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AEROSPACE MATERIAL SPECIFICATION

SAE AMS-S-29574 | REV. A

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Superseded by AMS3277

Sealing Compound, Polythioether, for Aircraft Structures, Fuel and High Temperature Resistant, Fast Curing At Ambient and Low Temperatures

RATIONALE

Technical requirements of this specification have been incorporated into AMS3277. This specification was never used for reference or material purchase since MIL-S-29574 was still active at the time this specification was generated.

CANCELLATION NOTICE

This document has been declared "CANCELLED" as of February 2011 and has been superseded by AMS3277. By this action, this document will remain listed in the Numerical Section of the Aerospace Standards Index noting that it is superseded by AMS3277.

Cancelled specifications are available from SAE.

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NOTICE

This document has been taken directly from U.S. Military Specification MIL-S-29574, Amendment 1, and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-S-29574, Amendment 1. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this SAE technical document.

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1. SCOPE:

1.1 Form:

This specification establishes the requirements for two types and three classes of a two component, fast curing at low and ambient temperature, polythioether sealing compound for use in sealing integral fuel tanks and other aircraft structures. Temperature capabilities are identified in 1.2.1.

1.2 Classification:

The sealing compound shall be classified as follows:

1.2.1 Types: There are two types of sealants furnished to this document. Additionally, Type I is furnished in 3 grades as shown below.

Type I - Fuel resistant sealant for use from -80°F to +300°F (-62°C to +149°C) with intermittent use to +400°F (204°C).

Grade A - For general use in fuel tanks and aircraft structures

Grade AI - Ambient cure or immediate heat cure at temperatures up to 350°F (175°C) immediately after application. Available as Class B and Class C.

Grade B - Enhanced craze resistance, for use with acrylic aircraft transparencies.

Type II - Corrosion inhibitive, fuel resistant sealant for use from -80°F to +300°F (-62°C to +149°C) with intermittent use to +360°F (+182°C).

1.2.2 Classes:

Class A - Suitable for brush application
Class B - Suitable for application with extrusion gun or spatula
Class C - Suitable for faying surface sealing applications

1.2.3 Application time: The minimum application time in hours for each class shall be:

Class A - 1/4, 1/2, 2
Class B - 1/4, 1/2, 2
Class C - 4

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. Unless otherwise specified, the applicable issue of other publications shall be the issue in effect on the date of the purchase order.

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2.2 U.S. Government Publications:

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

L-P-378	Plastic Sheet and Strip, Thin Gauge, Polyolefin
Q-S-1926	Sodium Chloride, Technical
P-D-680	Dry Cleaning Solvent
QQ-A-250/4	Aluminum alloy, 2024, Plate and Sheet
QQ-A-250/12	Aluminum Alloy 7075, Plate and Sheet
QQ-A-250/13	Aluminum Alloy Alclad 7075, Plate and Sheet
QQ-P-416	Plating, Cadmium (Electrodeposited)
PPP-B-636	Box, Shipping, Fiberboard
PPP-C-96	Can, Metal, 28 Gage and Lighter
PPP-D-729	Drums, Shipping and Storage, Steel 55 Gallons (208 Liters)
PPP-P-704	Pails, Metal, Shipping, Steel, 1 Through 12 Gallons
MIL-S-5002	Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems
MIL-S-5059	Steel, Corrosion Resistant (18-8) Plate, Sheet and Strip
MIL-C-5541	Chemical Conversion Coatings on Aluminum Alloys
MIL-D-6998	Dichloromethane, Technical
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number 0-148
MIL-P-8184	Plastic Sheet, Acrylic, Modified
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-S-8802	Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion
MIL-T-9046	Titanium and Titanium Alloy, Sheet, Strip and Plate
MIL-A-9962	Abrasive Mats, Non-Woven, Non-Metallic
MIL-L-10547	Liner, Case, and Sheet, Overwrap, Water Vaporproof or Waterproof, Flexible
MIL-P-23377	Primer Coating, Epoxy Polyamide, Chemical and Solvent Resistant
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engines, Synthetic Base
MIL-P-25690	Plastic, Sheets and Parts, Modified Acrylic Base, Monolithic, Crack Propagation Resistant
MIL-C-27725	Coating, Corrosion Preventive, for Aircraft Integral Fuel Tanks
MIL-S-38714	Packaging and Packing of Two-Component Materials in Semkits
MIL-C-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-C-83286	Coating, Urethane, Aliphatic Isocyanate, for Aerospace Applications
MIL-C-83430	Sealing Compound, Integral Fuel Tanks and Fuel Cavities, Intermittent Use to 360°F (182°C)
MIL-C-87962	Cloths, Cleaning, for Aircraft Fuel Tanks
FED-STD-313	Material Safety Data Sheets, Preparation and Submission of
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-147	Palletized Unit Loads

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2.3 ASTM Publications:

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

ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM B 117	Method of Salt Spray (Fog) Testing
ASTM D 412	Rubber Properties in Tension
ASTM D 2240	Rubber Property Durometer Hardness

2.4 SAE Publications:

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

AMS 2629	Jet Reference Fluid
AMS 4377	Magnesium Alloy, Sheet and Plate, 3.0 Al 1.0 Zn, Cold Rolled, Partially Annealed (AZ31B-H26)
AMS 3166	Solvents, Cleaning, Cleaning Prior to Application of Sealing Compounds (DoD Adopted)

2.5 Uniform Classification Committee, Agent Publications:

Available from Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.

Uniform Freight Classification

2.6 National Motor Freight Traffic Association, Inc., Agent Publications:

Available from American Trucking Association, Traffic Department, 2200 Mill Road, Alexandria, VA 22314.

National Motor Freight Classification

2.7 Order of precedence:

In the event of conflict between the text of this document and the references cited herein (except for elated associated detail specifications, specification sheets or MS standards(, the text of this document takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS:

3.1 Bid sample:

The sealing compounds furnished under this specification shall be products which have been evaluated in response to an invitation for bid. The evaluation shall be completed before the award of the contract (see 4.3 and 6.3).

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3.2 First article:

When specified (see 6.2.1), the sealing compound shall be subjected to first article inspection in accordance with 4.4.

3.2.1 Toxicological formulations: The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate medical service who will act as an advisor to the contracting agency.

3.3 Materials:

The sealing compound shall consist of a base compound which will cure to an elastomeric state upon addition of a separate curing agent.

3.3.1 Base compound: The base compound shall be primarily a synthetic polymer of the polythioether type. Neither the base compound nor the cured sealant shall be red or pink in color.

3.3.2 Curing agent: The curing agent shall be of sufficiently different color from the base compound to easily identify an incompletely mixed system. Type II curing agent shall have an added soluble chromate ion for corrosion inhibition.

3.3.3 Primer: A primer, as recommended by the manufacturer, is required. The primer shall be included as part of the package (see 5.1.1.1.1).

3.4 Examination of product:

After mixing and extrusion, the compound shall be uniform, free of skins, lumps, gels or coarse particles.

3.5 Properties before cure:

3.5.1 Viscosity of base compound: The viscosity of the base compound, when tested in accordance with 4.10.2 shall be as follows:

Class A - 100 to 500 poises (10 to 50 pascal seconds (Pa.s))
Class B - 9,000 to 18,000 poises (900 to 1800 Pa.s)
Class C - 1,000 to 4,000 poises (100 to 400 Pa.s)

3.5.2 Application time: The application time of the mixed sealing compound shall be as designated in 1.2.3. When tested as specified in 4.10.3, the viscosity or extrusion rate for the stated application item (see 1.2.3) shall be as follows:

Class A - 2,500 poises (250 Pa.s) max.
Class B - 15 grams per minute, min.
Class C - 30 grams per minute, min.

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3.5.3 Tack-free time: When tested in accordance with 4.10.4, the mixed sealing compound shall cure to a tack-free condition in not more than the time in hours specified in the applicable portions of Tables I or II.

3.5.4 Assembly time (Class C): When tested in accordance with 4.10.5, the mixed Class C sealing compound shall have an assembly time of not less than 4 hours. The sealant shall squeeze out to a thickness of 0.005 inch (.13mm) or less at the bolts.

3.5.5 Flow (Class B only): When tested as specified in 4.10.6, the class B sealing compound shall flow within the limits of 0.1 to 0.75 inch (2.5 to 19 mm) within the specified test time.

