



# Scotch-Weld™

## Structural Adhesive Film

### AF 191

Technical Datasheet

March 2009

#### Introduction

3M™ Scotch-Weld™ Structural Adhesive Film AF 191 is a thermosetting, modified epoxy designed for bonding composites, metal to metal and metal to honeycomb components where high strength and peel at 350°F (177°C) is required. It offers the following advantages:

- Unique toughening system.
- High shear strength.
- Excellent elevated temperature performance.
- Extremely high peel strength.
- Excellent long-term durability.
- Excellent cryogenic performance.
- Flexible cure cycles (275-400°F).
- Unsupported versions (Scotch-Weld AF 191U Film) available for reticulation.
- Isolation version (Scotch-Weld AF 191G108 Film) available for bonding dissimilar substrates.
- Sprayable version of Scotch-Weld AF 191 Film available (3M™ Scotch-Weld™ Structural Adhesive Primer EC-3710).
- Available with light-weight conductive screens for lightning strike/composite surfacing applications.

#### Product Description

Product	Scotch-Weld AF 191K Film	Scotch-Weld AF 191K Film	Scotch-Weld AF 191M Film	Scotch-Weld AF 191M Film	Scotch-Weld AF 191M Film	Scotch-Weld AF 191U Film	Scotch-Weld AF 191U Film	Scotch-Weld AF 191U Film
Film Weight: ( $\pm .005$ lb/ft <sup>2</sup> ) ( $\pm 24.4$ g/m <sup>2</sup> )	.100 488	.08 390	.06 293	.035 170	.030 146	.05 244	.035 170	.015 73
Film Thickness (mils)	16	13	10	6	5	8	6	2.5
Scrim: K = Nylon Knit M = Polyester Matte U = Unsupported	K	K	M	M	M	U	U	U
Recommended Cure Temperature:	350°F (177°C)*							
Recommended Cure Time:	1 Hour*							
Volatile Content:	Less than 1%							
Color:	Tan							

\*Note: See alternate cure cycle information.

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## Typical Product Performance

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

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 (3.1 Bar). A 4-5°F (2-3°C) minute rise rate to cure temperature was used. Parts were cooled below 200°F (93°C) before removing from autoclave.

### 1. Thick Adherend Shear with 3M™ Scotch-Weld™ Structural Adhesive Film AF 191K (.08 lb/ft<sup>2</sup>) – Tested on phosphoric acid anodized, unprimed aluminum

Test Temperature °F (°C)	Stress (psi)	Strain, %	Modulus (psi)
-67°F (-55°C)	4278	3.58	119,680
75°F (23°C)	1885	2.11	103,380
250°F (121°C)	1247	2.67	44,720
350°F (177°C)	900	3.12	28,670

### 2. 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 2024-T3 aluminum. Tests were conducted per MMM-A-132. Values are in psi (MPa).

Temperature °F (°C)	Scotch-Weld AF 191K Film .10 lb/ft <sup>2</sup> (488 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191K Film .08 lb/ft <sup>2</sup> (390 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191M Film .06 lb/ft <sup>2</sup> (293 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191M Film .035 lb/ft <sup>2</sup> (170 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191M Film .030 lb/ft <sup>2</sup> (146 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191U Film .05 lb/ft <sup>2</sup> (244 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191U Film .035 lb/ft <sup>2</sup> (170 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191U Film .015 lb/ft <sup>2</sup> (73 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer
-423 (-253)	1460 (10.1)	–	–	–	–	1755 (12.1)	–	–
-67 (-55)	4000 (27.6)	4700 (32.4)	4300 (29.6)	5350 (36.9)	4000 (27.6)	4000 (27.6)	4000 (27.6)	–
75 (23)	4500 (31.0)	5400 (37.2)	5100 (35.2)	5060 (34.9)	5000 (34.5)	4500 (31.0)	5000 (34.5)	4100 (28.3)
250 (121)	–	3200 (22.1)	3200 (22.1)	–	3050 (21.0)	–	–	–
300 (149)	3000 (20.7)	2800 (19.3)	–	3770 (26.0)	–	2300 (16.0)	2300 (16.0)	2400 (16.5)
350 (177)	2600 (17.9)	2100 (14.5)	1700 (11.7)	2900 (20.0)	1900 (13.1)	2000 (14.0)	2000 (14.0)	2000 (14.0)

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

Peel strength was measured on 1" wide specimens cut from 3" x 8" x .063" 2024-T3 bare aluminum panels bonded to 3" x 10" x .025" 2024-T3 bare panels. Tests were conducted according to ASTM D 3167.

