SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3278A

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Superseding AMS 3278

Sealing and Coating Compound: Polyurethane (PUR) Fuel Resistant High Tensile Strength / Elongation For Integral Fuel Tanks / Fuel Cavities / General Purpose

RATIONALE

AMS 3278A results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers polyurethane (PUR) in the form of two-component sealing compounds.

1.2 Application

This product has been used typically for contact with fuels, but usage is not limited to such applications. Each application should be considered separately. This polyurethane (PUR) has a service temperature range of -65 to +250 °F (-54 to 121 °C) with a continuous fuel service temperature range of -65 to +160 °F (-54 to +71 °C). It may be used for faying surface sealing, wet-installation of fasteners, overcoat of fasteners, sealing joints and seams and, in some cases, as a non-structural adhesive.

NOTE: The use of an adhesion promoter shall be required to obtain proper adhesion.

1.3 Classification

1.3.1 Type I - For integral fuel tanks and fuel applications only.

1.3.1.1 Class B - For application by extrusion gun or spatula. Available in the following application times:

B-1/4 (solvent-free sealing compound)

1.3.2 Type II - For integral fuel tanks, fuel cavities, and general purpose applications

1.3.2.1 Class A - For application by brush or spray. Available in the following application times:

A-4

1.3.2.2 Class B - For application by extrusion gun or spatula. Available in the following application times:

B-1/2 (solvent-borne sealing compound)
B-1 (solvent-borne sealing compound)

1.4 Precautions

1.4.1 Safety - Hazardous Materials

Shall be in accordance with AS5502 (1.1).

2. APPLICABLE DOCUMENTS

Shall be in accordance with AS5502 (2.).

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS 2471	Anodic Treatment of Aluminum Alloys, Sulfuric Acid Process, Undyed Coating
AMS 3276	Sealing Compound, Integral Fuel Tanks and General Purpose, Intermittent Use to 360 °F (182 °C)
AMS 3277	Sealing Compound, Polythioether Rubber, Fuel Resistant, Fast Curing, Intermittent Use to 400 °F (204 °C)
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
AMS 4911	Titanium Sheet, Strip and Plate, 6Al-4V, Annealed
AMS 5516	Steel, Corrosion Resistant, Sheet, Strip, and Plate, 18Cr - 9.0Ni, (SAE 30302) Solution Heat Treated
AMS-S-8802	Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion
AMS-C-27725	Type 2 Coating, Corrosion Preventive, for Aircraft Integral Fuel Tanks
AS5127	Methods for Testing Aerospace Sealants
AS5127/1	Methods for Testing Aerospace Sealants, Two-Component Synthetic Rubber Compounds
AS5502	Standard Requirements for Aerospace Sealants

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D 1319	Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
ASTM D 2556	Standard Test Method for Apparent Viscosity of Adhesives Having Shear-Rate-Dependent Flow Properties

2.3 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

MIL-PRF-23377	Primer Coatings: Epoxy, High Solids
MIL-DTL-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-DTL-83133	Turbine Fuels, Aviation, Kerosene Types, NATO F-34 (JP-8), NATO F-35, and JP-8+100

2.4 PRI Publications

Available from Performance Research Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7257, Tel: 724-772-1616, www.pri-network.org.

PD 2000	Procedures for an Industry Qualified Product Management Process
PRI-QPL-AMS-S-8802	Products Qualified Under AMS-S-8802
PRI-QPL-AMS 3276	Products Qualified Under AMS 3276
PRI-QPL-AMS 3277	Products Qualified Under AMS 3277
PRI-QPL-AMS 3278	Products Qualified Under AMS 3278
PRI-QPL-AMS-C-27725	Products Qualified Under AMS-C-27725

3. TECHNICAL REQUIREMENTS

3.1 Material

3.1.1 Basic Ingredient

Synthetic rubber of the polyurethane type.

3.1.2 Color

Not red or pink in color. The curing agent shall possess sufficient color contrast to the base compound to permit easy identification of an unmixed or incompletely mixed sealing compound.

3.1.3 Texture

The base compound and the curing agent shall be of uniform blend and free of excessive air, skins, lumps and gelled or coarse particles. There shall be no separation of ingredients that cannot be easily redispersed.

3.1.4 Cure

Curing agent shall be added to the base compound to cure at room temperature. Higher temperatures may be used to accelerate the cure.

3.1.5 Exclusions

Lead compounds or leachable chromate compounds are prohibited.

3.1.6 Shelf Life

Shelf life shall be a minimum of 9 months from the date of packaging. Material may be retested for shelf life extension (See 4.3.3).

3.2 Properties

The sealing compound, when mixed in accordance with the manufacturer's instructions and cured as specified in 4.4.4.1, shall conform to the requirements shown in Table 1, determined in accordance with the specified test methods.

