

Shims, Molded, Filled Resin Compound and Sheet Prepeg

RATIONALE

This document was taken from a MIL SPEC that was written in 1970, updating information and new product types is required.

1. SCOPE

1.1 Scope

This specification covers the requirements for filled, resinous thermosetting compound and sheet pre-preg to fabricate shims for use during assembly of aircraft and marine components and parts.

1.2 Classification

The material shall be classified in the three types as specified:

Type I - A two component material (base and hardener) which, after mixing and application of heat (350 °F), will cure to a hard, strong resin. Type I material may also be cured in ambient temperature of 75 °F ± 5 for a period of 96 hours minimum.

Type I Class A - A two component material (base and hardener) which after mixing may be cured to a hard, strong resin in ambient temperature of 75 °F ± 5 for a period of 9 hours.

Type II - A precatyzed (B-staged) sheet material which will cure to a hard, strong resin with the application of heat. Type II material may also be cured in ambient temperature of 75 °F ± 5 for a period of 96 hours.

Type III - A precatyzed (B-staged) material supplied frozen in a tube from which it can be extruded and cured to a hard strong resin with the application of heat (200 °F). Type III material may also be cured in ambient temperature of 75 °F ± 5 for a period of 96 hours minimum.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user." SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions. Copyright © 2010 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

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

SAE WEB ADDRESS:

SAE values your input. To provide feedback on this Technical Report, please visit
<http://www.sae.org/technical/standards/AMSS83474A>

2.1 U.S. Government Publications

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

MIL-Y-1140 Yarn, Cord, Sleeving, Cloth and Tape Glass
 MIL-DTL-5624 Turbine Fuel, Aviation, Grades JP-4 and JP-5
 MIL-T-81533 Trichloroethane 1,1,1 (Methyl Chloroform Inhibited, Vapor Degreasing)

A-A-55828 Sulfuric Acid, Technical
 A-A-59123 Sodium Dichromate, Dihydrate, Technical
 MMM-A-132 Adhesive, Heat Resistant, Airframe Structural, Metal to Metal

2.2 SAE Publications

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

AMS3167B Solvents, Wipe for Cleaning Prior to Application of Primer and Top Coat Materials, or Sealing Compounds

2.3 ASTM Publications

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

ASTM A 309 Standard Test Method for Weight and Composition of Coating on Terne Sheet by the Triple-Spot Test
 ASTM A 630 Standard Test Methods for Determination of Tin Coating Weights for Electrolytic Tin Plate
 ASTM B 117 Standard Practice for Operating Salt Spray (Fog) Apparatus
 ASTM D 740 Methyl Ethyl Ketone Technical
 ASTM E 172 Standard Practice for Describing and Specifying the Excitation Source in Emission Spectrochemical Analysis (International Specification)
 ASTM E 376 Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Examination Methods
 ASTM E 427 Standard Practice for Testing for Leaks Using the Halogen Leak Detector (Alkali-Ion Diode)
 ASTM E 498 Standard Test Methods for Leaks Using the Mass Spectrometer Leak Detector or Residual Gas Analyzer in the Tracer Probe Mode
 ASTM E 515 Standard Test Method for Leaks Using Bubble Emission Techniques
 ASTM E 1282 Standard Guide for Specifying the Chemical Compositions and Selecting Sampling Practices and Quantitative Analysis Methods for Metals, Ores, and Related Materials
 ASTM G 47 Standard Test Method for Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products
 ASTM G 69 Standard Test Method for Measurement of Corrosion Potentials of Aluminum Alloys

3. REQUIREMENTS

3.1 Qualification

The materials furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (See 4.2 and 6.2).

3.2 Type I

Type I material shall meet all of the requirements specified in Table 1 when cured for 60 to 70 minutes at 180 to 190 °F plus 60 to 70 minutes at 350 to 360 °F or cured to the manufacturer's recommended step cure cycle, or minimum of 96 hours at ambient temperature of 75 °F ± 5.

Type I Class A material shall meet all of the requirements specified in Table 1 when cured for a period of 9 hours minimum at ambient temperature of 75 °F ± 5.

3.3 Types II and III

Types II and III materials shall meet all of the requirements specified in Table 1 when cured for 120 to 130 minutes at 200 to 210 °F or to the manufacturers recommended cure cycle, or minimum of 96 hours at ambient temperature of 75 °F ± 5.