Test Temperature °F (°C)	Scotch-Weld AF 191K Film 0.080 lb/ft <sup>2</sup> (390 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191U Film 0.05 lb/ft <sup>2</sup> (244 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191K Film 0.03 lb/ft <sup>2</sup> (146 g/m <sup>2</sup> ) Scotch-Weld EC-3917 Primer
-67 (-55)	15 piw (66 N/25 mm)	–	21 piw (92 N/25 mm)
75 (23)	40 piw (175 N/25 mm)	30 piw (131 N/25 mm)	45 piw (197 N/25 mm)
250 (121)	–	–	30 piw (131 N/25 mm)
350 (177)	–	–	24 piw (105 N/25 mm)

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## Typical 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 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.

Temperature °F (°C)	Climbing Drum Peel 3M™ Scotch-Weld™ Structural Adhesive Film AF 191 / 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917	
	Scotch-Weld AF 191K Film 0.080 lb/ft <sup>2</sup> (390 g/m <sup>2</sup> )	Scotch-Weld AF 191U Film 0.05 lb/ft <sup>2</sup> (244 g/m <sup>2</sup> )
	In•lb/3" (cm•N/cm)	In•lb/3" (cm•N/cm)
-67 (-55)	39 (57.8)	–
75 (23)	43 (63.8)	40* (59.3)*
250 (121)	24 (35.6)	–
350 (177)	17 (25)	–
		*Reticulated on Core
Skin: .020" thick 2024-T3 bare aluminum. Core: .50" thick, 1/4" cell, 4 mil foil, 5052 aluminum.		

### 5. Metal to Honeycomb – Flatwise Tensile

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

Test Temperature °F (°C)	Scotch-Weld AF 191K Film (.10) with Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191K Film (.08) with Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191M Film (.035) with Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191U Film (.05) with Scotch-Weld EC-3917 Primer
-423 (-253)	691 psi ( 4.8 MPa)	–	–	697 psi (4.8 MPa)
-67 (-55)	1500 psi (10.3 MPa)	1600 psi (10.9 MPa)	940 psi (6.5 MPa)	1288* psi (8.9 MPa)
75 (23)	1500 psi (10.3 MPa)	1400 psi ( 9.7 MPa)	680 psi (4.7 MPa)	1016* psi (7.0 MPa)
300 (149)	650 psi ( 4.5 MPa)	–	–	490* psi (3.4 MPa)
350 (177)	600 psi ( 4.1 MPa)	450 psi ( 3.1 MPa)	245 psi (1.7 MPa)	378* psi (2.6 MPa)
				*Reticulated on Core
Skin: .020" thick 2024-T3 bare. Honeycomb Core: .50" thick, 1/4" cell, 4 mil foil, 5052 aluminum				

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## Typical 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. MMM-A-132B Type II Test Data

Cure Cycle: 350°F – 60 minutes – 45 psig – 4 to 5°F per minute rise rate.

MMM-A-132B Test	MMM-A-132B Type II Requirements	3M™ Scotch-Weld™ Structural Adhesive Film AF 191K (0.080 lb/ft <sup>2</sup> ) 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917
75°F shear	2750 psi	4680 psi
300°F shear	2250 psi	2853 psi
300°F shear after 192 hours at 300°F	2250 psi	3558 psi
-67°F shear	2750 psi	3935 psi
75°F shear after 30 days at 120°F and 95-100% RH	2750 psi	4992 psi
75°F shear after immersion		
a.) 7 days in MIL-H-83282	2750 psi	4993 psi
b.) 7 days in MIL-T-5624	2750 psi	4875 psi
75°F Fatigue	750, psi 10 <sup>6</sup> cycles	No Failure
75°F creep 1600 psi – 192 hours	0.015" maximum	0
300°F creep	0.015" maximum	0.0002"