TABLE 1 - PROPERTIES (APPLICATION, PERFORMANCE AND STORAGE STABILITY)

Paragraph	Property	Requirement	Test Method
3.2.1	Properties - Application		
3.2.1.1	Appearance	3.1.3	Visual
3.2.1.2	Nonvolatile Content by weight, min		AS5127/1 (5.1)
3.2.1.2.1	Class A-4	55%	
3.2.1.2.2	Classes B-1 & B-1/2	85%	
3.2.1.2.3	Class B-1/4	99%	
3.2.1.3	Air Content, max		AS5127/1 (5.2)
3.2.1.3.1	Class B	4%	
3.2.1.4	Viscosity of Base Compound		AS5127/1 (5.3)
3.2.1.4.1	Class A-4	5 to 120 poises (0.5 to 12 Pa•S)	Use No. 2 spindle at 10 rpm
3.2.1.4.2	Classes B-1 & B-1/2	5000 to 14000 poises (500 to 1400 Pa•S)	Use No. 7 spindle at 4 rpm
3.2.1.4.3	Class B-1/4	300 to 3000 poises (30 to 300 Pa•S)	Use No. 4 spindle at 2 rpm after heating for 4 hours at 140 °F
3.2.1.5	Flow (initial)		AS5127/1 (5.5)
3.2.1.5.1	Classes B-1 & B-1/2	0.1 to 0.75 inches (2.5 to 19.0 mm)	AS5127/1 (5.5.1)
3.2.1.5.2	Class B-1/4	0.1 to 4.25 inch (2.5 to 108 mm)	AS5127/1 (5.5.1)
3.2.1.6	Application Time, min		AS5127/1 (5.6)
3.2.1.6.1	Class A-4	4 hours From the beginning of mixing, the viscosity shall not exceed 2500 poise (250 Pa•S).	AS5127/1 (5.6.1) Use No. 7 spindle at 10 rpm
3.2.1.6.2	Class B-1	1 hour From beginning of mixing, not less than 15 grams per minute shall be extruded.	AS5127/1 (5.6.2)
3.2.1.6.3	Class B-1/2	1/2 hour From beginning of mixing, not less than 15 grams per minute shall be extruded.	AS5127/1 (5.6.2)
3.2.1.6.4	Class B-1/4	1/4 hour From beginning of mixing, not less than 5 grams per minute shall be extruded.	AS5127/1 (5.6.2)
3.2.1.7	Tack-Free Time, max	Measured from beginning of mixing	AS5127/1 (5.8)
3.2.1.7.1	Class A-4	2.5 hours	
3.2.1.7.2	Class B-1	4 hours	
3.2.1.7.3	Class B-1/2	3.5 hours	
3.2.1.7.4	Class B-1/4	3 hours	
3.2.1.8	Standard Cure Time, max Time to reach 50 Durometer A		AS5127/1 (5.9)
3.2.1.8.1	Class A-4	24 hours	
3.2.1.8.2	Class B-1	20 hours	
3.2.1.8.3	Class B-1/2	18 hours	
3.2.1.8.4	Class B-1/4	16 hours	
3.2.1.9	Fluid Immersion Cure Time, min Class B-1/4, only		AS5127/1 (5.11)
3.2.1.9.1	After 8 hours	35 Durometer A	
3.2.1.9.2	After 16 hours	50 Durometer A	

TABLE 1 - PROPERTIES (APPLICATION, PERFORMANCE AND STORAGE STABILITY) (CON'T.)