TABLE 1 - PROPERTY REQUIREMENTS (PAGE 1 OF 2 PAGES)

PROPERTY	MATERIAL		TEST METHOD
	TYPE I	TYPES II & III	
Weight Loss, %, 350° 10 Hours, Max. Avg.	.5	.5	4.5.1
Shore D Hardness After Cure, Min. Avg.	95	93	Fed. Test Method Std. 406 Method 1083
Exposure Shrinkage, %, 350°F, 10 Hours, Max. Avg.	.2	.2	4.5.1
Cure Shrinkage, %, Max. Avg.	.35	.2	4.5.1
Density After Cure, lb/ft ³ , Avg.	101	98	4.5.4
Lap Shear Fluid Resistance Strength, psi, Min. Avg.			4.5.2 4.5.3
(a) Salt Spray: Aluminum	1500	1500	
(b) Humidity: Aluminum	1700	1650	
(c) 180°F JP-4: Aluminum	1800	1850	
Minimum Average Compressive Strength, psi			4.5.4
(a) Ultimate at:			
-65°F	35,000	30,000	
Room Temp.	23,000	21,000	
270°F	12,500	10,000	
350°F	8,000	8,000	
420°F	5,500	----	

TABLE 1 - PROPERTY REQUIREMENTS (PAGE 2 OF 2 PAGES)

PROPERTY	MATERIAL		TEST METHOD
	TYPE I	TYPES II & III	
(b) Proportional Limit at:			
-65°F	16,000	15,000	4.5.4
Room Temp.	10,000	9,000	
270°F	7,500	4,000	
350°F	6,000	----	
420°F	4,500	----	
(c) Minimum Modulus 10 ⁵ psi at:			
-65°F	6.0	7.5	4.5.5
Room Temp.	5.0	6.5	
270°F	2.0	3.0	
350°F	1.1	1.1	
420°F	0.95	0.95	

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspections requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 the prescribed requirements.

4.2 Quality Conformance Inspection

4.2.1 Acceptance Tests

- a. Lap shear strength at room temperature and 350 °F for Type I and Type I Class A and room temperature and 270 °F for Types II and III. Metal shall be 2024-T81 clad.
- b. Ultimate compression strength at room temperature and at 350 °F for Type I and Type I Class A and at room temperature and 270 °F for Types II and III.

c. Density

- 4.2.2 Tests and test specimens shall be in accordance with this specification. Results shall meet the applicable requirement of Table 1. Three test specimens shall be used for each property requirement specified in Table 1 for each type of material except that the sheer strength specimens shall be in accordance with Figure 1 and 4.5.2.4. Specimens of each type shall be tested for each shipment of each batch if a shipment consists of more than one batch. Data from test shall be forwarded with the shipment.

4.2.3 Retests shall automatically be accomplished in the event of a test failure. Failure of the retest shall result in rejection of the represented material.

4.2.4 Verification of any test in Table 1 may be conducted at the option of the Purchaser on any material received on production orders. Failure of the compound to meet test requirements shall result in rejection of the lot and necessary action to correct the discrepancy.

4.3 Cleaning of Adherends

4.3.1 Aluminum (except where use of release agent is specified - no cleaning required in that case).

4.3.1.1 Remove all surface dyes and other foreign material by solvent wiping with methyl-ethyl-ketone conforming to Federal Specification ASTM D 740, or an environmentally compliant solvent per AMS3167B.

4.3.1.2 Vapor degrease parts with 1,1,1 Trichloroethane, inhibited conforming to Specification MIL-T- 81533, or an equivalent environmentally compliant vapor degreasing method. The parts shall be suspended in vapor until condensation ceases.

4.3.1.3 The parts shall be immersed 9 to 15 minutes in a solution of the following composition which is maintained at temperature of 145 to 160 °F. (Solution composition shall be maintained within ±10%.)

Water (tap)	30 parts by weight
Sulphuric Acid (66° Be) Fed. Spec. A-A-55828	10 parts by weight
Sodium Dichromate Fed. Spec. A-A-59123	4 parts by weight

4.3.1.4 Rinse the parts in clean tap water at room temperature for a minimum of 2 minutes, followed by a spray rinse for a minimum of 2 minutes in clean distilled or demineralized water at room temperature. If an air supply is used for spray rinsing, the air shall be filtered.