### 7. MIL-A-25463B Type II Test Data

Description Test Number	MIL-A-25463B Type II Requirements	Scotch-Weld AF 191K Film (0.080 lb/ft <sup>2</sup> ) Scotch-Weld EC-3917 Primer
Sandwich Peel $\frac{\text{in}\cdot\text{lb}}{\text{in}}$ width		
Normal Temperature	10	15.8
180 ± 2°F	10	14.5
-67 ± 2°F	10	11.5
Flatwise Tensile Strength (psi)		
Normal Temperature	750	1413
300 ± 5°F	350	554
-67 ± 2°F	800	1735
Flexural Strength (lb)		
Normal Temperature	2100	3181
300 ± 5°F	1500	1838
-67 ± 2°F	2150	3167
Flexural Strength after 192 hours Exposure (lb)		
300 ± 5°F	1200	1861
Creep Deflection flexure when loaded for max. 192 hours max. deflection		
Normal Temperature/1600 psi (inch)	.025	0.001
300 ± 5°F/1000 psi (inch)	0.05	0.038
Flexure Strength after 30 days exposure (lb)		
To 95 to 100% RH at 120 ± 2°F	1800	3197
To turbine fuel JP-4 of MIL-T-5624	1800	3148

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**Typical 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.**

## 8. High Temperature Durability Data – Metal to Metal Overlap Shear

Bonds were made on 2024-T3 FPL etched and primed aluminum and exposed at 350°F (177°C). Overlap shear values were obtained at 75°F (23°C) and at 350°F (177°C) as indicated below.

Hours of Exposure at 350°F (177°C)	Overlap Shear Scotch-Weld AF 191K Film 0.08 lb/ft <sup>2</sup> (390 g/m <sup>2</sup> )/Scotch-Weld EC-3917 Primer			
	75°F (23°C)		350°F (177°C)	
Hours	psi	(MPa)	psi	(MPa)
0	5150	(35.5)	2367	(16.3)
1000	3967	(27.4)	2960	(20.4)
2500	3606	(24.9)	3046	(21.0)
6000	3050	(21.0)	3020	(20.8)
11000	2973	(20.4)	2920	(20.1)
17120	2740	(18.9)	2760	(19.0)
26000	2480	(17.1)	2470	(17.0)
34320	2015	(13.9)	2440	(16.8)

## 9. Prebond Humidity Resistance (relative humidity exposure before cure)

3M™ Scotch-Weld™ Structural Adhesive Film AF 191K 0.080 lb/ft<sup>2</sup> (390 g/m<sup>2</sup>) film was exposed to 50% relative humidity and 77°F (23°C) for the number of days specified below before bonding using 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917.

Properties	Test Temp.	Control	2 Days	4 Days	7 Days	8 Days	10 Days
Overlap Shear (SW EC-3917 Primer) (psi)	75°F 350°F	4800 2726	4666 2543	4666 2646	4646 2773	4433 2633	4406 2573
Floating Roller Peel (SW EC-3917 Primer) (piw)	75°F	27	26	23	21	20	17
Honeycomb Peel 3/8" cell (in•lb) 3"	75°F	35	35	35	36	35	32
Flatwise Tensile (psi) (3/8" cell)	75°F 300°F	1050 406	— —	1022 438	1046 392	— —	— —

Overlap Shear — 2024-T3 clad 4" x 7" x .063". FPL etched and primed with Scotch-Weld EC-3917 Primer.  
 Floating Roller Peel — 2024-T3 bare 3" x 8" x .063" and 3" x 10" x .025" FPL etched and primed with Scotch-Weld EC-3917 Primer.  
 Honeycomb Peel — 2024-T3 clad, 8" x 3" x .020" face sheet, 3/8" cell, 5056 alloy, 5/8" thick, 3 mil foil, NP, CI type.  
 Flatwise Tensile — 2024-T3 bare, 8" x 8" x .020" FPL etched and primed with Scotch-Weld EC-3917 Primer.

## 10. Prebond Open Time Data

Scotch-Weld AF 191U Film 0.035 lb/ft<sup>2</sup> (170 g/m<sup>2</sup>) was exposed at 92 ± 2°F (33 ± 1°C) at low relative humidity for the number of days specified below before bonding using Scotch-Weld EC-3917 Primer. For flatwise tensile specimens, the film was reticulated after 50% of specified aging and completed aging on the core.

Properties	Test Temp.	Control		7 Days		10 Days	
		psi	(MPa)	psi	(MPa)	psi	(MPa)
Wide Area Lap Shear	75°F (23°C)	3300	22.8	3413	23.5	3326	22.9
	350°F (177°C)	2326	16.0	2357	16.3	2200	15.2
Flatwise Tensile	75°F (23°C)	836	5.8	811	5.6	—	—
	350°F (177°C)	272	1.9	297	2.0	—	—

Wide Area Lap Shear — 2024-T3 clad, 6" x 8" x .063" panel FPL etched and primed with Scotch-Weld EC-3917 Primer.  
 Flatwise Tensile — 2024-T3 clad 8" x 8" x .032" panel FPL etched and primed with Scotch-Weld EC-3917 Primer.  
 Core — 5052 alloy, 3/8" cell, 4 mil foil, 5/8" thick, NP, CI.