3.5.6 Cure rate characteristics (see 4.8.1):

3.5.6.1 Standard temperature cure rate: After curing as specified in 4.10.7, the instantaneous hardness shall be as specified in the applicable portion of Table I.

Table I. Standard temperature cure characteristics 1/ 2/

Property for Application time of-	Class A 1/4	1/2	2	Class B 1/4	1/2	2	Class C 4
Cure time, hours	1.5	3	14	1.5	3	14	24
Hardness, pts, min	25	25	25	30	30	25	30
Tack free time, hours, min	1	1.5	9	1	2	9	--
Assembly time, hours, min	-	-	-	-	-	-	8
Pressure Rupture, psi, (kPa), min	20 (138)	-	-	25 (175)	-	-	--

1/ All specimens cured at standard conditions (see 4.9.7).
2/ the "-" indicates no requirement for that property.

3.5.6.2 Low temperature cure rate (Class A-1/4 and 1/2; B-1/4 and 1/2 only: After curing as specified in 4.10.8, the instantaneous hardness shall be as specified in the applicable portion of Table II.

3.5.6.3 Fluid immersed curing rate (Class A-1/4 and 1/2; B-1/4 and 1/2 only: When tested in accordance with 4.10.9, A-1/4 and B-1/4 sealing compounds shall have a hardness of not less than 25 after curing for 2 hours and not less than 35 after curing for 4 hours. Class A-1/2 and B-1/2 hardness shall be not less than 25 after 3 hours and not less than 35 after 6 hours cure.

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Table II. Low temperature curing characteristics

Property at Cure temperature of -	Class A				Class B			
	40°F		20°F		40°F		20°F	
Application time	1/4	1/2	1/4	1/2	1/4	1/2	1/4	1/2
Cure time, hours	4	8	8	16	4	8	8	16
Hardness, pts., min	20	20	20	20	25	25	25	25
Tack free time, hours	3	3	6	6	3	6	6	6
Pressure rupture, psi, (kPa), min.	20 (138)	20 (138)	20 (138)	20 (138)	25 (175)	25 (175)	25 (175)	25 (175)

3.5.7 Pressure rupture (Class A-1/4 and -1/2; B-1/4 - 1/2 only: Low temperature and standard cure test specimens shall be tested as specified in 4.10.10. Conformance to the appropriate section of Table I or Table II as noted.

3.5.8 Nonvolatile content: The minimum percent nonvolatile content of the freshly mixed sealing compound, when tested as specified in 4.10.11 shall be as follows:

Class A - 84 percent
Class B - 97 percent
Class C - 98 percent

3.6 Properties after cure (see 4.8.2 for cure cycle):

3.6.1 Specific gravity: The specific gravity of the cured polythioether material shall be no greater than 1.50 when determined in accordance with 4.10.12.

3.6.2 Hardness: When tested in accordance with 4.10.13, the sealing compound shall have a hardness of not less than 40.

3.6.3 Peel strength: The as received peel strength of the sealing compound, when tested as specified in 4.10.14, shall be 20 pounds per inch width minimum. After immersion values shall be 20 pounds per inch width minimum or type I, and 15 pounds per inch width minimum for Type II. There shall be 100 percent cohesive failure of all test specimens.

3.6.4 Repairability: The sealing compound shall repair minor breaks in itself and other polythioether sealing compounds qualified to this specification. Additionally, these compounds shall repair polysulfide sealing compounds. A coat of sealing compound, applied over a cured and aged film of polythioether or polysulfide material as specified in 4.10.15, shall show satisfactory bonding, no lifting, blistering, loss of adhesion or other film irregularities. The film shall have a 10 pounds per inch width minimum peel strength, except Grade B to polysulfide shall be 5 pounds per inch width.

3.6.5 Tensile and elongation properties (classes B and C): When tested as specified in 4.10.16, tensile and elongation properties shall be in accordance with Table III.

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3.6.6 Shear strength (class C only): The shear strength of the cured sealing compound shall be not less than 200 psi (1,380 kPa) when tested as specified in 4.10.17. At least 75 percent of the area of separation produced in the shear test specimens shall be within the sealing compound.

3.6.6.1 Shear strength after heat reversion test (class C only): When tested as specified in 4.10.17.1 the sealant shall remain elastomeric. The conditioned material, when evaluated in 4.10.17, shall have a minimum shear strength of 100 psi (690 kPa). At least 75 percent of the area of separation produced in the shear test specimens shall be within the sealing compound (cohesive failure).

3.6.7 Low-temperature flexibility: The compound shall withstand the bend test as specified in 4.10.18 without cracking, checking, or loss of adhesion.

Table III. Tensile strength and elongation. (Classes B and C only)

Condition	Tensile strength, psi (kPa) Min.	Elongation, % Min.
As cured (4.9.16.1)	250 (1725)	250
14-day immersion in jet reference fluid at 140° ± 2°F (60° ± 1° C) (4.10.16.2)	125 (862)	150
2 hours at 420° ± 5°F (215° ± 3°C) (4.10.16.3)	150 (1035)	100
72 hours immersion in jet reference fluid at 140° ± 2° F (60° ± 1° C), followed by 72 hours air-drying at 120° ± 2° F (49° ± 1° C), followed by 7 days at 300° ± 5° F (149° ± 3° C) or 141° ± 3° C (285° ± 5° F) for A-1/4 and B-1/4 (4.10.16.4)	150 (1035)	50
Standard heat aging, followed by 7 days immersion in jet reference fluid at 140° ± 2° F (60° ± 1° C) (4.10.16.5)	100 (690)	50

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3.6.8 Resistance to thermal rupture: When tested in accordance with 4.10.19, the sealing compound shall retain a pressure of 10 pounds per square inch (psi) (70 kPa) with no more than 5/32 inch (4 mm) deformation.

3.6.9 Chalking: The sealant shall not chalk when tested in accordance with 4.10.20 in jet reference fluid containing metal ions.

3.6.10 Hydrolytic stability: When tested for hardness after exposure as specified in 4.10.21, the specimens shall retain 80 percent of their original hardness.

3.6.11 Corrosion: When tested in accordance with 4.10.22, there shall be no corrosion under the sealing compound and the sealing compound shall show no sign of deterioration.

3.6.12 Soluble chromate ion (Type II only): When tested in accordance with 4.10.23, the curing agent for Type II compound shall contain 3.0 percent minimum added free chromate ion available for corrosion inhibition.

3.6.13 Craze Resistance (Type I Grade B only): When tested as specified in 4.10.24, the sealing compound shall not cause the stressed acrylic specimens to craze, crack or cause other chemical degradation.

3.6.14 Properties after immediate heat cure (Type I Grade C only):

3.6.14.1 Sponging: The test specimen shall show no visible evidence of blowing, sponging, or other chemical degradation when examined after sectioning as specified in 4.10.25.1.

3.6.14.2 Shear strength: Shear strength of the type I, grade C compound after curing as specified in 4.10.25.2 shall be not less than 200 psi (1380 kPa).

3.6.15 Weight loss and flexibility: When tested in accordance with 4.10.26, the sealing compound shall not lose more than 4.0 percent by weight and shall not crack when bent through 180 degrees over a 1/8 inch mandrel.

3.7 Storage requirements:

3.7.1 Long term storage: After storage as specified in 4.10.27.1, the sealing compound shall meet all the requirements specified for accelerated storage (3.7.2) and Tables I and II, as applicable.

3.7.2 Accelerated storage stability: After storage in accordance with 4.10.27.2, the base compound shall show no shrinking, hardening, separation, nor settling of the material upon visual inspection. It shall meet the viscosity requirement in 3.5.1. The aged curing compound shall not be adversely affected and shall be capable of being restored by normal agitation to a condition suitable for use. The aged base compound and the aged curing compound, when mixed, shall meet the requirements for flow (3.5.5), cure rate (3.5.6), application time (3.5.2), assembly time (3.5.4), tack-free time (3.5.3) and shear strength (3.6.6). As received and after immersion peel strength on adherend numbers 5, 7 and 9 (see Table IX) shall be determined. Immersion conditions shall be 7 days at 140° ± 2° F (60° ± 1° C) in the JRF II/3 % NaC1 solution in 4.10.14.3. The peel strength requirement (3.6.3) shall be 20 pounds per inch width minimum for classes A and B and 15 pounds per inch width, minimum for class C.

