AEROSPACE MATERIAL SPECIFICATION

AMS3688™	REV. B

Issued 1974-03
Revised 1988-10
Reaffirmed 2022-08

Superseding AMS3688A

Adhesive, Foaming, Honeycomb Core Splice, Structural
-55 to +82 °C (-65 to +180 °F)

RATIONALE

AMS3688B has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE:

1.1 Form: This specification covers a foaming-type, heat-curing, resin-base adhesive in the form of paste or sheet.

1.2 Application: Primarily for use in splicing aluminum alloy or nonmetallic honeycomb core and for providing a shear tie between core edges and inserts or edge members in honeycomb assemblies for use over the range -55° to +82°C (-65° to +180°F). It is useful for filling gaps between core faces which are inserted into channels or similar areas where bonding pressure cannot be obtained.

1.3 Safety - Hazardous Materials: While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications 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 4037 - Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024-T3 Flat Sheet, -T351 Plate)
AMS 4348 - Honeycomb Core, Aluminum Alloy, Corrosion Inhibited, for Sandwich Construction, 5052, 350 (175)

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

For more information on this standard, visit
https://www.sae.org/standards/content/AMS3688B/

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

2.2.1 Military Specifications:

MIL-C-7438 - Core Material, Aluminum, for Sandwich Construction
MIL-A-25463 - Adhesive, Film Form, Metallic Structural Sandwich Construction

2.2.2 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Material: The adhesive shall be a heat-curing, nominally 120°C (250°F), resin Ø system containing fillers and foaming agents necessary to meet the requirements of 3.2 and 3.3. The adhesive shall have low-sagging properties to ensure complete filling of core-splice gaps when splices are cured in a vertical position. Adhesive shall be suitable for splicing honeycomb core without damage to core node bonds located adjacent to the splice.

3.1.1 Sheet Adhesive: Shall be supplied as an unsupported sheet with a suitable nonadhering separator film on both surfaces.

3.1.2 Paste Adhesive: Shall be supplied as a thixotropic paste, single-component or two-part system, suitable for extrusion from a disposable cartridge or caulking gun.

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 Storage Life:

3.2.1.1 Single component adhesive, packaged as specified herein, shall meet the requirements of 3.3 after storage at a maximum temperature of -18°C (0°F) for up to 3 months from date of receipt from manufacturer.

3.2.1.2 Two-part paste system, as specified herein, shall meet the requirements of 3.3 after storage at the temperature and for the time specified by the manufacturer, but not less than 3 months. Manufacturer's specified storage life shall begin at date of receipt from manufacturer.

3.2.2 Working Life: Single-component adhesive, and two-part paste systems mixed in accordance with manufacturer's instructions, shall meet the requirements of 3.3 for any time up to 48 hr after exposure to a relative humidity of 50 - 70% and a temperature of 21 - 27°C (70° - 80°F); paste adhesive shall remain extrudable for this time period.

3.3 Properties of Cured Adhesive: Shall be as follows, determined on specimens prepared as in 4.5 and cured at 120°C ± 5 (250°F ± 10) for 60 min ± 5 using a heat-up rate of 2 - 3°C (3 - 5°F) minute.

3.3.1 Curing Properties:

3.3.1.1 Sagging, maximum	0.05 in. (1.3 mm)	4.5.1
3.3.1.2 Expansion Ratio, minimum	1.7	4.5.2 or 4.5.3
3.3.1.3 Peak Exotherm Temperature, maximum	177°C (350°F)	

3.3.2 Cured Properties:

3.3.2.1 Density, maximum	40 lb per cu ft (640 kg/m3)	4.5.5
3.3.2.2 Beam Shear Strength, minimum		4.5.6
At -55°C (-65°F)	720 psi (4.95 MPa)	
At +24°C (+75°F)	720 psi (4.95 MPa)	
At +82°C (+180°F)	500 psi (3.45 MPa)	

3.4 Quality: Adhesive, as received by purchaser, shall be uniform in quality and condition, smooth, homogeneous, and free from foreign materials and from imperfections detrimental to usage of the adhesive.

