

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

Sealing Compound, Polysulfide For Aircraft Windshields and Canopies, For Use up to 250 °F (121 °C)

1. SCOPE:

1.1 Form:

This specification covers types and classes of polysulfide sealing compound supplied as a two-component system suitable for application by brush, or by extrusion gun, spatula brush, or roller.

1.2 Application:

This product has been used typically for sealing aircraft windshields and canopies. This includes both sealing between the windshield/canopy and the aircraft structure for pressure sealing, and sealing around the windshield/canopy for weather sealing, but usage is not limited to such applications. The sealing compound cures at room temperature and may have an accelerated cure at higher temperatures. The sealing compounds are usable from -65 to 250 °F (-54 to 121 °C).

NOTICE: Class A material is not intended for use on plastic windshields or canopies.

1.3 Types:

This specification covers the following types:

- Type I - Low peel strength
- Type II - High peel strength

1.4 Classification:

Sealing compounds are classified as follows:

Class A - Suitable for brush application. Available in the following application times:

- a. A-1/2
- b. A-2

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1.4 (Continued):

Class B - Suitable for application by extrusion gun, spatula, brush, or roller. Available in the following application times:

- a. B-1/4
- b. B-1/2
- c. B-2

1.5 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 SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

- AMS 2471 Anodic Treatment of Aluminum Alloys, Sulfuric Acid Process, Undyed Coating
- AMS 3819 Cloths, Cleaning, for Aircraft Primary and Secondary Structural Surfaces
- AMS 4045 Aluminum Alloy, Sheet and Plate, 5.6Zn - 2.5Mg - 1.6Cu - 0.23 Cr, (7075; -T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
- AMS 4049 Aluminum Alloy, Sheet and Plate, Alclad, 5.6Zn - 2.5Mg - 1.6Cu - 0.23 Cr, (Alclad 7075; -T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
- AMS 4901 Titanium Sheet, Strip and Plate, Annealed, 70,000 psi (485 Mpa) Yield
- AMS 5516 Steel, Corrosion Resistant, Sheet, Strip and Plate, 18Cr - 9.0Ni (SAE 30302), Solution Heat Treated
- AMS XXXX Adhesion Promoter for Polysulfide Windshield Sealants (Draft G9-90AF)
- AMS 5127 Methods for Testing Aerospace Sealants (May 1997, See 4.5.3.1)
- AMS 5127/1 Methods for Testing Aerospace Sealants, Two-Component Synthetic Rubber Compounds (May 1997, See 4.5.3.1)

2.1 (Continued):

- AS7001 National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Program Description
- AS7002 National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Rules for Implementation
- AS7003 National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Program Operation
- AS7200/1 National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Audit and Inspection Procedures and Checklists for the Sealant Manufacturers Accreditation Program
- AS7201 National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Requirements for Accreditation of Pass-Thru Distributors
- AS7202 National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Requirements for Accreditation of Value Added Distributors

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 1974 Closing, Sealing, and Reinforcing Fiberboard Boxes

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

- PPP-C-96 Can, Metal, 28 Gage and Lighter
- MIL-P-5425 Plastic, Sheet, Acrylic, Heat Resistant
- MIL-P-8184 Plastic, Sheet, Acrylic, Modified
- MIL-P-23377 Primer Coatings: Epoxy, High Solids
- MIL-G-25667 Glass, Monolithic, Aircraft Glazing
- MIL-P-25690 Plastic, Sheets, and Formed Parts, Modified Acrylic Base, Monolithic, Crack Propagation Resistant
- MIL-P-38714 Sealant Cartridge for Two-Component Materials
- MIL-P-83310 Plastic, Sheet, Polycarbonate, Transparent
- MIL-C-85285 Coating, Polyurethane, High Solids
- MIL-P-85582 Primer Coatings: Epoxy, Waterborne

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

The basic ingredient used in the manufacture of these products shall be synthetic rubber of the polysulfide (T) type. The sealing compound shall cure by the addition of a curing agent to the base compound, and shall not depend on solvent evaporation or curing. The material shall contain no lead compounds or asbestos. Neither the base compound nor the cured sealant shall be red or pink in color.

3.2 Properties:

The sealing compound, when mixed in accordance with the manufacturer's instructions and cured in accordance with 4.5.2.5, shall conform to the requirements shown in Table 1, and determined in accordance with test methods as defined in Table 1.

3.3 Performance and Application Requirements:

Performance requirements define those properties of the cured sealant related to performance in service. Application requirements define those properties of the uncured sealant which affect the application parameters of the sealant, but have little or no effect on performance properties of the cured sealant. Minor variations in the Application requirements during quality conformance inspection such as receiving inspection tests, may not be cause for rejection if approved by the purchaser. Application requirements are listed below; all other properties are Performance requirements.