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4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance: All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.1.1 Source Inspection: Materials procured by the Government under this specification shall be source inspected so there is assurance that the sealing compound meets the quality conformance inspection prior to leaving the manufacturer's plant. Note that the material shall be packaged and mixed in containers specified in Section 5 of this specification.

4.2 Classification of inspections:

The inspection requirements specified herein shall be classified as follows:

a. Bid sample inspection (see 4.3)
b. First article inspection (see 4.4)
c. Quality conformance inspection (see 4.5)

4.3 Bid sample inspection:

The bid sample inspection shall consist of all the tests and inspections specified in Table IV.

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Table IV. Bid sample inspection

Inspection	Requirement	Paragraph	Test
Materials	3.3		4.10.1
Examination of product	3.4		4.10.1
Viscosity	3.5.1		4.10.2
Application time	3.5.2		4.10.3
Tack free time	3.5.3		4.10.4
Assembly time (class C)	3.5.4		4.10.5
Flow (class B)	3.5.5		4.10.6
Curing rate characteristics	3.5.6		4.10.7 4.10.8 4.10.9
Pressure rupture	3.5.7		4.10.10
Nonvolatile content	3.5.8		4.10.11
Specific gravity	3.6.1		4.10.12
Hardness	3.6.2		4.10.13
Peel strength	3.6.3		4.10.14
Repairability	3.6.4		4.10.15
Tensile strength	3.6.5		4.10.16
Elongation	3.6.5		4.10.16
Shear strength	3.6.6		4.10.17
Heat reversion resistance	3.6.6.1		4.10.17.1
Low temp flexibility	3.6.7		4.10.18
Resistance thermal rupture	3.6.8		4.10.19
Chalking	3.6.9		4.10.20
Hydrolytic stability	3.6.10		4.10.21
Corrosion	3.6.11		4.10.22
Soluble chromate ion	3.6.12		4.10.23
Craze resistance 1/	3.6.13		4.10.24
Prop. after immediate heat cure 2/	3.6.14		4.10.25
Weight loss and flexibility	3.6.15		4.10.26
Long term storage	3.7.1		4.10.27
Accelerated storage	3.7.2		4.10.27

1/ Type I, Grade B only.
2/ Type I, Grade C only.

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4.3.1 Bid samples: Bid test samples shall consist of 32 sectional type containers with the proper ratio of sealing compound to curing agent, along with the required primer, for the type and class specified in the Invitation for Bid. The compound and curing agent shall be furnished in containers of the type to be used in filling contract orders as specified in section 5. Samples shall be forwarded to the laboratory designated by the acquisition authorization letter. The samples shall be plainly and durably marked with the following information:

Sample for Bid Testing

Sealing Compound, Polythioether, For Aircraft Structures,
Fuel and High Temperature Resistant, Fast curing
At Ambient and Low Temperatures.

MIL-S-29574(AS)
Type
Grade (for type I compounds)
Class
Date of manufacture
Name and address of manufacturer
Manufacturer's identification (base and curing agent)
Submitted by (name) (date) for Bid tests in accordance with
the requirements of MIL-S-29574(AS) under authorization (reference
authorizing letter) (see 6.3)

4.3.2 Manufacturer's data to be submitted with Bid sample:

4.3.2.1 Test reports: Two copies of the manufacturer's certified test report shall be forwarded along with the bid samples specified in 4.3.1. The report shall show, by actual test results and specific paragraph references, the sealing compound submitted conforms to all the requirements of this specification.

4.3.2.2 Instructions for use: Duplicate copies of the manufacturer's instructions for use of the compound and the appropriate primer shall be furnished with qualification samples for approval.

4.3.2.3 Toxicolgical data: The manufacturer shall furnish the toxicological data required to evaluate the safety of the material for the proposed use through submission of material safety data sheets prepared in accordance with FED-STD-313.

4.3.3 Bid sample approval: After approval of the bid sample, the manufacturer shall not be subject to the Bid Sample process on subsequent Government purchases for a period of three years. After the three year period, the Government may, at its option, require the manufacturer to undergo the bid sample evaluation or request a certification to the effect that the sealing compounds are formulated and prepared as for the first bid sample inspection.

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4.4 First article inspection:

When specified by the acquisition activity (see 6.), the sealing compound shall be subjected to a first article inspection consisting of all the tests and inspections in Table IV.

4.4.1 First article procedures: First article samples and procedures shall be as specified for Bid Sample (see 4.3).

4.5 Quality conformance inspection:

4.5.1 Lot formation: Unless otherwise specified herein or in the contract, a lot shall consist of all the sealing compound formulated from the same components, under essentially the same conditions, forming part of one contract or order, and submitted for acceptance at one time (see 4.1.1.1).

4.5.2 Sampling:

4.5.2.1 Sampling for tests: A sufficient number of containers shall be selected at random to allow preparation of specimens for the tests specified in Table V. The sample shall be examined and tested as specified in 4.5.3.1.

4.5.2.2 Sampling for packaging:

4.5.2.2.1 Unit containers: A random sample of filled containers shall be selected from each lot in accordance with inspection level I of MIL-STD-105 examined as specified in 4.5.3.2. The lot size shall be the total number of containers.

4.5.2.2.2 Shipping containers: Shipping containers, just prior to closure, shall be randomly selected from each lot in accordance with inspection level I of MIL-STD-105 for examination as specified in 4.5.3.2. Lot size shall be the number of shipping containers.

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Table V. Quality conformance testing

Property	Test paragraph
Examination of product	4.10.1
Viscosity of base compound	4.10.2
Application time	4.10.3
Tack free time	4.10.4
Assembly time (C-4 only)	4.10.5
Standard cure rate	4.10.7
Low temperature cure rate	4.10.8
Fluid immersed cure rate	4.10.9
Hardness	4.10.13
Pressure rupture(A-1/4, B-1/4)	4.10.10
Nonvolatile content	4.10.11
Flow	4.10.6
Peel strength 1/	4.10.14
Shear strength	4.10.17
Resistance to thermal rupture	4.10.19
Soluble chromate, Type II, only	4.10.23
Weight loss and flexibility	4.10.26

1/. Initial and after immersion in JRF II/3 % NaCl solution at 140° ± 2° F (60° ± 1° C) for 7 days using adherend number 1 and 7 only.

4.5.3 Testing and examination of quality conformance samples:

4.5.3.1 Testing: The sample selected in 4.5.2.1 shall be tested to the requirements specified in Table V. Nonconformance of a test specimen to a single requirement shall be cause for rejection of the lot represented by the sample.

4.5.3.2 Packaging examination: Samples selected in accordance with 4.5.2.2 shall be visually examined to the requirements in Table VI and all other applicable container specification requirements to determine conformance to section 5 of this specification. The acceptable quality level (AQL) for this inspection shall be 2.5 percent defective except that unit containers with “fill” defects may be corrected. In addition, shipping containers fully prepared for delivery shall be inspected for closure defects.

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Table VI. Packaging examination

Examination	Defect
Unit container:	
Fill	Not volume specified in contract or order.
Packaging	Wrong size kits. Primer package not as specified or missing. Material or construction not as specified. Components damaged or missing. Intermediate package closure incomplete or damaged. Not level required by contract or purchase order.
Shipping container:	
Packing	Not level required by contract or purchase order. Any nonconforming component, incomplete closures. Bulged or damaged shipping containers.
Count	Less than specified or indicated quantity per shipping container.
Markings	Unit and intermediate package and packing--omitted, illegible, incorrect, incomplete, or not in accordance with contract requirements.

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4.6 Test conditions:

4.6.1 Standard conditions: Standard laboratory conditions shall be 77° ± 2° F (25° ± 1°C) and a relative humidity (RH) of 50 ± 5 percent. Unless otherwise specified herein, all mixing curing and testing of the sealing compound shall be at standard conditions.

4.7 Preparation of test specimens:

4.7.1 Cleaning of test panels:

4.7.1.1 Aluminum alloys: Except where otherwise specified herein, aluminum alloy panels shall be cleaned with lint free cheesecloth conforming to MIL-C-87962 using solvent in accordance with SAE AMS 3166. Immediately after rinsing, the panels shall be wiped dry with a clean, lint-free cloth.