Paragraph	Property	Requirement	Test Method
3.2.2	Properties - Performance		
3.2.2.1	Specific Gravity, max	1.2	AS5127/1 (6.1)
3.2.2.2	14-Day Hardness, min	45 Shore A	AS5127/1 (6.2)
3.2.2.3	Hydrolytic Stability, min	30 Durometer A	AS5127/1 (6.6)
3.2.2.4	Resistance to Thermal Rupture Class B only	No blistering or sponging 0.125 inch (3.0 mm) max	AS5127/1 (7.2) 250 °F at 10 psi for 60 minutes
3.2.2.5 3.2.2.5.1 3.2.2.5.2	Weight Loss & Flexibility Weight Loss, max Flexibility	 8% No cracking or checking	AS5127/1 (7.4)
3.2.2.6 3.2.2.6.1	Volume Swell, max In JRF per 4.4.5	 35%	AS5127/1 (7.5)
3.2.2.7	Low Temperature Flexibility	No cracking or checking, No loss of adhesion	AS5127/1 (7.6) Immerse in JRF per 4.4.5 for 14 days at 160 °F
3.2.2.8	Tensile Strength / Elongation, min All classes		AS5127/1 (7.7)
3.2.2.8.1	Standard Cure	3000 psi (20.7 Pa) 350% elongation	
3.2.2.8.2	Standard Cure + 24 hours at 250 °F ± 5 (121 °C ± 3) + 7 days at 160 °F (71 °C) in JRF per 4.4.5,	700 psi (4.8 Pa) 300% elongation	
3.2.2.8.3	Standard Cure + 72 hours at 160 °F (71 °C) in JRF per 4.4.5, + 72 hours at 120 °F (49 °C) in air + 7 days at 250 °F ± 5 (121 °C ± 3) in air	2500 psi (17.3 Pa) 300% elongation	
3.2.2.8.4	Standard Cure + 7 days at 250 °F ± 5 (121 °C ± 3) in air	2500 psi (17.3 Pa) 300% elongation	
3.2.2.8.5	Standard Cure +14 days at 160 °F (71 °C) in JRF per 4.4.5,	700 psi (4.8 Pa) 300% elongation	
3.2.2.9	Shear Strength, min (All Classes)	280 psi (1.9 Pa)	AS5127/1 (7.8)
3.2.2.10	Corrosion	No corrosion under sealant or signs of deterioration	AS5127/1 (7.9)
3.2.2.11	Peel Strength, min Class B only	20 lbf/inch, 100% cohesive failure, or 45 lbf/inch, failure mode recorded. (May be up to 100% adhesive failure.)	AS5127/1 (8.1, Figure 22) and Table 5
3.2.2.12	Reparability, min Class B only	20 lbf/inch, 100% cohesive failure, or 45 lbf/inch, failure mode recorded. (May be up to 100% adhesive failure.)	AS5127/1 (8.2) To itself + sealants AMS-S-8802, AMS 3276 and AMS 3277

TABLE 1 - PROPERTIES (APPLICATION, PERFORMANCE AND STORAGE STABILITY) (CON'T.)

Paragraph	Property	Requirement	Test Method
3.2.3	Properties - Storage Stability		
3.2.3.1	Accelerated Storage Stability		AS5127/1 (9.1)
3.2.3.1.1	Appearance	3.2.3	
3.2.3.1.2	Flow (Class B only)	Same as 3.2.1.5	
3.2.3.1.3	Viscosity of Base Compound	Same as 3.2.1.4	
3.2.3.1.4	Application Time	Same as 3.2.1.6	
3.2.3.1.5	Tack Free Time	Same as 3.2.1.7	
3.2.3.1.6	Standard Cure Time	Same as 3.2.1.8	
3.2.3.1.7	Shear Strength (Class A only)	Same as 3.2.2.9	
3.2.3.1.8	Peel Strength (Class B Only): min, 2 aluminum AMS 4045 panels, sulfuric acid anodized in accordance with AMS 2471 and coated with AMS-C-27725 Type 2, (See 8.4), After 7 days immersion in JRF per 4.4.5 at 160 °F (71 °C)	Same as 3.2.2.11	
3.2.3.2	Long Term Storage Stability		AS5127/1 (9.2)
3.2.3.2.1	Appearance	3.2.3	
3.2.3.2.2	Flow (Class B only)	Same as 3.2.1.5	
3.2.3.2.3	Viscosity of Base Compound	Same as 3.2.1.4	
3.2.3.2.4	Application Time	Same as 3.2.1.6	
3.2.3.2.5	Tack-Free Time, max	Same as 3.2.1.7	
3.2.3.2.6	Standard Cure Time	Same as 3.2.1.8	
3.2.3.2.7	Shear Strength (Class A only)	Same as 3.2.2.9	
3.2.3.2.8	Peel Strength (Class B Only): min, 2 aluminum (AMS 4045) panels, sulfuric acid anodized in accordance with AMS 2471 and coated with AMS-C-27725 Type 2, (See 8.4), After 7 days immersion in JRF per 4.4.5 at 160 °F (71 °C)	Same as 3.2.2.11	

3.3 Qualification

All products sold to this specification shall be listed, or approved for listing, on the qualified products lists, PRI-QPL-AMS 3278. The qualified products list shall be in accordance with PD 2000.

4. QUALITY ASSURANCE PROVISIONS

4.1 Qualification

Shall be in accordance with AS5502 (4.7.1).

4.2 Responsibility for Inspection

Shall be in accordance with AS5502 (4.1).

4.2.1 Source Inspection

Shall be in accordance with AS5502 (4.1.1).

4.3 Classification of Tests

Shall be in accordance with AS5502 (4.2).

4.3.1 Acceptance Tests

Shall be in accordance with AS5502 (4.2.3).

4.3.1.1 Initial Acceptance Tests

The tests in Table 2 shall be performed on each batch of product.

