

# 3M

## Scotch-Weld™

### Structural Adhesive Film

#### AF 147

Technical Data

May, 2002

#### Introduction

3M™ Scotch-Weld™ Structural Adhesive Film AF 147 is a thermosetting nonvolatile, modified epoxy film adhesive designed for bonding of honeycomb and metal to metal components where high strengths at 300°F (149°C) are required. Scotch-Weld AF 147 is a higher metal to metal peel version of 3M™ Scotch-Weld™ Structural Adhesive Film AF 143. Scotch-Weld AF 147 offers the following advantageous properties:

- Outstanding performance in metal to metal and metal to honeycomb strength over a temperature range of -67 to 300°F (-55 to 149°C).
- Controlled tack to allow easy positioning during layup operations.
- Contains no metallic fillers, thereby offering weight savings and radar transparency.
- 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917 corrosion inhibiting primer can be used with this film.

#### Description

	0.11 Wt.	0.08 Wt.
<b>Color:</b>	Tan	Tan
<b>Base:</b>	Modified Epoxy	Modified Epoxy
<b>Form:</b>	Flexible Supported Film	Flexible Supported Film
<b>Weight:</b>	.10 - .115 lb./ft. <sup>2</sup>	.070 - .090 lb./ft. <sup>2</sup>
<b>Recommended Cure Temperature:</b>	350°F (177°C)	350°F (177°C)
<b>Recommended Cure Time:</b>	1 hour	1 hour
<b>Volatile Content:</b>	Less than 2%	Less than 2%

# Scotch-Weld™ Structural Adhesive Film AF 147

## Product Performance

**Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.**

The following product performance data has been obtained in the 3M Laboratory under the conditions specified. Test specimens were prepared using the general application methods and procedures described in the product application section of the data sheet.

All data in this section was developed using 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917 primed aluminum panels and an adhesive cure cycle of 60 minutes at 350°F (177°C) and 45 psi. A 4-5°F/minute rise rate to cure temperatures was used. Parts were cooled below 200°F (93°C) before removing from autoclave.

### 1. Metal to Metal – Overlap Shear

All properties were measured on 1" wide, 1/2" overlap specimen cut from 0.063" thick 4" x 7" bonded panels of 2024T-3 alclad aluminum. Tests were conducted per MMM-A-132.

Test Temperature	Scotch-Weld AF 147 0.11 Wt. Scotch-Weld EC-3917	Scotch-Weld AF 147 0.08 Wt. Scotch-Weld EC-3917
-67°F (-55°C)	4500 psi	4500 psi
75°F (24°C)	5000 psi	5000 psi
300°F (149°C)	2200 psi	2000 psi

### 2. Metal to Metal – Floating Roller Peel

Peel strength was measured on 1" wide specimens cut from 3" x 8" x .063" 2024T-3 bare aluminum panels bonded to 3" x 10" x .025" 2024T-3 bare panels.

Test Temperature	Scotch-Weld AF 147 0.11 Wt. Scotch-Weld EC-3917	Scotch-Weld AF 147 0.08 Wt. Scotch-Weld EC-3917
75°F (24°C)	25 piw	25 piw

### 3. Metal to Metal Honeycomb – Climbing Drum Peel

Peel strength was measured on 3" x 8" honeycomb sandwich panel containing a 3" x 10" peel face sheet. Tests were conducted per MIL-A-25463.

**Skin:** .020" thick 2024T-3 bare aluminum.

**Core:** 0.50" thick, 1/4" cell, 4 mil, 5052 aluminum.

All below strength values given in inch lbs./inch width.

Test Temperature	Scotch-Weld AF 147 0.11 Wt. Scotch-Weld EC-3917	Scotch-Weld AF 147 0.08 Wt. Scotch-Weld EC-3917
-67°F (-55°C)	16	14
75°F (24°C)	18	15
205°F (96°C)	10	9

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**Product Performance**  
(continued)

**Note:** The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

#### 4. Metal to Honeycomb – Flatwise Tensile

All properties were measured on 2" x 2" honeycomb sandwich bonds using the procedure of MIL-A-25463.