4.7.1.2 All other panel materials: All other panels shall be cleaned by first wiping with solvent conforming to that formulated in accordance with SAE AMS 3166, followed by scuffing with abrasive mats conforming to Type I, Class 1, Grade A of MIL-A-9962, and finally cleaned as specified in 4.7.1.1.

4.7.2 Mixing: The sealing compound and curing agent along with all spatulas, molds, and other related equipment shall be conditioned at standard conditions (see 4.6.1) for at least 24 hours. Mixing of the sealing compound shall be at standard conditions and be in accordance with the manufacturer's instructions.

4.8 Curing conditions:

4.8.1 Cure rate characteristic tests: Curing conditions for cure rate characteristics (see 3.5.6) shall be as specified in Table I and Table II. Low temperature specimens shall be mixed at standard conditions followed by curing in the low temperature environment.

4.8.2 Tests other than cure rate characteristics: All sealing compounds shall be mixed as specified in 4.7.2, applied to test panels or other surfaces and allowed to cure for 14 days at standard conditions (see 4.6.1) prior to testing. An alternate cure of 48 ± 1 hours at standard conditions plus 24 ± 1 hours at 140° ± 2° F (60° ± 1° C) may be used.

4.9 Jet reference fluid (JRF-II):

Jet reference fluid shall be in accordance with SAE-AMS2629, Type I, except the chalking test shall use fluid in accordance with SAE-AMS2629, Type II. Fluid older than 90 days shall be retested for mercaptan and total sulfur content before use.

4.10 Test methods:

4.10.1 Examination of product: The sealing compound shall be visually examined for conformance to 3.3. and 3.4.

4.10.2 Viscosity of base compound: The viscosity shall be determined with base compound placed in a 1-pint (0.5-liter) can. The can shall be filled with base compound to within 1/2 inch (12 mm) of the top, then covered and stored at room temperature for at least 8 hours. The base compound shall then be thoroughly mixed by stirring slowly for 3 minutes after which the can shall be closed and the material allowed to stand for 1 hour. The Brookfield Model RVF viscosimeter, or equal, shall be used and the reading obtained converted to poises. For class A base materials, the No. 6 spindle at 10 revolutions per minute (rpm) shall be used; for class B material, the No. 7 spindle at 2 rpm shall be used; for class C materials, the No. 6 spindle at 2 rpm shall be used. The reading shall be taken after the spindle has run in the material for 1 minute. Conformance to 3.5.1 shall be noted.

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4.10.3 Application time:

4.10.3.1 Viscosity (Class A only): The base compound and curing compound shall be stabilized at standard conditions for not less than 8 hours before a sample of the base compound is mixed with the proper amount of curing compound. The mixed compound shall be sufficient to fill a standard 1/2 pt (1/3 L) can, 2-7/8 in. (70 mm) in diameter by 2-7/8 in. (70 mm) high, to within 1/2 in. (12 mm) of the top. This can shall be tightly covered except when testing for the viscosity. At the end of the application time (see 1.2.3), indicated in hours, measured from the beginning of the mixing period, the sealing compound shall be tested for viscosity using a Brookfield Model RVF viscosimeter, or equivalent. The No. 7 spindle, at 10 rpm, shall be used. One reading shall be taken after the spindle has run in the mixed compound for 1 minute.

4.10.3.2 Application time (Class B and C): A sectional cartridge shall be mixed as specified, then allowed to stand (from start of mix) for the application times indicated in 1.2.3. The extrusion rate shall be determined by a 15 second extrusion of the sealing compound into a suitable tared container. The extrusion rate (grams/minute) shall be 4 times the obtained weight of sealing compound.

4.10.4 Tack-free time: An aluminum test panel conforming to temper T6 of QQ-A-250/13 and measuring 0.040 by 2.75 by 6 inches (1 by 64 by 150 mm) in size shall be cleaned in accordance with 4.7.1 and covered with freshly mixed sealing compound to a depth of 1/8 inch (3 mm). The sealing compound shall be allowed to cure till the end of the specified tack-free time (see Table I or II), then two 1 by 6 inch (25 by 150 mm) pieces of polyethylene film 0.004 ± 0.002 inch (.1 ± .015 mm) thick conforming to L-P-378, Type I, Class 1, Grade C, Finish 1, shall be applied to the sealing compound and held in place at a pressure of 1/2 ounce per square inch for 2 minutes. The strips shall then be withdrawn at right angles to the sealing compound surface. The polyethylene shall come away clean and free of sealing compound.

4.10.5 Assembly time (class C only): Six test panels 0.40 by 1-1/2 by 4 inches (1.00 by 38 by 100 mm) in size shall be prepared from aluminum alloy conforming to temper T6 of QQ-A-250/13. Drill two holes with a number 11 drill, 1.2 inches (30 mm) from one end with centers 3/4 inch (20 mm) apart and 3/8 inch (10 mm) from each side. The panels shall be deburred and cleaned in accordance with 4.7.1. Accurately determine the thickness of the panels around the holes. Approximately 0.015 inches (0.40 mm) of freshly mixed sealant shall be applied to the drilled end of three specimens and allowed to cure for 1/2 hour. Place the other cleaned panels on those with sealant so that the holes line up resulting in a one-inch (25 mm) overlap. Sealant shall cover the entire one-inch (25 mm) faying surface overlap area. Two steel bolts (10-32) that have been heat treated to at least 160,000 psi (1.10 Megapascals (MPa) shall be inserted into the holes. The nuts (NAS 679-A3) shall be tightened only until sealant starts to squeeze out. The thickness of the assembly shall be measured at this time and the thickness of the sealant shall be 0.010 to 0.015 inch (0.25 to 0.40 mm). Allow the specimens to be exposed to standard conditions for 8 hours for the class C-4 material. Tighten nuts to a torque value of 40 inch lbs (4.5 Newton meter (N.m). The thickness of the assembly shall be measured at the bolts with a micrometer and from this thickness subtract the thickness of the panels. Evaluate in accordance with 3.5.4.

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4.10.6 Flow (class B only): One cartridge of class B sealing compound and curing agent shall be mixed and prepared for testing in accordance with 4.7.2. The test shall be conducted with a flow-test fixture as shown in Figure 1. Depth of plunger tolerance is critical and shall be controlled within the tolerance during the test.

4.10.6.1 Procedure: The flow-test fixture shall be placed on a table with the front face upward and the plunger depressed to the limit of its travel. Within 10 minutes after the beginning of mixing, enough of the mixed sealing compound shall be extruded from the application gun to fill the recessed cavity of the fixture and leveled off even with the block. Within 10 seconds after the leveling operation, the fixture shall be placed on its end and the plunger immediately advanced to the limit of its forward travel. The flow measurement shall be taken exactly 30 minutes after the sealing compound has been applied to the test fixture. The flow shall be measured from tangent to the lower edge of the plunger to the farthest point to which flow has advanced.

4.10.7 Standard temperature cure rates: All specimens prepared for those characteristics specified in Table I, shall be cured at standard conditions (4.6.1) for the designated cure rate times in Table I.

4.10.8 Low temperature cure rate (class A-1/4, B-1/4 only): All specimens prepared for those characteristics specified in Table II shall be mixed at standard conditions. One-half of the specimens shall be cured in a cold chamber maintained at 40° ± 2° F (4.4° ± 1° C) for 4 hours, the remaining specimens shall be cured at 20° ± 2°F (-6.7° ± 1°C) for 8 hours. All specimens shall be tested within 15 minutes after removal from the chamber.

4.10.9 Fluid immersed curing rate (class A-1/4, -1/2, and B-1/4 -1/2 only: An aluminum test panel conforming to temper T6 of QQ-A-250/13 and measuring 0.040 by 2 3/4 by 6 inches (1.00 by 70 x 150 mm) shall be cleaned in accordance with 4.7.1 and covered with sealing compound to a depth of 1/4 inch (6 mm). After curing the Class A-1/4 and B-1/4 for 1.5 hour and Class A-1/2 and B-1/2 for 3 hours at standard conditions, the test panels shall be immersed in jet reference fluid (see 4.9.) at 77° ± 2° F (25° ± 1° C). The instantaneous hardness shall be determined at the times specified in 3.5.6.3 in accordance with ASTM D 2240.

