

## 3M™ Scotch-Weld™ AF 3109-2

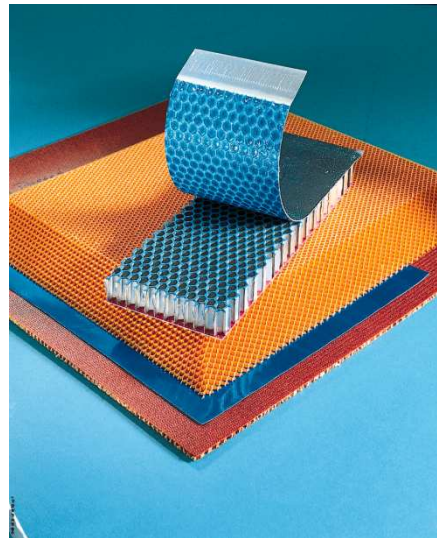
### Structural Adhesive Film

#### Product Description

3M™ Scotch-Weld™ Structural Adhesive Film AF 3109-2 is a thermosetting, modified epoxy adhesive film. AF 3109-2 was designed for bonding honeycomb and metal-to-metal & composite components, where high strength at 150 °C is required.

#### Key Features

- Cure temperatures as low as 107 °C and up to 177 °C.
- High and moderate tack versions available.
- Excellent performance in metal-to-metal and honeycomb sandwich applications over a temperature range of -55 to 150 °C.
- Improved resistance to high moisture pre-cure conditions.
- Can be cured at low pressure (low volatile by-products).
- Unsupported version can be reticulated on honeycomb.



#### Product Characterization

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

General Properties	AF 3109-2K	AF 3109-2K	AF 3109-2K	AF 3109-2U	AF 3109-2U
Colour	blue	blue	blue	blue	blue
Carrier	Knit Scrim	Knit Scrim	Knit Scrim	Unsupported	Unsupported
Tack	High	High	High	Moderate	Moderate
Weight (± 25 g/m <sup>2</sup> )	414 g/m <sup>2</sup>	293 g/m <sup>2</sup>	219 g/m <sup>2</sup>	170 g/m <sup>2</sup>	73 g/m <sup>2</sup>
Weight (± .005 lb/ft <sup>2</sup> )	.085 lb/ft <sup>2</sup>	.060 lb/ft <sup>2</sup>	.045 lb/ft <sup>2</sup>	.035 lb/ft <sup>2</sup>	.015 lb/ft <sup>2</sup>

#### Product Performance

The following product performance data were obtained under the conditions specified.

All data in this section was developed using 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960 primed aluminium panels and an adhesive cure cycle of 60 minutes at 121 °C and, 276 KPa. A 2-3 °C / minute rise rate to cure temperature was used. Parts were cooled below 93 °C before removing from autoclave.

### 1. Metal to Metal- Overlap Shear

All properties were measured on 25.4 mm wide, 12.7 mm overlap specimens cut from 1.6 mm thick, 102 mm x 178 mm bonded panels of 2024-T3 alclad aluminium. Tests were conducted per MMM-A-132.

Test Temperature °C	AF 3109-2K 0.085 Wt. EC-3960 MPa	AF 3109-2K 0.060 Wt. EC-3960 MPa	AF 3109-2K 0.045 Wt. SW EC-3960 MPa	AF 3109-2K 0.035 Wt. SW EC-3960 MPa	AF 3109-2K 0.015 Wt. EC-3960 MPa
-55	35.9	37.9	39.3	41.2	36.3
23	41.9	40.0	40.0	38.6	36.8
121	24.1	23.4	19.0	21.4	22.1
150	12.0	11.0	9.7	12.6	13.8

### 2. Metal to Metal- Blister Detection

Properties measured on 25.4 mm x 178 mm blister detection specimens with a 5.53 mm notch cut to form the 12.7 mm overlap. Aluminium was 1.6 mm 2024-T3 bare.

Test temperature °C	AF 3109-2K 0.085 Wt. EC-3960 MPa
23	29.7
132	27.8
149	12.8

### 3. Metal to Metal- Floating Roller Peel

Peel Strength was measured on 25.4 mm wide specimens cut from 76 mm x 203 mm x 203 mm 2024-T3 bare aluminium panels bonded to 76 mm x 254 mm x 0.64 mm 2024-T3 bare peeling panel.

