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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3698B

Issued 15 OCT 1979
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Superseding AMS 3698A

Submitted for recognition as an American National Standard

ADHESIVE FILM, HOT-MELT, ADDITION-TYPE POLYIMIDE
For Foam Sandwich Structure, -55 to +230 °C (-65 to +450 °F)

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of July, 1992. It is recommended, therefore, that this specification not be specified for new designs.

This cover sheet should be attached to revision "A" of the subject specification.

"NONCURRENT" refers to those materials which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these as standard materials for future use in new designs. Each of these "NONCURRENT" specifications is available from SAE upon request.

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE "CP".

AN AMERICAN NATIONAL STANDARD

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AMS 3698A

Issued 10-15-79
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Superseding AMS 3698

ADHESIVE FILM, HOT-MELT, ADDITION-TYPE POLYIMIDE For Foam Sandwich Structure, -55° to +230°C (-65 to +450°F)

1. SCOPE:

1.1 Form: This specification covers one type of hot-melt, addition-type, polyimide adhesive in the form of supported film furnished in rolls or cut sheets.

1.2 Application: Primarily for structural adhesive bonding of foam sandwich and glass-fiber, honeycomb-core sandwich assemblies requiring high strength, excellent electrical properties, and heat resistance up to 230°C (450°F).

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 3715 - Core, Honeycomb, Glass/Phenolic
AMS 3824 - Cloth, Type "E" Glass, Finished for Resin Laminates
AMS 3844 - Cloth, Type "E" Glass, Style 7781 Fabric, Hot-Melt, Addition-Type, Polyimide Resin Impregnated
AMS 3849 - Cloth, Quartz, Style 581 Fabric, Hot-Melt, Addition-Type, Polyimide Resin Impregnated

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

ASTM C247 - Tension Jest of Flat Sandwich Constructions in Flatwise Plane
ASTM D1002 - Strength Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal)
ASTM D1781 - Climbing Drum Peel Test for 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 Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be a bis-maleimide, hot-melt, addition-type, polyimide adhesive compounded to meet the requirements of 3.2 through 3.6 and supplied in film form with an E-glass scrim carrier, such as Style 112 complying with AMS 3824, in rolls or as cut sheet, with a suitable non-adhering separator film on both surfaces.

3.2 Storage Life: The adhesive shall meet the requirements of 3.3 through 3.6 when tested at any time up to three months from the date of shipment when stored or shipped in a barrier container and maintained at a temperature below 4°C (40°F).

3.3 Working Life: The adhesive shall meet the requirements of 3.4, 3.5, and 3.6 when tested at any time when held at room temperature up to five days after removal from refrigerated storage.

3.4 Properties of Uncured Adhesive: The adhesive, as received, shall conform to the requirements of Table I Tests No. 1 through No. 5; tests shall be performed on the product supplied and in accordance with specified test methods.

3.5 Curing Properties: The adhesive shall be compatible with, and capable of being co-cured with, the hot-melt, addition-type, polyimide resin impregnated cloth conforming to AMS 3644 or AMS 3849.

3.6 Properties of Cured Adhesive:

3.6.1 Co-cured Adhesive Bonding: The adhesive, co-cured with AMS 3844 or AMS 3649 face sheets on AMS 3715 glass fiber/phenolic honeycomb core, shall meet the requirements of Table I, Tests No. 7 through No. 9. Test specimens shall be prepared as specified in 4.5.1.2.

3.6.2 Cured Face Sheet Adhesive Bonding: The adhesive used to bond specimens of precured face sheets of AMS 3844 or AMS 3849 to AMS 3715 glass fiber/phenolic honeycomb core, shall meet the requirements of Table I, Tests No. 10 through No. 14. Test specimens shall be prepared as specified in 4.5.1.3 and 4.5.1.4.

3.6.3 Tensile Shear Strength: The adhesive shall meet the requirements of Table I, Tests Nos. 15 and 16. Test specimens shall be prepared as specified in 4.5.1.5.

3.7 Quality: The product, as received by purchaser, shall be uniform in quality and condition, clean, smooth (wrinkle and distortion free), homogeneous, and free from contamination or foreign materials and from imperfections detrimental to usage of the product.

3.8 Tolerances: Width shall not vary more than +1/2 in. (+12 mm), -0, from the width ordered.

4. QUALITY ASSURANCE 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 the requirements specified in Table II are classified as acceptance tests and shall be performed on each lot.