4.10.10 Pressure rupture (class A-1/4, B-1/4 only):

4.10.10.1 Specimen preparation: A 1 inch (25 mm) diameter by 0.125 inch (3 mm) thick layer of sealing compound shall be molded onto a primed QQ-A-250/13, temper T6 aluminum alloy panel, dimensioned as specified in Figure 2. The specimens shall be cured and conditioned as specified in 4.10.7 or 4.10.8 as applicable, prior to testing.

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4.10.10.2 Test procedure: The test specimen shall be mounted in the pressure rupture fixture as shown in Figure 2. The air hose bib of the apparatus shall be connected, using appropriate tubing, to a pressure gage or manometer, and a variable pressure source. Starting at atmospheric pressure, the pressure on the apparatus shall be uniformly increased at the rate of 0.5 psi per 15 seconds until failure occurs. Failure shall be indicated by a rapid drop in pressure. The pressure applied at the time of failure shall be recorded. Two additional specimens shall be tested in the same manner. The average pressure of the three specimens shall be reported to the nearest 1.0 psi (6.9 kPa).

4.10.11 Nonvolatile content: Five to ten grams of the mixed sealing compound shall be transferred as soon as possible to a dish about 8 centimeters in diameter. A tight fitting cover shall be placed immediately over the dish and the weight determined to the nearest 0.001 gram. The cover shall then be removed and the sealing compound heated for 72 ± 1 hours at 158° ± 2° F (70° ± 1° C). It shall then be cooled in a desiccator, the cover replaced and the weight determined to the nearest milligram. The percent nonvolatile content shall be calculated as follows:

$$\text{Percent nonvolatile content} = \frac{\text{Final Weight}}{\text{Initial Weight}} \times 100$$

4.10.12 Specific gravity: Three specimens, 1/8 by 1 by 2 inches (3 by 25 by 50 mm), shall be prepared in an open mold and cured as specified in 4.7.2. The specimens shall be weighed in air and then in water by means of an analytical or Jolly balance. The specific gravity shall be computed by means of the following formulas:

$$\text{Specific gravity (Analytical balance)} = \frac{\text{Weight in air}}{\text{Weight in air - Weight in water}}$$

$$\text{Specific gravity (Jolly balance)} = \frac{\text{Weight in air}}{\text{Weight in water}}$$

4.10.13 Hardness: Two specimens, 0.25 by 1 by 2 inches (6 by 25 by 50 mm), shall be prepared in an open mold and cured as specified in 4.8.2, instantaneous hardness shall be determined in accordance with ASTM D 2240.

4.10.14 Peel strength:

4.10.14.1 Adherends and surface treatment: The adherends, surface treatment and number of specimens required shall be as specified in Table VII.

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4.10.14.2 Specimen preparation: Test panel materials (0.064 by 3 by 6 inches) (1 by 75 by 150 mm) and the required number of specimens shall be as specified in Table VII. All panels shall be cleaned as specified in 4.7.1 then primed in accordance with manufacturer's recommended procedures. Each panel shall be coated with a 0.125 inch (3 mm) thickness of the sealing compound. A 3 by 6 inch (75 by 150 mm) area of 3 by 12 (75 by 300 mm) inch strips of wire screen (20 to 40 mesh stainless steel or monel wire fabric) shall be cleaned (4.6.1) and primed in accordance with the manufacturer's recommended practice, then impregnated with the sealing compound. The sealant must be worked well into the fabric. The sealant-impregnated end of the fabric shall be placed on the sealant coated panel and smoothed down on the layer of the sealant, taking care not to trap air beneath the fabric. An additional approximate 1/32 inch (1 mm) thick coating of sealing compound shall be applied over the fabric. Curing shall be as specified in 4.8.2.

4.10.14.3 Immersion procedures: After curing, one panel from each material shall be used to determine the initial peel strength (One panel yields two test specimens). All other panels shall be immersed in the respective fluids as identified in Table VIII. Immersion temperature shall be 140° ± 2° F (60° ± 1° C) for the times specified in Table VIII. After expiration of the test period specified in Table VIII, the fluids shall be cooled to standard conditions. The panels shall then be removed and peel strength determined within 10 minutes after removal from the fluids. Two 1 inch (25 mm) wide strips shall be cut lengthwise through the fabric and sealing compound to the panel surface and extended the full length of the loose end of the fabric creating two test specimens for each panel. The edges of the panel shall not be used as one edge of the test strip.

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Table VII. Adherends, surface treatment and specimens for peel strength 1/

Adherend No.	Substrate and surface treat	No. of Panels for Qualification
1	Aluminum alloy, 7075-T6, conforming to QQ-A-250/12, chemically treated with materials conforming to MIL-C-81706, class 1A. To produce coating conforming to MIL-C-5541.	7
2	Aluminum alloy, QQ-A-250/13, T6.	4
3	Aluminum alloy, 7075-T6, conforming to QQ-A-250/12, chemically treated in accordance with MIL-A-8625, type II, class 1 dichromate sealed.	4
4	Stainless steel MIL-S-5059, composition 304, annealed finish 2B.	4
5	Titanium, MIL-T-9046, type III, composition C (6Al-4V).	6
6	Aluminum alloy, 7075-T6, conforming to QQ-A-250/12, chemically treated in accordance with MIL-C-5541. Primed in accordance with MIL-P-23377.	3
7	Aluminum alloy, 7075-T6, conforming to QQ-A-250/12, chemically treated in accordance with MIL-A-8625, type II, class 1, dichromate sealed, and coated with material conforming to MIL-C-27725.	5
8	Acrylic plastic conforming to MIL-P-25690.	2
9	Graphite/Epoxy Composite. Hercules AS/3501-6 or equal	9
10	Magnesium. AMS 4377	6
11	Cadmium plated steel (4130), ASTM A108 plated in accordance with QQ-P-416, CLass 1, Type 2.	6
12	Composite Material GR/BMI T300/V-378	7
13	Aluminum alloy, 7075-T6, conforming to QQ-A-250/12 Chemically treated in accordance with MIL-A-8625, Type II, Class 1, dichromate sealed and coated with MIL-C-83286 materials, and lightly abrade.	6

1/. Type I, Grade B materials shall be tested for adherend numbers 1, 3, 6, and 9 only.

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Table VIII. Immersion fluids, exposure times and panels exposed 1/

Fluid	Specification	Exposure time (days)	Adherend No's. exposed (see Table VIII)
Jet reference fluid	see 4.8	70 2/	5,7,9
Jet reference/ NaCl 3%	see 4.8	70 2/	5,7,9
Jet reference fluid	see 4.8	7	1,2,3,4,5,7,9,10, 11 and 12
Jet reference/ NaCl 3%	see 4.8	7	1,2,3,4,5,7,9 and 12
NaCl 3%	O-S-1926	2	1,2,3,4,5,6,8,9, 10,11,12 and 13
Hydraulic fluid	MIL-H-83282	2	1,9,10,11,12,13
Lubricating fluid	MIL-L-7808	2	1,9,10,11,12,13
Lubricating fluid	MIL-L-23699	2	1,9,10,11,12,13
Jet reference fluid	See 4.8	2	6,13

1/ Type I, Grade B materials shall be tested with adherends1,3,6, and 9 only.
2/ Fluids are to be changed every 14 days and replaced with fresh.

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4.10.14.4 Test procedure: The specimens shall be individually tested in an autographic testing machine whose capacity shall be such that the tension at failure is not more than 85 percent nor less than 15 percent of the full scale load. If the machine is of the pendulum type, the weight shall swing as a free pendulum without engagement of the pawls. The rate of separation of the paws shall be 2 inches (50 mm) per minute. Specimens shall be mounted in the machine so that the loose end of the 1 inch (25 mm) wide fabric strip will be folded 180 degrees as it is pulled from the panel. Each strip shall be pulled as follows: A cut through the sealant to the panel at the junction of separation shall be made at an angle of 45° in the direction of separation. If the sealant separates from the fabric, similar 45 degree cuts shall be made to promote separation of the sealant from the panel. A minimum of 5 cuts shall be made. The adhesion, in pounds (kg), shall be automatically recorded on a chart as a continuous curve. The adhesion value shall be calculated by averaging the maximum forces required to separate the sealant from the panel.