3.5 Tolerances of Sheet Adhesive: Thickness shall be as specified, ±0.010 inch (±0.25 mm). Width and length shall be 12 x 24 in. (300 x 600 mm) or as specified, +0.250 inch (+6 mm), -0.125 in. (-3 mm). Width and length of specially slit foam shall be as specified, ±0.030 in. (±0.75 mm).

4. QUALITY ASSURAN PROVISIONS:

4.1 Responsibility for Inspection: The vendor of 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 expansion ratio (3.3.1.2) and beam shear strength at 24°C (75°F) (3.3.2.2) are classified as acceptance tests and shall be performed to represent 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, contracting officer, or 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 and presented for vendor's inspection at one time. An inspection lot shall not exceed 500 lb (225 kg) and may be packaged in smaller quantities and delivered under the basic lot approval provided lot identification is maintained.

4.3.1.2 When a statistical sampling plan and acceptance quality level (AQL) for the adhesive 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 4.6.1 shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor. Only one panel need be tested for peak exotherm temperature (3.3.1.3).

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 procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Sagging: The sagging characteristics of an adhesive shall be determined by fabricating a beam shear specimen in accordance with 4.5.6.1, with no face bonding adhesive between the upper facing and the core and using a 0.020 inch (0.50 mm) thick upper facing. After curing as in 3.3, remove the upper facing, observe the degree of fill of the splice, and measure the sag of the splice adhesive from the upper face of the core. Evidence of adherence of foam adhesive on the upper face over the entire splice area will also constitute evidence of acceptable sagging characteristics.

4.5.2 Expansion Ratio for Sheet Adhesives:

4.5.2.1 Cut three 2 x 2 inches (50x 50 mm) pieces of sheet adhesive and measure the thickness of each piece at each corner and at the center to the nearest 0.01 inch (0.25 mm).

4.5.2.2 Place the specimens separately on a caul plate which has been covered with a suitable parting agent to prevent adhesion of the test pieces to the plate.

4.5.2.3 Place the caul plate with the specimens in a circulating-air oven which is at a temperature not higher than 27°C (80°F) and raise the temperature to 120°C ± 5 (250°F ± 10) at a rate of 2 - 3°C (3 - 5°F)per minute Maintain the specimens at 120°C ± 5 (250 °F ± 10) for 60 min. ± 5 and cool to room temperature,

4.5.2.4 Measure the thickness of each specimen at each quadrant to the nearest 0.01 inch (0.25 mm) and calculate the expansion ratio as follows:

$$\text{Expansion Ratio} = \frac{\text{Average thickness of each specimen after cure}}{\text{Average original thickness of the specimen}}$$

4.5.3 Expansion Ratio for Paste Adhesives:

4.5.3.1 Clamp a sheet of 0.100 inch (2.50 mm) thick aluminum alloy, having a 2.0. inches (50 mm) diameter hole in the center, to a caul plate. All metal surfaces, including the inside edges of the hole, shall be covered with a suitable parting agent to prevent adhesion of the test specimen to the tool.

4.5.3.2 Extrude sufficient paste adhesive to fill the hole in the sheet. Using a knife blade or suitable scraper, wipe across the hole to fair the adhesive flush with the upper surface of the sheet.

4.5.3.3 Place the caul plate with the specimens in a circulating-air oven which is at a temperature not higher than 27°C (80 °F) and raise the temperature to 120°C ± 5 (250°F ± 10) at a rate of 2 - 3 °C (3 -5 °F) per minute. Maintain the specimens at 120°C ± 5 (250°F ± 10) for 60 min. ± 5 and cool to room temperature.