TABLE II

ACCEPTANCE TEST REQUIREMENTS

Property	Table I, Test No.	Sampling	Number of Specimens Per Test, min
Color	1	Each Roll	(See 4.5.2)
Weight	3	Each Roll	3
Thickness	4	Each Roll	3
Tack	5	Each Roll	3
Drape	6	Each Roll	3
Working Life	-	Each Roll	(See 4.5.2)
Flatwise Tensile Strength			
At 25°C ± 2 (77°F ± 4)	10	Each Lot	3
At 232°C ± 2 (450°F ± 4)	11	Each Lot	3
Tensile Shear Strength			
At 25°C ± 2 (77°F ± 4)	15	Each Lot	3
At 232°C ± 2 (450°F ± 4)	16	Each Lot	3

4.2.2 Preproduction Tests: Tests to determine conformance to all technical Ø 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 Ø 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 product 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 Table II.

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 adhesive subjected to the same unit chemical and physical process intended to make the final product homogeneous, and presented for vendor's inspection at one time. A lot shall not exceed 500 lb (225 kg) of adhesive 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 4.6.1 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 procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Specimen Preparation: Each roll to be sampled shall be allowed to warm to above the dew point before opening the sealed package for sampling. Immediately after sampling, the roll shall be resealed and returned to refrigerated storage.

4.5.1.1 Uncured Adhesive Tests: Specimens shall be cut from test material and tested immediately after sampling as specified in the applicable test procedure.

4.5.1.2 Co-cured Flatwise Tensile Test Article Fabrication: Specimens 2.0 x 2.0 in. (50 x 50 mm) for flatwise tensile test shall be cut from a honeycomb sandwich panel prepared by placing one ply of adhesive film on the open cell ends of each side of glass/phenolic - 3/16-4.0 (4.8-64) honeycomb core, conforming to AMS 3715, 0.50 in. (12.5 mm) thick, with face sheets of 3 plies of uncured polyimide resin impregnated glass cloth, style 7781 fabric, conforming to AMS 3844, or 3 plies of uncured quartz cloth, style 581 fabric, conforming to AMS 3849, and cured in accordance with the adhesive manufacturer's recommendations. The cure cycle shall be reported for each test panel. Mounting blocks shall be attached by any suitable adhesive of strength sufficient to ensure failure in the test specimen and not at the specimen/test block interface.

4.5.1.3 Precured Facing Flatwise Tensile Test Article Fabrication: Specimen size, preparation, and adhesive cure shall be the same as in 4.5.1.2, except that facing sheets shall have been previously cured in accordance with manufacturer's recommendations. The honeycomb sandwich panel shall be prepared by placing one ply of adhesive film on the open cell ends of each side of glass/phenolic-3/16-4.0 (4.8-64) honeycomb core, conforming to AMS 3715, 0.50 in. (12.5 mm) thick, with face sheets of 3 plies of precured polyimide resin impregnated glass cloth, style 7781 fabric, conforming to AMS 3844, or 3 plies of precured polyimide resin impregnated quartz cloth, style 581 fabric, conforming to AMS 3849 and curing in accordance with adhesive manufacturer's recommendations. The cure cycle shall be reported for each test panel.

4.5.1.4 Honeycomb Climbing Drum Peel Test Article Fabrication: Specimens shall be cut from test panels specified in ASTM D1781, using precured facing sheets and honeycomb core as specified in 4.5.1.3, with the ribbon direction of the core in the lengthwise specimen direction. Specimens shall be prepared and cured in accordance with manufacturer's instructions. The specimen fabrication procedure shall be reported in the preproduction test report.

4.5.1.5 Tensile Shear Strength Test Article Fabrication: Specimens shall be cut from test panels specified in ASTM D1002, using 0.064-in. (1.60-mm) thick aluminum alloy sheet, cleaned and the adhesive applied and cured in accordance with manufacturer's instructions. The specimen fabrication procedure shall be reported in the preproduction test report.

4.5.2 Color and Working Life: Examine the adhesive film for color and working life during preparation of test panels and the other acceptance tests.

4.5.3 Solids Content of Film Adhesive:

4.5.3.1 Cut one approximately 4.0-in. (100-mm) square specimen from each sample and punch a small hole in one corner. Weigh each specimen to the nearest 0.01 g (W_1). Remove the protective film immediately prior to weighing.

4.5.3.2 Hang each specimen in a forced-draft oven maintained at 260°C ± 5 (500°F ± 9) for 15 min. ± 1.

4.5.3.3 Remove specimens from oven, cool to room temperature in a desiccator, and reweigh to the nearest 0.01 g (W_2).

4.5.3.4 Calculate solids content as follows:

$$\text{Solids Content, \%} = \frac{W_2}{W_1} \times 100$$

where, W_1 = original weight of specimen, g

W_2 = final weight of specimen, g

4.5.3.5 Report individual values and the average value for all specimens.

4.5.4 Weight of Film Adhesive: Shall be determined on specimens not less than 6-in. (150-mm) square with the protective separator removed immediately before weighing. The weight shall include the glass cloth carrier and shall be determined to the nearest 0.01 gram. Report weight in lb per sq ft (kg/m^2) of individual specimens and the average for all specimens from each lot.