4.10.15 Repairability: A 3 by 6 by 0.064 inch (75 by 150 by 1.6 mm) aluminum alloy panel, QQ-A-250/13, temper T6, shall be coated with a 1/8 inch (3 mm) thickness of the sealing compound. Curing shall be as specified in 4.7.2. The panel shall be placed in an air circulating oven and conditioned for 48 ± 1 hours at 180° ± 2° F (82° ± 1° C). The specimen shall be removed from the oven and returned to standard conditions. A sufficient number of 3 by 6 by 0.064 inch (75 by 150 by 1.6 mm) aluminum alloy panels conforming to QQ-A-250/13, temper T6 shall be used so that there are 2 panels for each of the following:

a. Previously qualified polythioether sealing compounds
b. A polysulfide material conforming to MIL-S-8802 or MIL-S-83430.
c. The sealing compound undergoing qualification testing

Two panels shall be coated with a 1/8 inch (3 mm) thickness of the appropriate sealing compound from the above. All panels shall be cured using the accelerated procedure specified in 4.8.2. After cure, 1 panel of each sealing compound (the sealant undergoing test and those from (a), (b), and (c) above) shall be conditioned as follows:

a. Immersion in JRF-II for 3 days at 140° ± 2°F (60° ± 1°C)
b. Air dry for 3 days at 120° ± 2°F (49° ± 1°C)
c. Heat age in air for 3 days at 250° ± 2°F (121° ± 1°C)

All panels, conditioned and non-conditioned shall be cleaned with solvent specified in 4.7.1, air dried for 2 hours, primed and another coat of the sealant undergoing qualification shall be applied as above over the previously cured sealant. A 3 by 6 inch (75 by 150 mm) area of a 3 by 12 inch (75 by 300 mm) strip of wire mesh shall be impregnated with the sealing compound. An additional 1/32 inch (1 mm) thick coating of sealing compound shall be applied over the wire mesh. After the 14 day cure period specified in 4.8.2, the specimen shall be tested as specified in 4.10.14.

4.10.16 Tensile and elongation properties: Tensile strength and elongation shall be determined “as cured”, after fluid immersion, after heat aging, after combinations of heat/fluid immersions and a standard heat cycle as specified below in 4.10.16.1 thru 4.10.16.5. Testing shall be in accordance with ASTM D 412, with specimens cut using Die C from 0.100 inch ± 0.015 inch (2.5 ± 0.4 mm) thick molded slabs cured as specified in 4.8.2. Obtained values shall be in accordance with Table IV.

4.10.16.1 As cured: Five as cured specimens shall be conditioned as specified in 4.6.2 prior to determining tensile strength and elongation.

4.10.16.2 After fluid immersion: Specimens shall be immersed in Jet Reference Fluid (JRF-II) (see 4.9) for 14 days at 140° ± 2° F (60° ± 1° C) prior to testing. The volume of the fluid shall be not less than 20 times the volume of the specimens. Specimens shall not touch one another or the side of the vessel while immersed.

4.10.16.3 After heat aging: Tensile specimens shall be exposed in an air circulating oven for 2 hours at 400° ± 5° F (204° ± 3° C), cooled to standard conditions, then tested.

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4.10.16.4 Fluid/dry heat cycle: Specimens shall be immersed in JRF-2 (4.8) for 72 hours at 140° ± 2° F (60° ± 1° C) followed by air drying at 120° ± 2° F (49° ± 1° C) for 72 hours, then heat aged for 7 days at 285° ± 5° F (140° ± 3° C) prior to testing.

4.10.16.5 Standard heat cycle: Standard heat cycle shall consist of the following:

1 hour at 320° ± 5° F (160° ± 3° C)
30 minutes at 360° ± 5° F (182° ± 3° C)
15 minutes at 420° ± 5° F (216° ± 3° C)

Repeat these conditions for a total of 6 cycles, followed by immersion in JRF-II for 7 days at 140° ± 2° F (60° ± 1° C)

4.10.17 Shear strength (class C only): Six test panels 0.040 by 1 by 3 inches (1.00 by 25 by 75 mm) in size shall be prepared from aluminum alloy conforming to temper T6 of QQ-A-250/13. All panels shall be cleaned as specified in 4.6.1 and primed in accordance with manufacturer's recommendation. Apply a coat of sealant 0.010 to 0.020 inch (0.25 to 0.50 mm) thick to one end of three panels covering approximately 1 inch (2.5 cm) on each panel. Overlap the sealant with another panel making a 1 square inch (6.45 square cm) lapshear test specimen. Reduce the thickness of the sealant to 0.005 to 0.010 inch (0.13 to 0.25 mm). Cure the sealant as specified in 4.7.2 and determine the shear strength by pulling in shear at a speed of 2 inches (50 mm) per minute.

4.10.17.1 Heat reversion resistance (class C only): Two aluminum test panels anodized and coated with 0.001 inch (0.25 mm) of MIL-C-27725, measuring 0.020 x 3 x 12 inches (0.5 x 75 x 300 mm) shall be coated with freshly mixed sealing compound applied over one coated surface of one panel and the other panel positioned over the sealant covered surface to form a sandwich with a layer of sealing compound approximately .010 inch (.025 mm) thick. The panels shall be given a standard cure (per 4.8.2) then shall be exposed to 2 hours at 204° C ± 2° (400° ± 5°F). The panels shall be cooled to room temperature and then shall be pulled in shear at a speed of 2 inches per minute and inspected to the requirements of 3.5.6.1.

4.10.18 Low-temperature flexibility: Primer and sealing compound shall be applied to one side of each of the three 7075-T6 aluminum panels conforming to QQ-A-250/12, treated with MIL-A-8625, Type I, measuring 1 inch by 6 inches by 0.032 inch (25 by 150 by 1 mm) in a manner which shall produce a thickness of approximately 0.075 inch leaving 1 inch (25 mm) at each end of the panels uncoated. Upon completion of the curing time (4.8.2), the panels shall be immersed in JRF-2 solution at 140° ± 2° F (60° ± 1° C) for 120 ± 4 hours, followed by 160° ± 2° F (71° ± 1° C) for 60 ± 4 hours, followed by 180° ± 2° F (82° ± 1° C) for 6 ± 1 hours. After fuel immersion, the panels shall be dried at 120° ± 2° F (49° ± 1° C) for 72 ± 2 hours. The panels shall then be placed in a flexibility fixture as shown in Figures 3 and 4 so that the uncoated side will contact the contour block and the weight will contact only the uncoated end of the panel. The flexibility fixture and panels shall be subjected to a conditioning temperature of -80° ± 2° F (-62° ± 1° C) for 4 hours. After the specified conditioning, the specimens shall then be bent around the curved portions of the flexibility fixture by releasing the fastening hook. The panels shall be removed and examined for conformance to 3.5.7.

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4.10.19 Resistance to thermal rupture: Two specimens shall be prepared, each having a fillet 1/8 inch (3 mm) by 2 inches (50 mm) in diameter applied to a test panel. The test panels shall be temper T81 of QQ-A-250/4 and shall be 0.040 by 3-1/2 by 3-1/2 inches (1.00 by 90 by 90 mm) in size with a hole 1/4 inch (6 mm) in diameter in the center of the panel. Panels shall be cleaned and primed in accordance with the manufacturer's instructions. The sealant fillets shall be cured for 14 days ± 4 hours at standard conditions. One of the panels shall then be placed in jet reference fluid for 120 ± 4 hours at 140° ± 2° F (60° ± 1° C) followed by for 60 ± 4 hours at 160° ± 2° F (71° ± 1° C) and 6 ± 1 hours at 180° ± 2° F (82° ± 1° C). The panel shall be removed from the fluid and immediately applied, using a suitable gasket, to the test fixture shown in Figure 5. The panel shall be so positioned on the fixture that the sealant is within the fixture chamber. The fixture shall be placed in an oven at 400° ± 5° F (204° ± 2° C). Using dry air, immediately apply 10 psi air pressure using an air regulator to maintain a constant pressure. The clamp fixture shall be maintained in the oven for 60 ± 2 minutes after the pressure is applied. With the clamp jig still in the oven and the pressure still applied, deformation shall be measured from the surface of the test panel not exposed to pressure to the point of maximum deformation of the sealant. Repeat the test on the panel that was not immersed in jet reference fluid. Both panels shall meet the requirements of 3.5.8.