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**Typical 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.**

## 11. Effect of Composite Post Cure Cycles of 400°F (205°C) and 450°F (232°C)

3M™ Scotch-Weld Structural Adhesive Film AF 191K (0.08 lb/ft<sup>2</sup>) compatibility with composite cure cycles that require post cure at 400°F (205°C) or 450°F (232°C) is shown below. Scotch-Weld AF 191 Film was first cured for 1 hour at 350°F (177°C) using a 4-5°F (2.2-2.7°C) rise rate and 45 psi (0.31 MPa) and FPL Etched 2024-T3 alclad 0.063" thick using 3M™ Scotch-Weld Structural Adhesive Primer EC-3917. Scotch-Weld AF 191 Film was then exposed to the post cures specified below to simulate different composite cure cycles.

### Overlap Shear Strength @ -67, 75, 350, and 400°F Test Temperature

Hours Exposed At 400°F (204°C):	Test Temperature	-67°F (-55°C) psi (MPa)	75°F (23°C) psi (MPa)	350°F (177°C) psi (MPa)	400°F (204°C) psi (MPa)
<b>Control</b> (Zero Hours)		4400 (30.3)	4897 (33.8)	2800 (19.3)	1750 (12.1)
2 Hours		4450 (30.7)	4896 (33.8)	2870 (19.8)	2106 (14.5)
4 Hours		4503 (31.1)	4866 (33.6)	2960 (20.4)	2273 (15.7)
6 Hours		4433 (30.6)	4772 (32.9)	2910 (20.0)	2190 (15.1)
Hours Exposed At 450°F (232°C):	Test Temperature	-67°F (-55°C) psi (MPa)	75°F (23°C) psi (MPa)	350°F (177°C) psi (MPa)	400°F (204°C) psi (MPa)
<b>Control</b> (Zero Hours)		4400 (30.3)	4897 (33.8)	2800 (19.3)	752 (5.2)
2 Hours		4500 (31.0)	4789 (33.0)	2846 (19.6)	846 (5.8)
4 Hours		4263 (29.4)	4617 (31.8)	2953 (20.4)	816 (5.6)
6 Hours		4226 (29.1)	4582 (31.6)	2600 (17.9)	793 (5.5)

### Peel Strength At 75°F (23°C)

Hours Exposed At 400°F (204°C)	Honeycomb Peel		Floating Roller Peel	
	$\frac{\text{in}\cdot\text{lb}}{3''}$	(cm•N/cm)	piw	(N/25 mm)
<b>Control</b> (Zero Hours)	46	(68)	28	(125)
2 Hours	28	(42)	20	(89)
4 Hours	28	(42)	25	(111)
6 Hours	27	(40)	17	(76)
Hours Exposed At 450°F (232°C)	Honeycomb Peel		Floating Roller Peel	
	$\frac{\text{in}\cdot\text{lb}}{3''}$	(cm•N/cm)	piw	(N/25 mm)
<b>Control</b> (Zero Hours)	46	(68)	28	(125)
2 Hours	29	(43)	23	(102)
4 Hours	30	(44.5)	27	(120)
6 Hours	30	(44.5)	23	(102)

