), determined on specimens shown in Fig. 1 and tested in accordance with ASTM D1002.

3.4.2 T-Peel Strength: Shall not be less than 20 lb per in. (3500 N/m) width, determined in accordance with ASTM D1876.

3.4.3 Durability of Adhesive: Specimen surface preparation, fabrication, and testing shall be in accordance with Table I, Fig. 2, and ARP 1675. The maximum wedge crack extension acceptable shall be 0.05 in. (1.2 mm) cohesive failure when exposed to 95 to 100% relative humidity at 50°C ± 1 (120°F ± 2) for 1.0 hr ± 0.1. Any adhesive failure is unacceptable.

3.5 Quality: The adhesive, as received by purchaser, shall be uniform in quality and condition, clean, and free from foreign materials and from imperfections 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 tests 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 viscosity (3.2.2), lap shear strength (3.4.1), T-Peel strength (3.4.2), and quality (3.5) 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, 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 in a single production run from the same batches of raw materials under the same fixed conditions, or all materials subjected to the same unit chemical or physical processes intended to make the final product homogeneous, and presented for vendor's inspection at one time. An inspection lot shall not exceed 500 lb (225 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, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material, processing, or both and, when requested, sample adhesive. Production adhesive made by the revised procedures shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Viscosity: Shall be determined with a Brookfield RVT Viscosimeter with a No. 6 spindle at 10 rpm in accordance with ASTM D2393.

4.5.2 Degree of Cure: The degree of cure of the adhesive, using the standard cure cycle of 60 min. + 5 at 125°C + 3 (255°F + 5), shall be determined by differential scanning calorimetry (DSC) as described in ASTM E537 or ARP 1610.

4.5.2.1 The following test parameters shall be used:

4.5.2.1.1 A 0.020 to 0.030 g sample of adhesive shall be placed in an aluminum cup and cured in an oven.

4.5.2.1.2 The cup shall be placed in a DSC cell and analyzed. At complete cure, there shall be no peaks exceeding 0.10 millicalories per sec from 120° to 180°C (250° to 355°F).

4.5.2.2 Sample requirements:

4.5.2.2.1 Place 0.020 to 0.030 g of adhesive in an open aluminum cup with the reference equal to an empty aluminum cup.

4.5.2.3 Instrument parameters:

4.5.2.3.1 Shall be as follows:

Temperature Range	Room temperature to 300°C (575°F)
Heat-Up Rate	10°C (18°F) per min.
Dial Setting	0.5 m cal/sec/in. (0.5 m cal/sec/25 mm)
Gas Flow	Nitrogen at 0.4 mL/min.

4.5.3 Weldbond Surface Preparation: Shall be as shown in Table I.

4.5.3.1 Parts Handling and Storage: Parts processed as in Table I shall be handled only on the trim edges with clean cotton gloves. The surfaces to be bonded shall not be touched. The parts shall be wrapped in MIL-P-17667 chemically neutral paper or stored in a closed protective container where the parts rest only on the edges and do not touch. Wrapped parts shall not be stacked. Parts shall be maintained in a clean room environment for up to five days following processing prior to bonding.

4.5.4 Lap Shear Strength: Test specimens shall be fabricated to the configuration shown in Fig. 1 using AMS 4045 aluminum alloy, nominally 0.125 in. (3 mm) thick. Four specimens shall be machined from the bonded panel for test.

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 3708, vendor's material designation, lot number, date of manufacture, 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 the purchaser, concurrent with the first shipment of 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 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 3708, contractor or other direct supplier of adhesive, supplier's material identification, and quantity. When adhesive for making parts adhesive is produced or purchased by the parts vendor, that vendor shall inspect each lot of adhesive to determine conformance to the requirements of this specification and shall include in the report either a statement that the adhesive conforms or copies of laboratory reports showing the results of tests to determine conformance.

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 The adhesive shall be packaged in suitable containers or in disposable polyethylene cartridges, as ordered, for use in extrusion equipment. Each container or cartridge shall be sealed to prevent penetration of moisture or loss of volatiles. All containers shall be maintained at not higher than -18°C (0°F).

5.1.2 Each container shall be identified with not less than the following information applied to durable labels, using characters of such size as to be legible and which will not be obliterated by normal handling:

ADHESIVE, EPOXY PASTE, FOR STRUCTURAL WELDBOND, 80°C (180°F) Service
AMS 3708
MANUFACTURER'S MATERIAL DESIGNATION _____
DATE OF MANUFACTURE _____
LOT NUMBER _____
QUANTITY _____
PERISHABLE - STORE BELOW -18°C (0°F)
APPROPRIATE WARNINGS OR PRECAUTIONARY NOTICES

5.1.3 The protected containers or cartridges shall be packed in an exterior container capable of protecting the adhesive and maintaining the required temperature during shipment and storage.