Test temperature °C	AF 3109-2K 0.085 Wt. EC-3960 N/25mm	AF 3109-2K 0.060 Wt. EC-3960 N/25mm	AF 3109-2K 0.045 Wt. EC-3960 N/25mm	AF 3109-2K 0.035 Wt. EC-3960 N/25mm	AF 3109-2K 0.015 Wt. EC-3960 N/25mm
-55	214	-	-	200	-
23	200	218	214	129	125
149	111	-	-	102	-

### 4. Metal to Metal Honeycomb- Climbing Drum Peel

Peel strength was measured on 76 mm x 203 mm honeycomb sandwich panels containing a 76 mm x 254 mm peel face sheet. Testes were conducted per MIL-A-25463.

Skin: 0.5 mm thick 2024-T3 bare aluminium

Core: 12.7 mm thick, 6.35 mm cell, 0.1 mm foil, 5052 aluminium

Test temperature °C	AF 3109-2K 0.085 Wt. EC-3960 mN/m	AF 3109-2K 0.060 Wt. EC-3960 mN/m	AF 3109-2K 0.035 Wt. EC-3960 mN/m	AF 3109-2K 0.015 Wt. EC-3960 mN/m
23	120.1	70.7	45.8	20.5
149	44.5	-	22.2	-



**5. Metal to Honeycomb – Flatwise Tensile**

All Properties were measured on 50.8 mm x 5.08 mm honeycomb sandwich bonds using the procedure of MIL-A-25463.

Skin: 0.5 mm thick 2024-T3 bare aluminium

Honeycomb Core: 12.7 m thick, 6.35 mm cell, 0.1 mm foil, 5052 aluminium

Test temperature °C	AF 3109-2K 0.085 Wt. EC-3960 MPa	AF 3109-2K 0.035 Wt. EC-3960 MPa
23	12.1	7.6
149	1.9	1.2

**6. Metal to Honeycomb- Beam Flexure**

Tested as per MIL-A-25463 method on etched 1.6 mm thick 2024-T3 bare metal and 6.35 mm cell, 5052, .01 mm , 12.7 mm thick core.

Test temperature °C	AF 3109-2K 0.085 Wt. EC-3960 kN	AF 3109-2K 0.035 Wt. EC-3960 kN
23	15.6	13.3
149	2.7	1.7

**7. AF 3109-2K 0.085 Wt./ EC-3960 Fatigue and Creep Resistance**

Test procedure per MMM-A-132

Creep Rupture at 82°C 0.00 mm

and 5.5 MPa for 192 hours

Fatigue at 23 °C, 5.1 MPa at 10<sup>6</sup> cycles No Failures

**8. Relative Humidity Exposure before Cure of AF 3109-2U (.035 Wt.)/ EC- 3960.**

Exposure: 50% RH and 23 °C for specified number of days.

Metal: Overlap shear, 2024-T3 clad 101 mm x 178 mm x 1.6 mm bare, floating roller peel, 76 mm x 254 mm x .06 mm bonded to 76 mm x 203 mm x .16 mm 2024-T3 bare.

Overlap Shear

Test temperature °C	Control MPa	5 Days MPa	10 Days MPa	15 days MPa
23	40.8	38.8	37.5	39.4
121	20.1	20.5	20.3	19.7

Floating Roller Peel

Test temperature °C	Control N/25mm	5 Days N/25mm	10 Days N/25mm	15 days N/25mm
-55	280	289	289	307
23	289	249	245	227

## 9. AF 3109-2U (.035 Wt.) / EC-3960 Heat Aging Resistance

Metal: 2024-T3 bare aluminium, FPL etched, primed with EC- 3960.

Overlap Shear aged at	121 °C		149 °C		177 °C	
Tested at	23 °C	121 °C	23 °C	149 °C	23 °C	177 °C
Unit	MPa	MPa	MPa	MPa	MPa	MPa
Control (0 Hours)	43.9	21.8	43.9	12.5	43.9	3.6
500 Hours	41.6	22.8	39.4	11.4	37.4	4.1
1000 Hours	39.0	26.0	35.2	13.7	34.4	5.7
2000 Hours	39.1	25.5	30.9	12.5	35.5	5.2
5000 Hours	31.0	22.5	-	-	27.9	7.3
10000 Hours	34.3	24.4	28.2	11.4	30.8	5.2

## 10. AF 3109-2 Cure Cycle parameters

Metal: 2024-T3 bare aluminium FPL etched and primed with 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960.