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**Typical Product**

**Performance (continued)**

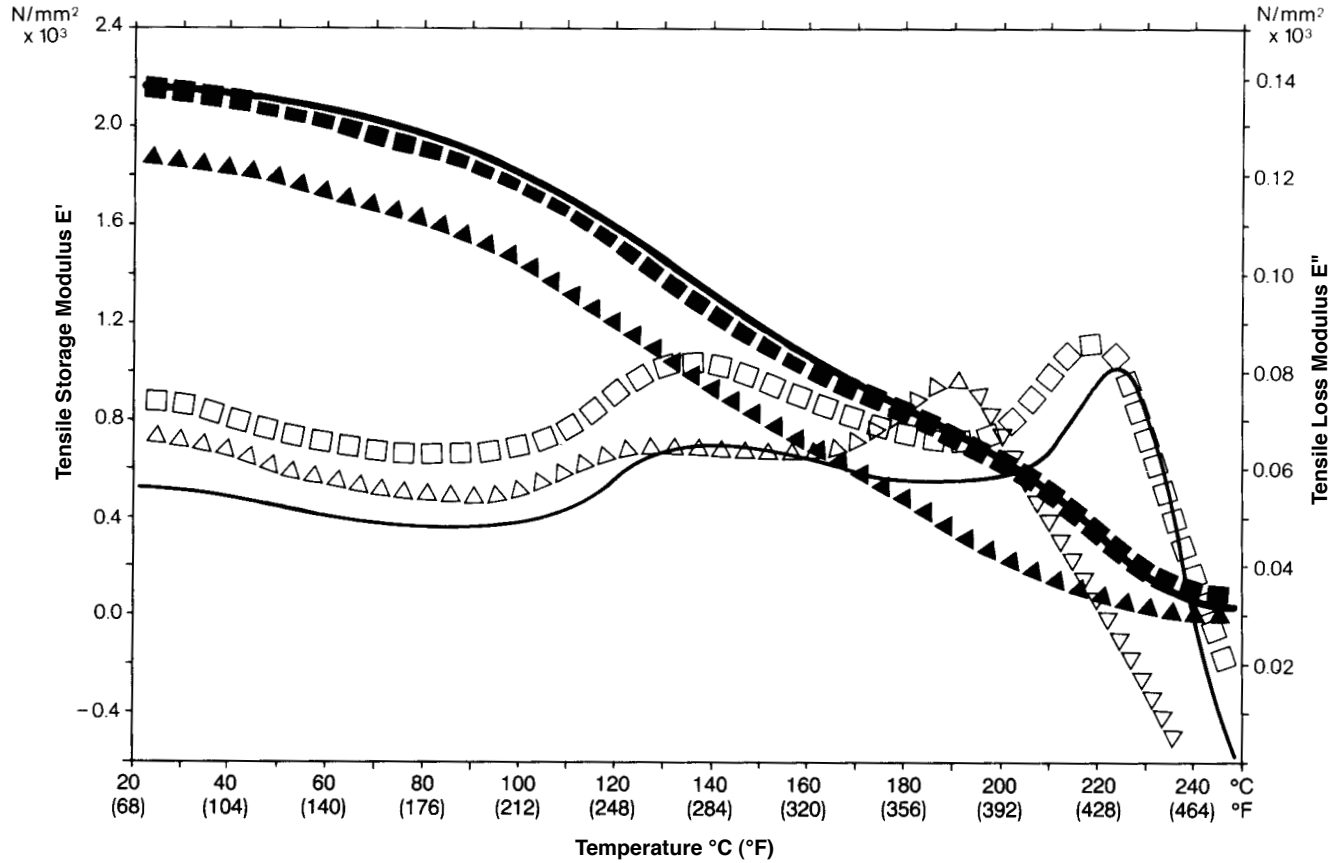
**Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.**







**12. Dynamic Mechanical Analysis**

3M™ Scotch-Weld™ Structural Adhesive Film AF 191U .035 lb/ft<sup>2</sup> (170 g/m<sup>2</sup>) cured under standard conditions.

Specimen size: 11.7 x 10.2 x 1.5 mm.

Test equipment: Dupont™ 1090 – Heating Rate: 20°C/minute



Conditions After Cure	Glass Transition Temp.	Cure Characteristics Graph Key E' = Tensile Storage Modulus E'' = Tensile Loss Modulus
Dry	439°F (226°C)	E'  E'' 
20 Days, 90°F (33°C) 83% relative humidity (1.42% water absorption)	424°F (218°C)	E'  E'' 
20 Days, 120°F (49°C) 100% relative humidity (2.8% water absorption)	374°F (190°C)	E'  E'' 

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**Typical 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.

### 13. Dielectric Constant and Dissipation Factor of 3M™ Scotch-Weld™ Structural Adhesive Film AF 191

	Frequency	Dielectric Constant	Dissipation Factor
Scotch-Weld AF 191K Film	1 MHz	3.56	$2.4 \times 10^{-2}$
Scotch-Weld AF 191U Film	1 MHz	4.75	$2.7 \times 10^{-2}$