5.1.4 Containers of adhesive shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the adhesive to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.1.5 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1.1, 5.1.3, and 5.1.4 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Adhesive not conforming to the requirements of this specification or to modifications authorized by purchaser will be subject to rejection.

8. NOTES:

8.1 Toxicity and Safety: Suppliers of this adhesive shall indicate if the material supplied, including the curing agent(s), contains active epoxide groups, amines, or other compounds which may be toxic through handling, inhalation of, or dermal exposure to their vapors. If such toxic compounds are present, suitable precautions shall be taken to ensure safe handling of the adhesive and suitable safety instructions shall be supplied with each shipment of adhesive.

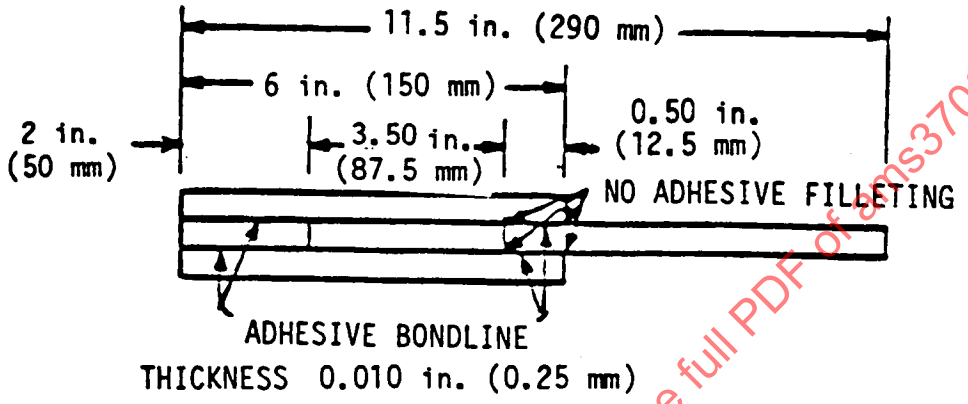
8.2 Dimensions and properties in inch/pound units and the Celsius temperatures are primary; dimensions and properties in SI units and the Fahrenheit temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

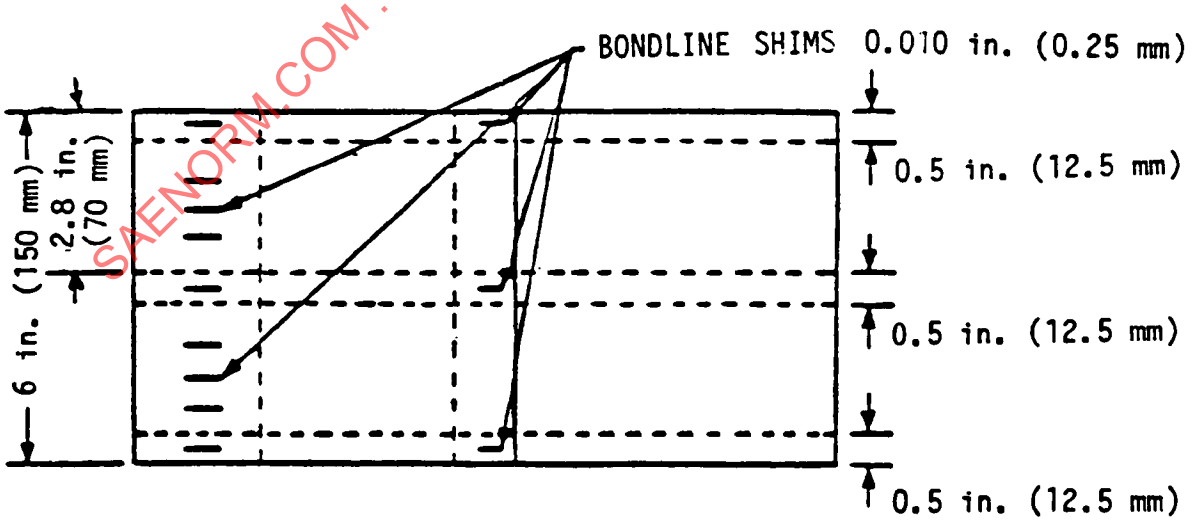
8.3 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Size and type of containers or cartridges desired
Quantity of adhesive desired
Applicable level of packaging (See 5.1.5)
Specified place of delivery, if applicable

8.4 Adhesive meeting the requirements of this specification has been classified under Federal Supply Classification (FSC) 8040.

All Detail Parts Are 0.125 in. (3.2 mm) Thick AMS 4045 Aluminum





Double Lap Shear Test Specimen Configuration
Figure 1