Honeycomb: 5052, 6.35 mm. cell, 0.1 mm foil

Cure Cycle	Overlap Shear MPa				Floating Roller Peel N/25mm		H.C. Peel mN/m
Tested at	-55 °C	23 °C	121 °C	149 °C	23 °C	149 °C	23 °C
Cure parameters							
AF-3109-2K, .085 wt.							
121 °C, 1 h, 276 KPa 2-3 °C Rise Rate/Min. (Standard)	(38.5	42.3	20.6	12.7	254	151	128
121 °C, 1 h, 276 KPa 0.6 °C Rise Rate/Min.	(35.8	41.1	23.3	14.8	(240	147	108
121 °C, 30 min, 276 KPa 2-3 °C Rise Rate/Min.	40.2	42.8	20.2	11.2	311	138	117
121 °C, 1 h, 276 KPa 6 °C Rise Rate/Min.	38.8	(41.9	22.1	15.0	280	160	118
107 °C, 90 min., 276 KPa 2-3 °C Rise Rate/Min.	37.2	41.2	20.8	12.7	285	133	125
107 °C, 1 h, 276 KPa 2-3 °C Rise Rate/Min.	34.6	41.5	18.5	10.8	285	129	113
200 °F (93 °C), 2 h, 276 KPa 2-3 °C Rise Rate/Min.	36.2	40.1	12.2	10.1	254	120	110
300 °F (149 °C), 1 h, 276 KPa 2-3 °C Rise Rate/Min.	39.9	42.3	24.8	13.4	280	133	117
177 °C, 1 h, 276 KPa 2-3 °C Rise Rate/Min.	40.3	41.2	24.0	14.4	311	148	117

## 11. Typical Cured Free Film Properties:

### 23 °C Tensile Strength Bulk Modulus, Shear Modulus, and Poisson's Ratio –

AF 3109-2K.085 wt. ~ 2.54 mm thick (ASTM D-3039) cure- 60 minutes at 121 °C –  
2-3 °C rise rate/minute.

Tensile Strength	59.6 MPa
Modulus of Elasticity	2689 MPa
Poisson's Ratio	0.31
Shear Modulus	1020 MPa

# Handling, Application, Storage

## Precautionary Information

Refer to Product Label and Material Safety Data Sheet for health and safety information before using this product.

## Instructions for use

The product performance data were developed using the following suggested procedures.

Process step	Instruction										
<b>Surface preparation</b>	<p>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.</p> <p>A. <u>Aluminium</u> (optimized FPL etch- 3M Company, Test Method C-2803 or ASTM D 2651).</p> <ol style="list-style-type: none"><li>1. Alkaline Degrease –Oakite No. 164 solution 67.4 – 82.4 g / litter water at <math>88 \pm 5.6</math> °C for 10- 20 minutes. Rinse immediately in large quantities of cold running water.</li><li>2. Optimized FPL Etch Solution (1 liter)<table border="1"><thead><tr><th>Material</th><th>Amount</th></tr></thead><tbody><tr><td>Distilled water</td><td>700 ml plus balance of liter (see below)</td></tr><tr><td>Sodium Dichromate</td><td>28 to 67.3 grams</td></tr><tr><td>Sulfuric Acid</td><td>287.9 to 310.0 grams</td></tr><tr><td>Aluminium Chips</td><td>1.5 grams/liter of mixed solution</td></tr></tbody></table><p>To prepare 1 liter of this solution, dissolve sodium dichromate in 700 ml of distilled water. Add sulphuric acid and mix well. Add additional distilled water to fill to 1 liter. Heat mixed solution to 66 to 71°C. Dissolve 1.5 grams of 2024 bare aluminium chips per liter of mixed solution. Gentle agitation will help aluminium dissolve in about 24 hours.</p><p>To FPL etch panels, place them in the above solution at (66 to 71 °C for 12 to 15 minutes.</p><p>Note: Review and follow MSDS and other safety recommendations provided by chemical manufacturers prior to preparation of this etch solution.</p></li><li>3. Rinse- Rinse panels in clear running tap water.</li><li>4. Dry- Air dry 15 minutes; force dry 10 minutes minimum at 60 °C maximum.</li><li>5. It is available to coat the freshly cleaned surface with adhesive or primer within 4 hours after surface preparation.</li></ol> <p>B. <u>Aluminium Honeycomb Core</u></p> <ol style="list-style-type: none"><li>1. Soak in clean Aliphatic Naphtha (to conform to TT-N-95A) for five minutes at room temperature. Dry 10 minutes at 60 °C maximum.</li><li>2. Optional- Immerse in etching solutions for two (2) minutes at <math>66 \pm 20</math> °C. Rinse, air dry and force dry in similar manner to skin panels.</li></ol>	Material	Amount	Distilled water	700 ml plus balance of liter (see below)	Sodium Dichromate	28 to 67.3 grams	Sulfuric Acid	287.9 to 310.0 grams	Aluminium Chips	1.5 grams/liter of mixed solution
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Distilled water	700 ml plus balance of liter (see below)										
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<b>Primer application</b>	<p>3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960 has been successfully used with 3M™ Scotch-Weld™ Structural Adhesive Film AF 3109-2 using the following procedure:</p> <p>Spray Application: Refer to Scotch-Weld™ EC-3960 Technical Data Sheet for equipment and technique.</p>										
<b>Primer Dry Cycle</b>	<p>Air Dry: 30 minutes at ambient temperature.</p> <p>Force Dry: 60 minutes at 121°C in an air circulating oven.</p> <p>Primer Thickness: Approximately 3.8 micron thick (dry).</p> <p>See Scotch-Weld EC-3960 Technical Data Sheet for application techniques.</p>										
<b>Adhesive Layup</b>	<p>Remove film from -18 °C storage and allow to warm to room temperature (preferable overnight). While warming to room temperature the adhesive should be allowed to remain in the sealed polyethylene bag to minimize moisture condensation on the adhesive surface.</p> <p>Care should be taken to avoid contaminating adhesive and cleaned aluminium by any substance which will hinder wetting action of the adhesive.</p> <p>A. <u>3M™ Scotch-Weld™ Structural Adhesive Film AF 3109-2K application</u></p> <ol style="list-style-type: none"><li>1. Cut portion of film to be used from roll with protective liners in place.</li><li>2. Place high tack side of film on the primed metal using the separating liner as a protective cover. (High tack side is adjacent) to heavy paper liner).</li><li>3. Roll film into position with a rubber roller insuring that no air is trapped between the surface and the film.</li></ol>										