4.3.1.5 The panels shall be observed to make sure they hold a continuous film of water on the areas to be bonded. They shall be re-cleaned if the water film is not continuous.

4.3.1.6 The parts shall be dried in circulating air at 150 °F or below.

4.3.1.7 Specimens shall be assembled and bonded within 72 hours of the completion of the cleaning process. Cleaned metal shall be protected from contamination during that time.

4.4 Curing of Specimens

4.4.1 Specimens shall be cured in accordance with the applicable cure cycle as required by 3.2 or 3.3 or in accordance with the manufacturer's recommended cure cycle. When applying heat, the time from room temperature to the applicable cure temperature shall be not less than 10 minutes or more than 60 minutes.

4.4.2 All lap shear specimens and sandwich panel specimens shall be cured under 25 psi ± 5 pressure. One layer of Fabric 1165, MIL-Y-1140 glass fabric, plain weave shall be used as a bond line spacer in lap shear specimens. Bond line thickness shall be 0.005 to 0.010 for lap shear tests.

4.5 Specimen Configuration and Test Procedure

4.5.1 Shrinkage and Weight Loss of Molded Specimens

4.5.1.1 A closed steel mold with a rectangular cavity approximately 16 inch x 1.5 inch x 0.5" inch is to be used to prepare specimens. Alternatively, a glass cylinder approximately 1.0 inch ID and 5.0 inches in length may be used to prepare specimens. Catalyzed material is to be injected into the mold until it is completely filled.

4.5.1.2 The material shall be cured using the specified time-temperature cycle, then cooled to approximately 75 °F and removed from the mold.

4.5.1.3 The length of the specimen shall be determined to the nearest 0.001 inch, and its weight to the nearest 0.1 gram.

4.5.1.4 The length of the mold cavity shall be determined to the nearest 0.001 inch.

4.5.1.5 Shrinkage "as molded" is calculated by: % shrinkage

$$(\text{as molded}) = \left(\frac{\text{length of cavity} - \text{length as molded}}{\text{length as molded}} \right) \quad (\text{Eq. 1})$$

4.5.1.6 The specimen shall be exposed to the specified temperature condition (unrestrained).

4.5.1.7 At the end of the exposure, the specimen shall be allowed to cool to room temperature, (70 to 80 °F) and its weight and length determined to the previous accuracies.

4.5.1.8 Time required to raise specimen to exposure temperature shall not be included in exposure time.

4.5.1.9 % Weight loss at each test interval shall be calculated by:

$$\% \text{ weight loss} = \frac{(\text{weight as molded} - \text{weight after exposure})}{\text{weight as molded}} \times 100 \quad (\text{Eq. 2})$$

4.5.1.10 % Shrinkage after exposure shall be calculated by:

$$\% \text{ shrinkage} = \frac{(\text{length as molded} - \text{length after exposure})}{\text{length as molded}} \times 100 \quad (\text{Eq. 3})$$

4.5.2 Lap Shear Test - Fluid Exposure

See Figure 1.