**Skin:** .020" thick 2024T-3 bare.

**Honeycomb Core:** 0.50" thick, 1/4" cell, .004" foil, 5052 aluminum.

Test Temperature	Scotch-Weld AF 147 0.11 Wt. Scotch-Weld EC-3917	Scotch-Weld AF 147 0.08 Wt. Scotch-Weld EC-3917
-67°F (-55°C)	1400 psi	1300 psi
75°F (24°C)	1300 psi	1250 psi
300°F (149°C)	400 psi	350 psi

#### 5. 3M™ Scotch-Weld™ Structural Adhesive Film AF 147 (0.08 weight)/ 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917 System Versus MMM-A-132 Type II

**Notes:**

**Film:** Scotch-Weld AF 147 0.08 Wt.

**Primer:** Scotch-Weld EC-3917

**Metal Preparation:** Alkaline degrease and FPL etch.

Test MMM-A-132	Description	MMM-A-132 Type II Reg.	Scotch-Weld AF 147 (0.08 Wt.) Scotch-Weld EC-3917
<b>Test Number:</b>			
1.)	75°F (24°C) shear	2250 psi	5063 psi
3.)	300°F (149°C) shear	2000 psi	2533 psi
4.)	300°F (149°C) shear after 192 hours at 300°F (149°C)	2000 psi	3562 psi
7.)	-67°F (-55°C) shear	2250 psi	3807 psi
8.)	75°F (24°C) Fatigue	750 psi 10 <sup>6</sup> cycles	No Failures
9.)	75°F (24°C) creep 1600 psi – 192 hours	0.015" maximum	0
11.)	300°F (149°C) creep 800 psi – 192 hours	0.015" maximum	0.0008"
13.)	75°F (24°C) shear after 30 day salt spray	2100 psi	5582 psi
14.)	75°F (24°C) shear after 30 days at 120°F (49°C) and 95-100% RH	2100 psi	5468 psi
15.)	75°F (24°C) shear after immersion a.) 30 days in tap water b.) 7 days in MIL-J-5624 c.) 7 days in MIL-F-5566 d.) 7 days in MIL-H-5606 e.) 7 days in TTS-735 (Type III Hydrocarbon)	2100 psi 2100 psi 2100 psi 2100 psi 2100 psi	5642 psi 5233 psi 5162 psi 4928 psi 5175 psi

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**Product Performance**  
(continued)

**Note:** The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

**6. Relative Humidity Exposure Before Cure of 3M™ Scotch-Weld™ Structural Adhesive Film AF 147 0.08 Weight**

**Exposure:** 80% RH and 80°F (27°C) for specified number of days.

**Cure:** 350°F (177°C) – 60 minutes – 45 psig – 4-5°F/minute.

**Metal:** Overlap shear, 2024T-3 clad 4" x 7" x .063"

**Primer:** 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917

**Overlap Shear (psi)**

Test Temperature	Control	1 Day	3 Days	5 Days	7 Days
-67°F (-55°C)	3945	3893	3753	3388	3008
RT	4847	4728	4321	3929	3500
300°F (149°C)	2710	2371	2115	1869	1698

**7. Scotch-Weld AF 147 (0.08 Wt.)/Primer EC-3917 Heat Aging Data in Overlap Shear**

Hours Exposure @ 300°F (149°C)	Test Temperature	
	RT	300°F (149°C)
0 Hours	5883 psi	2213 psi
2500 Hours	5250 psi	3227 psi
5000 Hours	4953 psi	2953 psi
7100 Hours	4387 psi	2093 psi
Hours Exposure 350°F (177°C)	RT	350°F (177°C)
0 Hours	5883 psi	1043 psi
2500 Hours	4490 psi	1997 psi
5000 Hours	3740 psi	2113 psi
7500 Hours	3720 psi	2340 psi
10000 Hours	3887 psi	2173 psi
15000 Hours	3687 psi	2293 psi
20000 Hours	3540 psi	1940 psi
30000 Hours	3210 psi	1810 psi

**Product Application**

**I. Surface Preparation**

A thoroughly cleaned, dry, grease-free surface is essential for maximum performance. Cleaning methods which will produce a breakfree water film on metal surfaces are generally satisfactory.