4. Remove second protective liner.
  5. Assemble parts and cure.
- B. 3M™ Scotch-Weld™ Structural Adhesive Film AF 3109-2U application
1. The area where the adhesive is to be used should be maintained at a temperature of 22-27 °C. As an alternative, the film may be warmed briefly to this temperature range using a heat lamp, hot air gun or similar device. At temperatures below 22 °C the film becomes increasingly brittle and may crack during handling. At temperatures above 27 °C the tack of the adhesive increases making it more difficult to handle.
  2. Cut portion of film to be used from the roll with the protective liners in place.
  3. Remove the paper liner from the adhesive keeping the colored polyethylene liner in place. It is suggested that the adhesive film with polyliner be held firmly on a flat surface and that the paper liner be pulled away from the adhesive using a slow steady force. Jerking or sudden increase in the speed of pull may cause the adhesive to crack.
  4. After the paper liner is removed, the adhesive film may be placed on the part to be bonded using the polyliner to help in positioning and to act as a protective cover.
  5. Remove the polyliner before reticulating or bonding.
  6. Any film remaining on the roll should be resealed in its polyethylene bag and returned to -18 °C storage as soon as possible. Excessive aging at room temperature will cause the film to become more susceptible to cracking.

#### Suggested cure Cycle

A cure of 60 minutes at 121 °C and 276 KPa 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)

	Cure Cycle
1. Bonding Pressure: Apply before starting rise rate cycle and maintain throughout cure cycle.	276 KPa
2. Bond line temperature rise rate.	(2 to 3 °C / min
3. Cure.	60 minutes at 121 °C
4. Temperature at which pressure is released.	93 °C or below

#### Storage

Storage Stability- Storage at 0 °F (-18 °C) or below is recommended for 3M™ Scotch-Weld™ Structural Adhesive Film AF 3109-2 to obtain maximum storage life.

Standard 3M Shelf Life for Scotch-Weld™ AF 3109-2 is 6 months from date of shipment from 3M™ when stored at 0 °F (-18 °C) or less.

Note: Scotch-Weld™ AF 3109-2 films should be permitted to thoroughly warm to room temperature before being used in order to prevent moisture condensation. (Do not open protective container prior to reaching ambient conditions).

## Further Information

For additional information on this product contact your local 3M Aerospace Sales Representative or visit our homepage at [www.3m.com/aerospace](http://www.3m.com/aerospace).

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