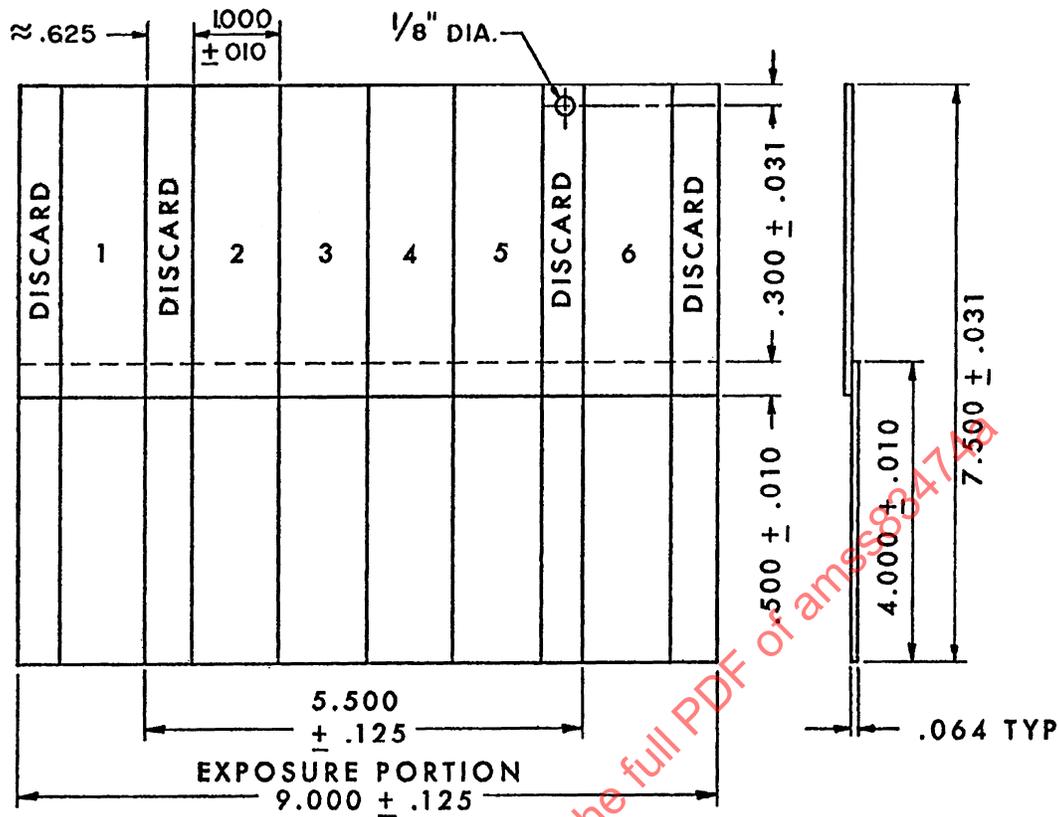


FIGURE 1

- 4.5.2.1 Prepunched panels (finger panels) in accordance with MMM-A-132 or precut individual pieces shall be used for all lap shear tests.
- 4.5.2.2 Metal to be 2024-T81 clad (0.064 inch).
- 4.5.2.3 Specimens 1 and 6 are controls and shall be removed and held while exposure portion of panel is exposed to specified environment.
- 4.5.2.4 After proper exposure as specified in 4.5.3, specimens 2, 3, 4, and 5 shall be tested with controls, within 6 hours.
- 4.5.2.5 Load specimens with clamp type jaws using a loading rate of 600 to 700 pound/minute.
- 4.5.2.6 Calculate shear in psi, τ , by $\tau = \frac{P}{LW}$

where:

P = failing load in pounds

L = overlap in inches

W = width of specimen in inches

- 4.5.2.7 L and W shall be determined to the nearest 0.001 inch.

4.5.3 Fluid Resistance Test Exposure Conditions

4.5.3.1 Salt Water Spray Condition

4.5.3.1.1 Use ASTM B 117 except as follows:

4.5.3.1.2 Suspend panel vertically by means of a non-metallic material, e.g., waxed string, through a 1/8 inch diameter hole drilled in the trim area.

4.5.3.1.3 The plane of the panel is to be parallel to the principal direction of flow of the water spray.

4.5.3.1.4 Panels are not to be in contact with each other or any metallic object during exposure.

4.5.3.1.5 Exposure duration is to be 30 days \pm 2 hours.

4.5.3.2 High Humidity Condition

4.5.3.2.1 Panels are to be suspended (as above) in a humidity cabinet in which the exposure zone of the closed humidity chamber is maintained at 120 °F \pm 5 and 95 to 100% relative humidity. The temperature of the cabinet shall be recorded at least twice each working day.

4.5.3.2.2 Condensate from one panel shall not drip upon other panels.

4.5.3.2.3 Distilled water containing not more than 200 ppm of total solids shall be used to maintain the humidity.

4.5.3.2.4 During exposure, panels shall not contact the water used, or any metallic material, or any material that might act as a wick.

4.5.3.2.5 Exposure shall be continuous for 30 days \pm 2 hours. Continuous exposure means that the chamber shall be closed and the humidity maintained continuously except for brief interruptions necessary to inspect, rearrange, or removal panels, or to check or replenish the reservoir.