4.5.3.4 Measure the thickness of each specimen at each quadrant to the nearest 0.01 inch (0.25 mm) and calculate the expansion ratio as follows:

$$\text{Expansion Ratio} = \frac{\text{Average thickness in in. (mm) of each specimen after cure}}{\text{0.10 in. (2.5 mm)}}$$

4.5.4 Peak Exotherm Temperature: Shall be determined on a test panel consisting of two 0.020 x 12.0 x 12.0 inches (0.50 x 300 x 300 mm) aluminum alloy faces and a 2.00-inches (50 mm) thick, 3/16-inch (4.8-mm) cell size nonmetallic core as shown in Figure 1. The core shall be spliced in the center of the panel. A suitable thermocouple shall be inserted in the approximate geometric center of the splice. The panel shall be cured as specified in 3.3. The maximum temperature of the thermocouple during cure of the test panel shall be reported.

4.5.5 Density of Cured Adhesive:

4.5.5.1 Measure the width and length or the diameter of the cured specimens used in the expansion ratio determinations (4.5.3) to the nearest 0.01 inch (0.25 mm).

4.5.5.2 Weigh each specimen to the nearest milligram.

4.5.5.3 Using the average thickness of each specimen obtained during the expansion ratio determination, calculate the density of the cured adhesive as follows:

$$\text{Density, lb/cu ft}^3 = \frac{\text{Weight, g}}{\text{Volume, cu in.}} \times 3.81$$

$$\text{Density, kg/m}^3 = \frac{\text{Weight, g}}{\text{Volume, cm}^3} \times 1000$$

4.5.6 Beam Shear Strength:

4.5.6.1 Specimen Preparation: Test panels shall be prepared using 0.125 inch (3.18 mm) thick AMS 4037, or equivalent, aluminum alloy sheet facings and 0.625 inch (15.88 mm) thick 7.9-l/4-40 (5052) T aluminum alloy honeycomb core conforming to AMS 4348 or to MIL-C-7438. Butting of core sections and splice locations shall be as shown in Figure 2. Test panels shall be bonded using a face-to-core adhesive conforming to MIL-A-25463, Type I, suitable for curing at 120°C (250°F). Test panels shall be cured in accordance with 3.3 using a pressure of 50 psi ± 5 (345 kPa ± 35).

4.5.6.2 Beam shear testing shall be conducted as specified in MIL-C-7438 for flexural shear. Tests shall be conducted at the temperature specified in 3.3.2.2 within ±l°C(±2°F) after not less than 10 min. at the test temperature as verified by a thermocouple attached to the specimen in the splice material.

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 of this specification and stating that the adhesive conforms to the other technical requirements of this specification. The report shall include the purchase order number, AMS 36888, vendor's material designation, lot number, date of manufacture, form, and quantity. For two-part paste adhesives, it shall also include the manufacturer's recommended time and temperature storage conditions.

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 adhesive for production used. 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 3688B, contractor or other direct supplier of adhesive, supplier's material designation, part number, and quantity. When adhesive for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of adhesive to determine conformance to the requirments 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 Sheet Adhesive: Shall be supplied flat with each sheet protected on both sides by nonadherent separator film. Sheets shall be packaged individually, or as specified, in sealed bags of suitable nonadherent material to prevent penetration of moisture or loss of volatiles.

5.1.2 Paste 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.

5.1.3 The protected sheets, containers, or cartridges shall be packed in an exterior container capable of protecting the adhesive adequately during shipment and storage,

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

ADHESIVE, FOAMING, HONEYCOMB CORE SPLICE, STRUCTURAL, -55° to +80°C (-65° to +180°F)
AMS 3688B
FORM (Sheet or Paste)
MANUFACTURER'S IDENTIFICATION _____
PURCHASE ORDER NUMBER _____
DATE OF MANUFACTURE _____
LOT NUMBER _____
QUANTITY OR THICKNESS _____
PERISHABLE - STORE -18°C (0°)(or, for two-part paste, as specified by the manufacturer including storage life time)

5.1.4.1 Sheet Adhesive: Shall be identified by marking on at least one of the protective separator films on each sheet.

5.1.4.2 Paste Adhesive: Shall be identified by marking on each container or cartridge

5.1.5 Each exterior shipping container shall be legibly marked with not less than the information of 5.1.4 in such a manner that the markings will not smear or be obliterated during normal handling or use.