4.10.20 Chalking: Four 1/8 by 1/8 by 5 inch (3 by 3 by 125 mm) specimens shall be cut from a sheet of the sealing compound that has been cured for 14 days at standard conditions (see 4.8.2). Four specimens will be suspended in a closed container with 900 ml of jet reference fluid containing metal ions so that the specimens are totally immersed in the fluid. The test temperature shall be 140° F (60° C) and the test duration shall be seven days. The fluid shall be changed after 96 hours during the test period. The specimens shall be allowed to remain at standard conditions after testing is completed until the fluid evaporates (do not blot or wipe dry). After evaporation the specimens shall be examined for chalking.

4.10.21 Hydrolytic stability:

4.10.21.1 Specimen preparation: Sufficient base compound and curing agent shall be mixed to prepare 3 molded test specimens, 2.5 inch diameter by 0.5 inch (62.5 by 12.5 mm) thick. Each specimen shall be subjected to cure of 4.8.2. Instantaneous hardness shall be determined using a type A durometer in accordance with ASTM D 2240. Hardness shall be determined at the same locations, before and after exposure.

4.10.21.2 Procedure: After determining hardness before exposure, the specimens shall be placed vertically on a tray in a suitable glass desiccator. The desiccator shall contain a glycerine (22 percent by weight) in water solution, in the bottom, which shall produce a relative humidity (RH) of 95 percent at the test temperature. The desiccator, containing the specimens, shall then be closed and inserted into an air circulating oven maintained at 160° ± 2° F (71° ± 1° C) for a period of 120 days ± 4 hours. At the end of the exposure period, the desiccator shall be removed from the oven and cooled to standard conditions for 14 days. Hardness shall be determined as specified in 4.9.13 and the obtained values for each specimen shall be in accordance with the requirements of 3.5.10.

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4.10.22 Corrosion:

4.10.22.1 Type I (All Grades): Two aluminum alloy panels, conforming to QQ-A-250/12, temper T6, 3 by 6 by 0.065 inch (75 by 150 by .3 mm), shall be cleaned as specified in 4.6.1 and primed in accordance with manufacturer's recommendation then coated with a 1/8 inch (3 mm) thickness of the sealing compound. After curing as specified in 4.8.2, one panel shall be completely immersed in a two phase liquid system consisting of jet reference fluid (see 4.8) and 3 percent aqueous sodium chloride solution for 14 days at 140° ± 2° F (60° ± 1° C). The other panel shall be kept at standard conditions for 14 days. At the expiration of the immersion period, the sealant shall be stripped from the panel with dichloromethane conforming to MIL-D-6998. Immediately upon removal of the sealant from the panel, comparison shall be made with the coated panel not subjected to the immersion test, for conformance to the requirement specified in 3.5.11.

Table IX. Mixed metal assemblies

Assembly	Metal B (Figure 6)	Metal A (Figure 6)
1	Aluminum 1/	Titanium 2/
2	Aluminum 1/	Magnesium 3/
3	Aluminum 1/	Cadmium 4/

1/ Conforming to QQ-A-250/12 treated with Class 1A materials conforming to MIL-C-81706.
2/ MIL-T-9046, Type III, Composition C (6 Al -4V)
3/ AMS 4377, treated with Class 1A materials conforming to MIL-C-81706
4/ QQ-P-416, Cadmium plated surface

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4.10.22.2 Type II: Corrosion testing shall consist of mixed metal panels, prepared as specified below, undergoing exposure in a corrosive environment.

4.10.22.2.1 Mixed metal assemblies: All classes shall be subjected to mixed metal corrosion testing. Three assemblies, as shown in Table IX, configured as shown in Figure 6, shall be used for each sealant. Five to seven mils of sealant shall be applied to one side of each metal as shown in Figure 6. The coated portions shall be mated using inert non-metal fasteners (e.g. nylon), tightened to produce a total sealant thickness of approximately 7 mils. Excess sealant shall be carefully removed from the panel surface. Type II Class C sealant shall not be mated until 1 to 2 hours after the panels are coated. Assemblies shall be exposed as specified in 4.10.22.2.2.

4.10.22.2.2 Exposure: The mixed metal assembly shall be exposed for a period of 4 weeks in a salt-$S0_2$ spray cabinet meeting the requirements of ASTM B 117 Appendix 1. The test shall be conducted under the following conditions:

Salt solution	5% by weight sodium chloride
Cabinet temperature	95° ± 2°F (35° ± 1°C)
Saturator tower temperature	115° ± 2°F (46° ± 1°C)
Cycle	Continuous spray; $S0_2$ injected for one hour in every six hours (4 X daily) at a flow rate of 1 cc/min ft^3 of box volume.

NOTE: The collected solution in the cabinet shall be tested weekly and shall conform to the following conditions:

(1) 1 to 2 mls/hr collection rate.
(2) pH of 2.5 to 3.2.
(3) Specific gravity 1.02 to 1.04.

4.10.22.2.3 Evaluation: When removed from the exposure cabinet, each assembly shall be disassembled. The sealant shall be visually examined for obvious degradation. After the sealant has been carefully from the surfaces each metal shall be examined for corrosion and compliance to 3.5.11.

4.10.23 Soluble chromate content:

4.10.23.1 Sample preparation: A minimum of 25 grams of sample cured in accordance with 4.8.2 shall be filed off such that all of the sealant will pass through an ASTM No. 40 sieve (0.165 inch screen size) or equivalent. A small portion shall be sifted. A 5 gram sample of filed, sifted material shall be place in a 250 ml erlenmyer flask and 100 ml of distilled water shall be added. The sample shall then be covered with a watchglass, placed on a hot plate, and boiled for 1 hour. After boiling for the time specified, the flask shall be removed from the heat and the liquid decanted into a 500 ml flask. The flask and sealant shall be rinsed with 5 to 10 ml of distilled water. The boiling procedure shall be repeated three times for a total of 4 extractions.

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4.10.23.2 Titration: After the filtrate collected above has cooled to ambient temperature, 10 ml of concentrated hydrochloric acid and 2 grams of potassium iodide shall be added to the solution, then covered immediately and allowed to stand for a minimum of 5 minutes. The solution shall be titrated with 0.1N sodium thiosulfate until the brown color of iodide is almost gone. Add 2 ml of freshly prepared starch solution and continue titrating until the dark blue color of the iodine-starch solution is gone. Do not mistake the green color of Cr+ for the blue color of the iodine-starch complex. The volume in ml of sodium thiosulfate shall be recorded. Percentage of soluble chromate shall be calculated as magnesium chromate pentahydrate as follows:

$$\frac{(\text{ml } Na_2S_20_2) \times (\text{N } Na_2S_20_2) \times (0.0768)}{\text{Wt. of sample in grams}} \times 117.6 = \%Mg\ Cr0_4 \cdot 5H_20$$

4.10.24 Craze resistance: Four acrylic specimens conforming to MIL-P-8184 and four specimens conforming to MIL-P-25690 shall be tested. MIL-P-8184 acrylics shall be annealed for 2 hours at 248°± 2°F (120° ± 1°C), then cooled in air for 1 hour. All specimens shall then be totally immersed in deionized/distilled water for 24 hours at 120°± 2°F (49° ± 1°C). The specimens shall be transferred to 73°± 2°F (23° ± 1°C) water for 2 to 3 hours, then removed from the water, wiped, to remove excess water, and inserted into the test fixture. Each specimen shall be stress loaded with the weight used determined as indicated in Figure 7. The specimens shall be stressed for 10 minutes, then examined for obvious crazing. Three of the four specimens from each material shall be coated with the type III sealant directly above the central fulcrum extending to a point 1 inch on either side. The sealant shall be approximately 1/16 inch thick and shall be covered with a polyethylene film. The sealant shall be applied within 1/16 inch of the side edges of the specimen. The fourth specimen shall be the control. The specimens shall remain stressed for 24 hours ± 10 minutes at 75°± 5°F (23° ± 2°C). After this period, the sealant shall be removed for each specimen using an acrylic spatula and dry cleaning fluid conforming to P-D-680. The specimens shall be examined as shown in Figure 7 for evidence of crazing, cracking, or other chemical degradation while still in the stressed mode.