4.5.5 Thickness of Film Adhesive: Shall be determined on weight-of-film adhesive specimens immediately after weighing. Report-thickness to the nearest 0.0001 in. (0.0025 mm) of individual specimen measurements and the average for all specimens in each lot.

4.5.6 Tack: The adhesive shall obtain a low enough tack to allow for removal of the separator film at temperatures between dew point and 22°C (72°F) and not permit excessive adhesive separation onto the adhesive separator film. With the separator film removed, the adhesive shall have slight tack to the touch.

4.5.7 Drape: The adhesive, at no lower than 22°C (72°F) with separator removed, shall bend around a 4-in. (100-mm) radius sphere without cracking or breaking. A heat gun may be used to warm the specimen.

4.5.8 Flatwise Tensile Strength: Specimens, approximately 2-in. (50-mm) square, and test procedures shall be in accordance with ASTM C297 except that honeycomb shall be as specified in 4.5.1.2. The number of specimens shall be as specified in Table I for preproduction testing and in Table II for acceptance testing.

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 3698A, vendor's product identification, 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 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 Ø The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 3698A, contractor or other direct supplier of adhesive, 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 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. Flatwise tensile specimens shall be cut from the original panels or from newly-prepared panels using the same procedures and curing cycles as used on the original panels. 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 Adhesive film in each roll or sheet shall be protected on both sides by nonadhering separator film. Rolls and sheets shall be packaged individually, or as specified, in sealed bags of suitable nonadherent material to prevent penetration of moisture or loss of volatiles. Packages shall be maintained below 4°C (40°F) during shipment and storage.

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

ADHESIVE FILM, HOT-MELT, ADDITION-TYPE, POLYIMIDE
-55° to +230°C (-65° to +450°F)
AMS 3698A
MANUFACTURER'S IDENTIFICATION _____
DATE OF MANUFACTURE _____
LOT NUMBER _____
QUANTITY _____
WEIGHT _____
WIDTH OR SHEET SIZE _____
PERISHABLE - STORE BELOW 4°C (40°F)
APPROPRIATE WARNINGS OR PRECAUTIONARY NOTICES

5.1.3 The individual packages shall be packed in an exterior shipping container capable of protecting the product and maintaining the required temperature during shipment and storage.

5.1.4 Each exterior container shall be legibly marked with not less than the information specified in 5.1.2 and, in addition, with the applicable purchase order number and date of shipment, in such a manner that the markings will not smear or be obliterated during normal handling or use.

5.1.5 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.

5.1.6 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 5.1.5 will be acceptable if it meets the requirements of Level C.

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

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

8. NOTES:

8.1 Marginal Indicia: The phi (Ø) symbol is used to indicate technical changes from the previous issue of this specification.

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
Weight of adhesive desired
Width or sheet size desired
Quantity or number of sheets desired
Applicable level of packaging (See 5.1.6)

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

TABLE I

PHYSICAL PROPERTIES OF POLYIMIDE ADHESIVE

Test No.	Property	Requirements	Test Method
1	Color	As Approved on Preproduction	Visual
2	Solids Content	98 - 100% by weight	4.5.3
3	Weight	0.080 - 0.105 lb per sq ft	4.5.4
4	Thickness	0.010 - 0.014 in.	4.5.5
5	Tack	Slight - Shall support own weight	4.5.6
6	Drape, Formable Over 4 in. radius sphere; use of heat gun allowed.	Pass	4.5.7

MECHANICAL PROPERTIES OF BONDED JOINTS

Test No.	Property	Environmental Exposure Conditions	Test Temperature	Requirements		No. of Specimens	Test Procedure
				Minimum Individual	Minimum Average		
			CO-CURED FACINGS				
7	Flatwise Tensile	10 min. ± 1 at test temp.	77°F ± 4	400 psi	450 psi	6	ASTM C297
8	Flatwise Tensile	10 min. ± 1 at test temp.	450°F ± 4	315 psi	350 psi	6	ASTM C297
9	Flatwise Tensile	10 min. ± 1 at test temp.	-65° ± 4	400 psi	450 psi	6	ASTM C297
			PRECURED FACINGS				
10	Flatwise Tensile	10 min. ± at test temp.	77°F ± 4	225 psi	250 psi	6	ASTM C297
11	Flatwise Tensile	10 min. ± at test temp.	450°F ± 4	180 psi	200 psi	6	ASTM C297
12	Flatwise Tensile	10 min. ± 1 at test temp.	-65°F ± 4	225 psi	250 psi	6	ASTM C297