- a. Viscosity of Base Compound
- b. Viscosity of Curing Agent
- c. Flow
- d. Application Time
- e. Tack-Free Time
- f. Cure Time

TABLE 1 - Properties

Paragraph	Property	Requirement	AS5127/1 Standard Test Method (paragraph)
3.2.1	Specific Gravity, max	1.65	(6.1)
3.2.2	Hardness, Durometer A, min	35	(6.2)
3.2.3	Nonvolatile Content, by weight, min		(5.1)
	Class A	85%	
	Class B	96%	
3.2.4	Viscosity of Base Compound		(5.3)
	Class A	100 to 600 poises (10 to 60 Pa·S)	Use No. 6 spindle at 10 RPM
	Class B	9000 to 16000 poises (900 to 1600 Pa·S)	Use No. 7 spindle at 2 RPM
3.2.5	Flow, (Class B only)	0.1 to 0.75 inches (2.5 to 19.1 mm)	(5.5.1)
3.2.6	Application Time, min		
3.2.6.1	Class A - From the beginning of mixing, the viscosity shall not exceed 2500 poises (250 Pa·S)		(5.6.1) Use No. 7 spindle at 10 RPM
	Class A-1/2	1/2 hour	
	Class A-2	2 hours	
3.2.6.2	Class B- From the beginning of mixing, not less than 15 grams per minute shall be extruded		(5.6.2)
	Class B-1/4	15 minutes	
	Class B-1/2	30 minutes	
	Class B-2	2 hours	
3.2.7	Tack-Free Time, max		(5.8)
	Class B-1/4	6 hours	
	Class A-1/2 and B-1/2	10 hours	
	Class A-2 and B-2	24 hours	
3.2.8	Standard Cure Time, max (30 Durometer A, min)		(5.9)
	Class B-1/6	12 hours	
	Class B-1/4	16 hours	
	Classes A-1/2 and B-1/2	30 hours	
	Classes A-2 and B-2	48 hours	

TABLE 1 - Properties (Continued)

Paragraph	Property	Requirement	AS5127/1 Standard Test Method (paragraph
3.2.9	Peel Strength, /95% cohesive failure Type I	5 to 15 lbf/inch (876 to 2627 N/m)	(8.1) and Table 4
	Type II, min	15 lbf/inch (2627 N/m)	
3.2.10	Shear Strength, min, average with 95% cohesive failure	180 psi (1241 kPa)	(7.8)
3.2.11	Resistance to Heat	No visual evidence of softening, sponging, blistering, checking, cracking, or powdering	4.5.4
3.2.12	Heat Reversion Resistance	The sealant shall not revert to a liquid or paste-like consistency, nor shall it become brittle or lose adhesion.	(6.5)
3.2.13	Tensile Strength and Elongation, min		(7.7)
	Standard Cure as in 4.5.2.5	250 psi (1724 kPa), 200% elong.	
	Standard Heat Cycle per 4.5.1.2	250 psi (1724 kPa), 80% elong.	
	8 hours at 250 °F (121 °C)	150 psi (1034 kPa), 100% elong.	
3.2.14	Low Temperature Flexibility	No visual evidence of cracking or checking. No loss of adhesion.	(7.6.2)
3.2.15	Hydrolytic Stability, min	30 Durometer A	(6.6)
3.2.16	Crazing	No evidence of crazing or chemical degradation.	(7.11)
3.2.17	Storage Stability		

TABLE 1 - Properties (Continued)

Paragraph	Property	Requirement	AS5127/1 Standard Test Method (paragraph)
3.2.17.1	Accelerated Storage		(9.1)
	Hardness	Same as 3.2.2	
	Viscosity of Base Compound	Same as 3.2.4	
	Application Time	Same as 3.2.6	
	Tack-Free Time	Same as 3.2.7	
	Peel Strength	Same as 3.2.9	
3.2.17.2	Long-Term Storage		(9.2)
	Hardness	Same as 3.2.2	
	Viscosity of Base Compound	Same as 3.2.4	
	Application Time	Same as 3.2.6	
	Tack-Free Time	Same as 3.2.7	
	Peel Strength	Same as 3.2.9	
3.2.18	Repairability, Peel Strength, average with 95% cohesive failure		(8.2)
	Type I	5 to 15 lbf/inch (876 to 2627 N/m)	
	Type II, min	15 lbf/inch (2627 N/m)	

3.4 Quality:

The sealing compound, as received by the purchaser, shall be uniform in quality and condition, as free from foreign materials as commercially practical and free from imperfections detrimental to the usage of the compound. There shall be no separation of ingredients that cannot be readily dispersed.