TABLE 2 - INITIAL ACCEPTANCE TESTS

Test	Requirement
Nonvolatile Content	3.2.1.2
Air Content (Class B only)	3.2.1.3
Viscosity of the Base Compound *	3.2.1.4
Flow (Class B only)	3.2.1.5
Application Time	3.2.1.6
Tack-Free Time	3.2.1.7
Standard Cure Time	3.2.1.8
Resistance to Thermal Rupture Fluid Immersed only	3.2.2.4
Shear Strength (Class A only)	3.2.2.9
Peel Strength (Class B only) 4 aluminum panels, AMS 4045, sulfuric acid anodized in accordance with AMS 2471 and coated with AMS-C-27725 Type 2 (See 8.4) (7 day immersion at 160 °F (71 °C) - 2 panels in JRF per 4.4.5 and 2 panels in JRF per 4.4.5 / salt water).	3.2.2.11
* Acceptance testing of Viscosity of Base Compound shall be conducted on material in 1-quart or 1-liter cans regardless of type of packaging being procured.	

4.3.1.1.1 Random Sampling

Shall be in accordance with AS5502 (4.3.1).

4.3.1.1.2 Sample

Shall be in accordance with AS5502 (4.3.1).

4.3.1.1.3 Report

Shall be in accordance with AS5502 (4.5).

4.3.1.1.4 Approval

After successful completion of testing, the batch shall be released for final packaging. Minor variations in application requirements during Acceptance Tests may not be cause for rejection if approved by the procuring agency.

4.3.1.1.5 Retest

Shall be in accordance with AS5502 (4.6).

4.3.1.2 Final Acceptance Tests

The tests listed in Table 3 shall be performed on lots from each batch of product.

NOTE: A lot shall be the quantity of finished product traceable to one batch, packaged in one size and/or type of container.

TABLE 3 - FINAL ACCEPTANCE TESTS

Test	Requirement
Air Content (Class B only)	3.2.1.3
Application Time	3.2.1.6
Tack-Free Time	3.2.1.7
Standard Cure Time	3.2.1.8

4.3.1.2.1 Random Sampling

During packaging, test kits shall be selected at random for final lot acceptance testing. Shall be in accordance with AS5502 (4.3.1).

4.3.1.2.1.1 Sample

If the same type and/or size containers are specified under different purchase orders it is only necessary to conduct the testing one time. If different types and/or size containers are specified, testing shall be conducted on each type and/or size containers.

4.3.1.2.1.2 Report

Shall be in accordance with AS5502 (4.5).

4.3.1.2.1.3 Approval

After successful completion of testing, the lot shall be released for shipment. Minor variations in application requirements during Acceptance Tests may not be cause for rejection if approved by the procuring agency.

4.3.1.2.1.4 Retest

Shall be in accordance with AS5502 (4.6).

4.3.2 Qualification Tests

Shall be in accordance with AS5502 (4.2.1).

4.3.2.1 Random Sampling

Shall be from a production batch of product.

4.3.2.1.1 Sample

Shall be of sufficient quantity as determined by the testing laboratory and packaged as supplied to the user.

4.3.2.1.2 Report

A complete test report will be furnished to the responsible qualification activity.

4.3.2.1.3 Approval

Shall be in accordance with AS5502 (4.4).

4.3.2.1.4 Retest

Shall be in accordance with AS5502 (4.6).

4.3.3 Shelf Life Tests

The tests listed in Table 4 may be performed at the end of the stated shelf life to extend the expiration date an additional 3 months. Only one shelf-life extension shall be allowed.

TABLE 4 - SHELF LIFE TESTS

Test	Requirement
Appearance	3.2.1.1
Viscosity of Base Compound *	3.2.1.4
Application Time	3.2.1.6
Tack-Free Time	3.2.1.7
Standard Cure Time	3.2.1.8
Shear Strength (Class A only)	3.2.2.9
Peel Strength (Class B only) 2 aluminum AMS 4045 panels, sulfuric acid anodized per AMS 2471, coated with AMS-C-27725 Type 2, corrosion preventive coating (See 8.4), and aged in JRF per 4.4.5, for 7 days at 160 °F (71 °C).	3.2.2.11
* Not possible with sectional-type containers.	

4.3.3.1 Statistical Sampling

Shall be in accordance with AS5502 (4.1.2).

4.3.3.1.1 Sample

Shall be of sufficient quantity as determined by the testing laboratory.

4.3.3.1.2 Report

A complete test report shall be prepared by the testing laboratory.

4.3.3.1.3 Retest

Shall be in accordance with AS5502 (4.6).

4.4 Test Methods

4.4.1 Standard Tolerances

Shall be in accordance with AS5127 (3.1), unless specified.

4.4.2 Standard Test Conditions

Shall be in accordance with AS5127 (4.) unless specified.

4.4.3 Preparation of Test Specimens

Shall be in accordance with AS5127 (6.).

4.4.3.1 Use of Adhesion Promoter

Shall be as defined by the manufacturer (See Note for 1.2).