4.10.25 Properties after immediate heat cure:

4.10.25.1 Sponging: Three type I, grade A-1 specimens shall be prepared in an open mold 0.25 by 1 by 2 inches (6 by 25 by 50 mm) then covered with an appropriate plastic film. The filled, covered molds shall be placed in an oven for 1 hour ± 2 minutes at 302°± 5°F (150° ± 2°C). Upon completion of the heating, the specimens shall be cooled to standard conditions and removed from the mold. The specimen shall then be sectioned using a knife or other sharp instrument and examined for internal chemical blowing, sponging or other chemical degradation or non-curing.

4.10.25.2 Type I, grade A-1 shear strength: Specimens shall be prepared and tested as specified in 4.9.17, except that curing shall be 1 hour at 302°± 5°F (150° ± 2°C).

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4.10.26 Weight loss and flexibility: Four 0.125 by 1 by 5 inch (3 by 25 by 125 mm) specimens shall be cut from a sheet of the sealing compound that has been cured for 14 days at standard conditions (see 4.5.1). The specimens shall be weighed (W_1) and immersed in 900 milliliters (ml) of JRF II (see 4.9.1) at 140°± 2°F (60° ± 1°C) in a closed container for a period of seven days. At the end of the exposure period, the specimens shall be removed from the fluid and air dried for 72 hours at 120°± 2°F (49° ± 1°C). The specimens shall then be cooled to standard test temperature in a desiccator and weighed (W_2). After weighing, the specimens shall be bent through 180 degrees over a 0.125 inch (3 mm) diameter mandrel and examined for evidence of cracking.

$$1 - (W_2 / W_1) \times 100 = \% \text{ Loss}$$

4.10.27 Storage characteristics:

4.10.27.1 Long term storage: Sufficient base compound and curing agent to accomplish the following tests shall be stored at standard conditions for 12 months. A the end of this time, the material shall be mixed and tested for application time (4.10.3), tack free time (4.10.4), flow (4.10.6), pressure rupture (4.10.10), shear strength (4.10.17) and initial and after immersion peel strength using panels prepared from adherends 5, 7, and 9. Immersion conditions shall be 7 days at 140°± 2°F (60° ± 1°C) in the JRF II/3% NaC1 solution of Table VIII.

4.10.27.2 Accelerated storage stability: An original, unopened 1 quart (1 liter) container of base compound and an original unopened container of the curing compound shall be stored for 14 days at 120°± 2°F (49° ± 1°C) in a suitably ventilated oven. After cooling at standard conditions for at least 24 hours, the material shall be examined for base compound viscosity (4.10.2), application time (4.10.3), tack free time (4.10.4), flow (4.10.6), pressure rupture (4.10.10), shear strength (4.10.17) and as received and after immersion peel strength using panels prepared from Adherend Numbers 5, 7 and 9. Immersion conditions shall be as specified in 4.10.27.1 for long term storage.

5. PACKAGING:

5.1 Preservation and packaging:

Preservation and packaging shall be level A and C as specified (see 6.2). For specification part number makeup, the following codes shall apply (see 1.3):

Kit size 1/	Code
6 ounce	1
1/2 pint	2
1 pint	3
1 quart	4
1 gallon	5
55 gallon	6

1/ Because of rapid application and cure times, Class A-1/4 and B-1/4 shall be supplied only in sectional type cartridges, Code 1.

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5.1.1 Level A:

5.1.1.1 Unit packaging: The base compound and the curing compound shall be packaged in separate or sectional containers. The containers, closure, lining, or space fillers shall not interact physically or chemically with the contents of the containers so as to alter quantity, strength, quality or purity of the container contents. The ratio of the quantity contained in the base compound container or section to the quantity contained in the curing compound container or section shall be the same as the recommended mixing ratio of the base and curing compounds.

5.1.1.1.1 Individual containers: The container containing the appropriate ratio of the curing compound shall be packaged with the container containing the unit quantity of base compound specified (see 6.2), and an appropriate amount of primer to form a unit of issue kit in a manner that will prevent accidental container separation or mis-identification. The base compound shall be furnished in 1/2-pint, 1-pint, 1-quart, and 1-gallon metal cans conforming to PPP-C-96, in 5 gallon cans conforming to PPP-P-704, or in 55-gallon drums conforming to PPP-D-729, Type III, except that tin plate cans with paper labels may be used unless otherwise specified. The base compound cans through 1-gallon sizes shall be filled to 75 percent capacity with a volume tolerance of ± 6 percent. The air in the unfilled space shall be replaced with nitrogen gas immediately prior to closing the container. Five-gallon pails shall contain 5 gallons of base compound and 55-gallon drums shall contain 50 gallons of base compound. The curing compound shall be furnished in the ratio quantity required by its own unit of issue base compound quantity. It shall be packaged in glass or plastic containers of adequate commercial quality and grade for the 1/2-pint, 1-pint, 1-quart, and 1-gallon sizes. The curing compound for the 5-gallon pails shall be packaged in gallon cans conforming to Type V, Class 2, PPP-C-96 and 55-gallon drums shall be packaged in pails conforming to PPP-P-704. The curing compound glass or plastic containers shall have vertical smooth inside walls and no internal projection or lips exceeding 1/16 inch (1.5 mm). The exterior configuration of all curing compound containers shall not preclude the container to form a kit or unit of issue. Curing compound containers shall be secured to the top of its own base compound container in such a manner as to prevent accidental separation. The curing compound containers for base compound packaged in pails or drum shall be packaged together with base compound containers in containers conforming to PPP-B-636, Type CF, Class Weather Resistant, Variety SW in a manner that will prevent movement and damage to each other. The primer shall be packaged in a glass jar, which shall be closed with an enameled cover and further sealed with cellulose bands of commercial quality, or equivalent.

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5.1.1.1.2 Sectional-type containers: The base compound and curing agent shall be furnished in sectional-type 6-ounce non-metal containers, conforming to MIL-P-38714, as specified in the contract or order. The total content of base compound and curing agent contained in the sectional-type container shall be as follows:

Size of container	Total content (base and curing)	Volume tolerance
6 ounce	3-1/2 fluid ounces	± 1/8 fluid ounce

5.1.2 Level C: The unit quantity of base compound specified (see 6.3) with its ratio of curing compound shall be packaged in accordance with the manufacturer's best commercial practice.

5.2 Packing:

Packing shall be Level A, B, or C as specified (see 6.3).

5.2.1 Levels A and B: The base and curing compound shall be packed in accordance with the appendix to PPP-C-96 for filled cans and MIL-P-38714 for the sectional type containers. Pails and drums shall be palletized in accordance with MIL-STD-147.

5.2.2 Level C: The base and curing compound packaged in compliance with 5.1 as specified (see 6.3) shall be packed in a manner to insure acceptance and safe delivery at destination. Containers shall be in accordance with Uniform Freight Classification Rules or Regulations of carrier applicable to the modes of transportation.

5.3 Marking of shipment:

In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. Marking shall include specification number, applicable class and dash number, name of manufacturer, date of manufacture (month and year), batch number, mixing instructions, and recommended storage temperature and a note.

6. NOTES:

6.1 Intended use:

All the sealing compounds covered by this specification are intended for use as multi-purpose aircraft structure and fuel tanks sealants with rapid ambient and low temperature curing capabilities without sacrificing application life. As an example, cure time at any given application time for these materials is approximately 80% less when compared to a two component polysulfide fuel tank sealant. These sealants give “fly-away” capability in 2 to 3 hours when cured at temperatures of at least 75° F. When cured as low as 40° F, these sealants provide a 4 hour “fly-away” capability when using 1/4 application time material (see 1.2.3). They will also cure at lower temperatures for example 20° F (-5° C) at proportionately longer periods of time. These sealants will also cure rapidly in low humidity desert environments. Type II materials are intended as protection for metal and dissimilar parts against corrosion.

6.1.1 Type I Grade A-1: Type I, grade A-1 sealants can be cured at elevated temperatures immediately after application and are suitable for composite co-cure bonding procedures in manufacture and repair processes. Direct heat at temperatures of up to 350° F (176° C) can be applied by heat gun or blanket immediately after sealant application.

6.1.2 Temperature Characteristics: These sealing compounds are for use in areas that may be subjected to long term service temperatures of -85°F to +285°F (-55°C to +140°C) and short term exposures in the +400°F (+204°C) to +420°F (+216°C).

6.1.3 Other characteristics: These materials have outstanding resistance to mercaptans present in fuels and also can withstand heating in a confined structural configuration.

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