4.5.3.3 Fuel Immersion Condition

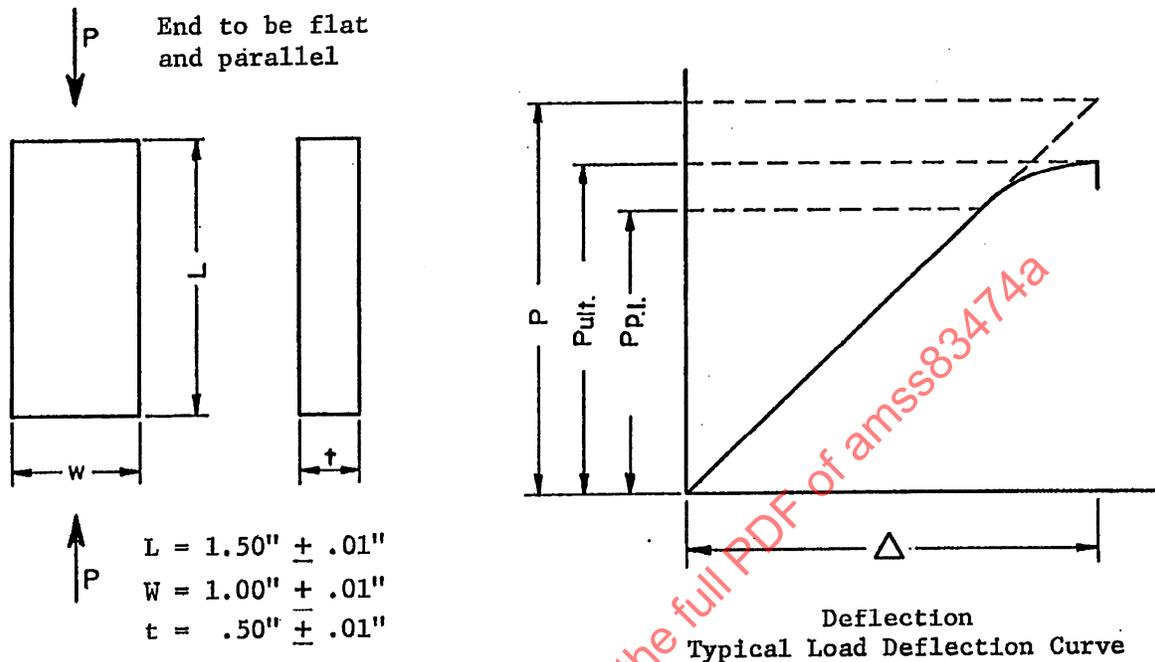
4.5.3.3.1 Panels shall be immersed in jet engine fuel (JP-4) per MIL-DTL-5624 maintained at 180 °F \pm 5 for 7 days \pm 2 hours.

4.5.3.3.2 Panels must be arranged so that the overlap area is fully exposed to the fuel.

4.5.3.3.3 The panels shall not come in contact with each other nor shall the bond line come into contact with any metallic material throughout the exposure.

4.5.4 Compression Test and Density

See Figure 2.



NOTE: Test equipment shall have rigid non-rotating loading platforms. Specimen shall be unsupported, i.e. free to deflect laterally.

FIGURE 2

- 4.5.4.1 Prior to compression testing, density of each specimen shall be determined by weighing to the nearest 0.01 gram and converting the weight measurement to pounds/feet³.
- 4.5.4.2 Load rate to be 0.05 inch per minute (head travel).
- 4.5.4.3 Specimens shall be molded and/or machined to tolerance as shown in Figure 2, or as prepared per paragraph 4.5.1.1.
- 4.5.4.4 Load-deflection curve to be determined autographically.
- 4.5.4.5 Calculate ultimate compressive strength $\sigma_{C_{ULT}}$, proportional limit compressive strength $\sigma_{C_{P.L.}}$, and compression modulus E_c by

$$\sigma_{C_{ULT}} = \frac{P_{ULT.}}{tw}; \sigma_{C_{P.L.}} = \frac{P_{P.L.}}{tw}; E_c = \frac{PL}{\Delta tw} \quad (\text{Eq. 4})$$

where:

$P_{ULT.}$, $P_{P.L.}$, P/Δ , L , t , and w are shown in the above figures and formulas
 $P_{P.L.}$ = proportional limit