**A. Aluminum** (optimized FPL etch – 3M Company, EAD Test Method C-2803)

1. Vapor Degrease – Perchloroethylene condensing vapors for 5-10 minutes.
2. Alkaline Degrease – Oakite 164 solution 9-11 oz./gallon water at 190°F ± 10°F (88°C ± 5°C) for 10-20 minutes. Rinse immediately in large quantities of cold running water.
3. Acid Etch – Place panels in the following solution for 10 minutes at 150° ± 5°F (66°C ± 2°C).
 

Sodium Dichromate (Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> •2H <sub>2</sub> O)	4.1 - 4.9 oz./gallon
Sulfuric Acid, 66° Be	38.5 - 41.5 oz./gallon
2024T-3 aluminum (dissolved)	0.2 oz./gallon minimum
Tap Water as needed for balance	

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**Product Application**  
(continued)

4. Rinse – rinse panels in clear running tap water.
5. Dry – Air dry 15 minutes; force dry 10 minutes at 150° ± 10°F (66° ± 5°C).
6. It is advisable to coat the freshly cleaned surface with adhesive within 4 hours after surface preparation.

**B. Aluminum Honeycomb Core**

1. Soak in clean Aliphatic Naptha (to conform to TT-N-95A) for five minutes at room temperature. Dry 10 minutes at 150° ± 5°F (66° ± 2°C).
2. Optional – Immerse in etching solutions for two (2) minutes at 150° ± 5°F (66° ± 2°C). Rinse, air dry and force dry in similar manner to skin panels.

**II. Primer Application**

3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917 corrosion inhibiting primer has been successfully used with 3M™ Scotch-Weld™ Structural Adhesive Film AF 147 film using the following procedure:

Spray Application: Refer to Scotch-Weld EC-3917 technical data sheet for equipment and technique.

**Primer Application**

**Primer Dry Cycle:**

- Air Dry: 30 minutes minimum at ambient temperature.  
 Force Dry: 60 minutes at 250°F (121°C) in an air circulating oven.  
 Primer Thickness: Approximately 0.1 mils dry.  
 See Scotch-Weld EC-3917 technical data sheet for application techniques.

**Adhesive Layup**

Care should be taken to avoid contaminating adhesive and cleaned aluminum by any substance which will hinder wetting action of the adhesive.

**A. Film Application**

1. Cut portion of film to be used from roll with protective liners in place.
2. Remove paper liner from one side of the film.
3. Place film on metal using a separating liner as a protective cover.
4. Roll film into position with a rubber roller, insuring that no air is trapped between film and panel.
5. Remove second protective liner.
6. Assemble parts and cure.

**Cure Cycle**

A cure of 60 minutes at 350°F (177°C) and 45 ± 5 psi pressure is suggested when maximum results are desired.

**Cure Cycle (Autoclave or Platen Press)**

The following cure cycle has been used to obtain dense glue lines.

**Cure Cycle (Autoclave or Platen Press)**

	<b>Cure Cycle</b>
1. Bond Pressure: Apply before starting rise rate cycle and maintain throughout cure cycle.	45 ± 5 psi
2. Bond line temperature rise rate.	4 to 5°F/minute
3. Cure.	60 minutes at 350°F (177°C)
4. Temperature at which pressure is released.	200°F (93°C) or below

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## Structural Adhesive Film

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**Storage** Store new shipments behind older lots. 3M™ Scotch-Weld™ Structural Adhesive Film AF 147 must be shipped or stored at 0°F (-18°C) or lower. Rotate stock on a “first-in–first out” basis. Upon request, your 3M Engineered Adhesives Sales Representative will be pleased to advise you of the anticipated shelf life of this product under the storage conditions in your plant.

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**Precautionary Information** Refer to Product Label and Material Safety Data Sheet for health and safety information before using this product. For additional health and safety information, call 1-800-364-3577 or (651) 737-6501.

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**For Additional Information** To request additional product information or to arrange for sales assistance, call toll free (800) 235-2376. Our fax number is (417) 869-5219. Address correspondence to: 3M Aerospace Central, 3211 E. Chestnut Expressway, Springfield, MO 65802.

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