3.5 Qualification:

Material furnished under this specification shall be products which are authorized by the qualifying agency for listing on the applicable qualified products list at the time of contract award.

3.6 Shelf Life:

Packaged material shall have a minimum shelf life of nine months from the Date of Packaging when stored unopened at 80 °F (27 °C) or lower.

- 3.6.1 Date of Packaging: Date of Packaging is defined as the date finished material is assembled from its components, base compound and curing compound, into a package, labeled kit or unit by the manufacturer or re-packager. Date of Packaging shall be no more than 90 days from the last day of full quality conformance testing in accordance with 4.2.2. Material may be retested by the manufacturer at any time to determine conformance to full quality conformance testing in accordance with 4.2.1.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The manufacturer of the sealing compound shall supply all samples for manufacturer's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the sealing compound conforms to the requirements of this specification.

- 4.1.1 Source Inspection: Material procured by the U.S. Military under this specification shall be third party approved prior to shipment, to ensure that material meets acceptance tests (4.2.1). Third party approval shall be by a third party accreditation process in accordance with AS7001, AS7002, AS7003, and AS7200/1. Sealant shall be from a manufacturer that currently holds a third party accreditation and shall be from a batch of material that has been third party source inspected in accordance with AS7200/1. Distributors supplying sealant shall supply material from an accredited manufacturer and from a batch of material that has been third party source inspected. Distributors shall also be third party accredited in accordance with AS7201 or AS7202, whichever is applicable.

4.1.2 Shelf Life Surveillance and Updating:

- 4.1.2.1 Sampling: The minimum number of samples to be tested during shelf-life surveillance and updating is shown in Table 2.

TABLE 2 - Sampling

Items in Stock	Samples to be Tested
Up to 100, excl	3
100 to 500, incl	5
Over 500	7

- 4.1.2.2 Testing: The following inspections are to be conducted for shelf-life surveillance and updating:

- Condition of Container
- Application Time
- Tack-Free Time
- Standard Cure Time
- Viscosity of Base Compound

4.1.2.2.1 Tests are to be conducted in accordance with test methods outlined in this specification for acceptance tests. If the tests are being performed at the end of the stated shelf-life to update the shelf life of the sealing compound, and all tests are passed, the shelf life will be extended an additional three months. Up to three updating will be allowed.

4.1.3 Curing Agent Replacement: There may be instances where the mixed sealant requires excessive time to cure. Occasionally, the curing agent is found to have deteriorated. It may be possible to replace the curing agent so that the base compound can be used. Whenever the curing agent is replaced, all acceptance tests must be met by the final curing agent/base compound combination.

4.2 Classification of Tests:

4.2.1 Qualification Tests: All technical requirements are qualification tests and shall be performed prior to or on the initial shipment of sealing compound to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.1.1 Qualification: For direct U.S. Military procurement, and for procurement on U.S. Military contracts, the sealant shall be a product that has been tested, has passed the qualification tests of 4.2.1, and has been listed or approved for listing on the applicable U.S. Military qualified products list.

4.2.2 Acceptance Tests: Tests for the following requirements are acceptance tests and shall be performed on each batch:

Hardness
Nonvolatile content
Viscosity of the base compound
Flow
Application time
Tack-free time
Peel strength on MIL-P-25690

4.3 Sampling and Testing:

4.3.1 For Acceptance Tests: Sufficient sealing compound shall be taken at random from each batch 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 herein, not less than three. Multiple testing is not required for viscosity, application time, flow, tack-free time and hardness.

4.3.1.1 A batch is defined as a quantity of formulated material mixed as one production entity.

4.3.1.2 Materials for testing shall be mixed, as much as possible, in the same containers in which the sealing compounds were procured.

4.3.1.3 A statistical sampling plan, acceptable to the purchaser, may be used in lieu of sampling as in 4.3.1.

- 4.3.2 For Qualification Tests: Samples shall consist of six 1 quart (1-L) containers of sealing compound, and two pints (1/2 L) of adhesion promoter. Samples shall be identified as specified below and forwarded to the activity responsible for qualification testing as designated in the letter of authorization from that activity (See 8.2).

SEALING COMPOUND, POLYSULFIDE, FOR AIRCRAFT WINDSHIELDS AND CANOPIES, FOR
USE UP TO 250 °F (121 °C)

AMS 3333 Class XX Type XX

Manufacturer's Identification

Batch Number

Date of Manufacture

Submitted by (name) (date) for qualification tests in accordance with AMS 3333

Class XX Type XX under authorization (reference authorizing letter).

4.4 Approval:

- 4.4.1 Sealing compound shall be approved by purchaser before sealing compound for production use is supplied, unless such approval be waived by purchaser. For direct U.S. Military procurement and for procurement for use on U.S. Military contracts, the sealing compound shall be listed, or approved on the applicable U.S. Military qualified products list. Results of tests on the production sealing compound shall be essentially the equivalent to those on the approved (qualified) sample.
- 4.4.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production product which are essentially the same as those used on the approval sample. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample product. Production product made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

- 4.5.1 Standard Conditions: Standard laboratory conditions shall be 77 °F ± 2 (25 °C ± 1) and 50% ± 5 relative humidity. Except as otherwise specified herein, all test specimens shall be cured under these conditions. Test specimens shall be prepared at 77 °F ± 5 (25 °C ± 3) and immediately upon completion of preparation, shall be placed into standard conditions for cure. Except as otherwise specified herein, tests shall be performed at 77 °F ± 5 (25 °C ± 3).
- 4.5.1.1 Standard Heat Cycle: Standard heat cycle shall consist of the cure cycle of 4.5.2.5 followed by 60 hours ± 4 at 160 °F (71 °C) and followed by 6 hours ± 1 at 180 °F (82 °C).
- 4.5.1.2 Standard Tolerances: Unless otherwise specified herein, standard tolerances of AS5127 under (3.1) "Standard Tolerances" shall apply.
- 4.5.2 Preparation of Test Specimens: Test panel configuration shall be in accordance with AS5127/1 under (8.) "Peel Strength Properties" and (8.1) "Peel Strength Testing" and as in figures for either (Figure 23) "Four-Inch Peel Specimen Configuration" or (Figure 22) "Five-Inch Peel Specimen Configuration".

- 4.5.2.1 Cleaning of Test Panels: Test panels shall be cleaned in accordance with Table 3 and methods in accordance with AS 5127.

NOTE—When organic coatings are specified for the test panels, the coatings shall be fully cured as defined by the applicable coating specification before cleaning. The applied coatings shall be at least 14 days old and a maximum of 6 months old stored at ambient indoor temperatures.

TABLE 3 - Cleaning of Test Panels

Panel Material	Cleaning Method, AS5127
Aluminum alloy, MIL-P-23377 test surface	(6.2.2.1) "Cleaning of MIL-P-23377 Surface for Sealing"
Aluminum alloy, MIL-C-85285 test surface	(6.2.3.1) "Cleaning of MIL-C-85286 Surface for Sealing"
Aluminum alloy, MIL-P-85582 test surface	(6.2.4.1) "Cleaning of MIL-P-85582 Surface for Sealing"
AMS 5516 Stainless steel	(6.3) "Preparation of AMS 5516 Stainless Steel Panel Test Surfaces"
AMS 4901 Titanium alloy	(6.4) "Preparation of AMS 4901 Titanium Panel Test Surfaces"
Transparent surfaces: (prior to applying adhesion promoter)	(6.6) "Preparation of Aircraft Transparent Surfaces"
MIL-P-5425	
MIL-P-25690	
MIL-P-83310	
MIL-G-25667	
MIL-P-8184	

- 4.5.2.2 Application of Adhesion Promoter: When specified, the panel surface shall be treated with AMS 3333 adhesion promoter. This shall be done immediately after the panel is cleaned and by wetting a clean AMS 3819 Grade A cloth and wiping the surface. Allow the adhesion promoter to air dry at least 30 minutes but not more than two hours before applying the sealant. If more than two hours has elapsed, reclean and reapply the adhesion promoter before applying the sealant.
- 4.5.2.3 Preparation of Sealing Compound: The quantity of sealing compound required for testing shall be thoroughly mixed in accordance with AS5127/1 under (4.) "Preparation of Sealing Compound".
- 4.5.2.4 Application of Sealing Compound: Unless otherwise specified herein, test panels shall be given an application of sealing compound to produce a coating having a total thickness of 0.125 inch $\pm$ 0.016 (3.0 mm $\pm$ 0.4) when cured.

4.5.2.5 Standard Cure: For qualification testing, the sealing compound shall be cured for 14 days at 77 °F (25 °C) and 50% ± 5 relative humidity. For acceptance testing, the sealing compound shall be given an accelerated cure for 48 hours at 77 °F (25 °C) and 50% ± 5 relative humidity plus 24 hours at 140 °F (60 °C). Tests on the cured sealing compound shall commence not more than two days after the completion of the specified cure.

4.5.3 Standard Test Methods: Standard test methods as shown in Table 4 shall be used. Standard test methods are in accordance with AS5127/1. In the event of a conflict between the text of this document and AS5127 and/or AS5127/1, the text of this document takes precedence.

TABLE 4 - Standard Test Methods

Test Method	AS5127/1
Specific Gravity	(6.1) "Specific Gravity"
Hardness	(6.2) "14-Day Hardness"
Nonvolatile content	(5.1) "Nonvolatile Content"
Viscosity of Base Compound	(5.3) "Viscosity of Base Compound"
Flow (class B only)	(5.5.1) "Flow, Classes B and D"
Application Time (Class A)	(5.6.1) "Application Time, Class A Material"
Application Time (Class B)	(5.6.2) "Application Time, Class B and C Material"
Tack-Free Time	(5.8) "Tack-Free Time"
Standard Cure Time	(5.9) "Standard Curing"
Peel Strength (See Table 4)	(8.1) "Peel Strength Testing"
Shear Strength	(7.8) "Shear Strength (Class C only)"
Heat Reversion Resistance	(6.5) "Heat Reversion Resistance (Classes B and C only)"
Tensile Strength and Elongation	(7.7) "Tensile Strength and Elongation"
Low Temperature Flexibility	(7.6.2) "Low Temperature Flexibility (Windshield Sealant)"
Hydrolytic Stability	(6.6) "Hydrolytic Stability"
Crazing	(7.11) "Crazing"
Accelerated Storage Stability	(9.1) "Accelerated Storage Stability"
Long-Term Storage	(9.2) "Long-Term Storage"
Repairability	(8.2) "Repairability"

4.5.3.1 Future Revisions of AS5127 and AS5127/1: Use of a specific issue of AS5127 and of AS5127/1 is for clarity. Future revisions of AS5127 and AS5127/1, when published, may be used providing test methods correspond in kind to those of the issues listed in 2.1.

- 4.5.4 Resistance to Heat: A 0.040 x 2.75 x 6 inch (1.02 x 70 x 150 mm) AMS 4049 aluminum alloy panel shall be cleaned in accordance with 4.5.2.1. Sealing compound shall cover the cleaned panel surface to a depth of 0.125 inch $\pm$ 0.016 (3.18 mm $\pm$ 0.4). At the end of the standard cure (see 4.5.2.5), the panel shall be immersed vertically for 48 hours at 140 °F (60 °C) in water in a closed container with one half of the sealing compound above the liquid. The panel shall be removed, air dried for 24 hours at 77 °F (25 °C) and baked for 24 hours at 250 °F (121 °C). Inspect to the requirements of 3.2.12. See Table 5.

TABLE 5 - Peel Strength Panels

Quantity Required	Panel Thickness, Inch (mm)	Panel Material	Immersion Media at 140 °F (60 °C)
2	0.040 (1.02)	Al alloy AMS 4045 sulfuric acid anodized per AMS 2471, 0.001 inch (0.025 mm) overcoat of MIL-P-23377 primer.	2 panels into distilled water for 7 days
2	0.040 (1.02)	Al alloy AMS 4045 sulfuric acid anodized per AMS 2471, 0.001 inch (0.025 mm) overcoat of MIL-P-23377 primer, 0.001 inch (0.025 mm) overcoat of MIL-C-85285 top coat	2 panels into distilled water for 7 days
2	0.040 (1.02)	Al alloy AMS 4045 sulfuric acid anodized per AMS 2471, 0.001 inch (0.025 mm) overcoat of MIL-P-85582 primer.	2 panels into distilled water for 7 days
2	0.040 (1.02)	AMS 5516 Stainless steel	2 panels into distilled water for 7 days
2	0.020 (0.51)	AMS 4901 Titanium alloy	2 panels into distilled water for 7 days
2	0.25 (6.35)	MIL-P-5425 Acrylic, Apply adhesion promoter	2 panels into distilled water for 7 days
2	0.25 (6.35)	MIL-P-25690 Acrylic, Apply adhesion promoter	2 panels into distilled water for 7 days
2	0.25 (6.35)	MIL-P-83310 Polycarbonate, Apply adhesion promoter	2 panels into distilled water for 7 days
2	0.25 (6.35)	MIL-G-25667 Glass, Type I, Apply adhesion promoter	2 panels into distilled water for 7 days
2	0.25 (6.35)	MIL-P-8184 Craze Resistant Acrylic, Apply adhesion promoter	2 panels into distilled water for 7 days