**Note:** Tests per ASTM D 150 and ASTM D 3380.

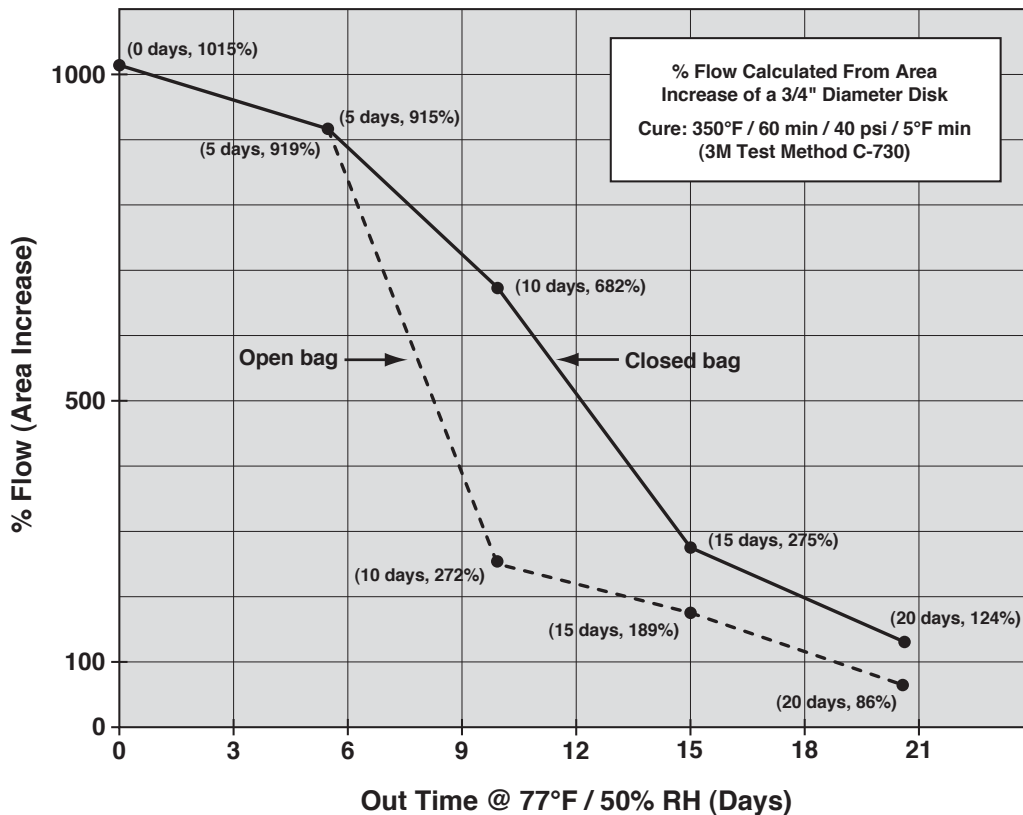
### 14. Scotch-Weld AF 191U Film Reticulation

Reticulation parameters for 1/4" or 3/16" cell size aluminum honeycomb core. Reticulation was completed on a MacKay Reticulator Model 320 (Mac Kay Industries, Temecula, CA).

Scotch-Weld AF 191U Film Weight	Knife Width	Temperature	Air Pressure	Pre Heat	Lamp Height	Speed Setting
.05 lb/ft <sup>2</sup>	3/16"	225°F	.5" of H <sub>2</sub> O	375°F	6"	6"/min.
	1/4"	235°F	.5" of H <sub>2</sub> O	350°F	6"	6"/min.

### 15. Scotch-Weld AF 191 Film Flow

**Scotch-Weld AF 191K Film (.08 lbs/ft<sup>2</sup>)  
% Flow vs. Out Time @ 77°F / 50% R.H.**





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## 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 Test Method C-2803 or ASTM D 2651).

1. Alkaline Degrease – Oakite® Aluminum Cleaner 164 (Chemetall GmbH) or equivalent solution 9-11 oz/gallon water at  $190 \pm 10^\circ\text{F}$  for 10-20 minutes. Rinse immediately in large quantities of cold running water.

2. Optimized FPL Etch Solution (1 liter):

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
Aluminum Chips	1.5 grams/liter of mixed solution

To prepare 1 liter of this solution, dissolve sodium dichromate in 700 ml of distilled water. Add sulfuric acid and mix well. Add additional distilled water to fill to 1 liter. Heat mixed solution to  $66$  to  $71^\circ\text{C}$  ( $150$  to  $160^\circ\text{F}$ ). Dissolve 1.5 grams of 2024 bare aluminum chips per liter of mixed solution. Gentle agitation will help aluminum dissolve in about 24 hours.

Place panels in FPL etch solution heated to  $150$ - $160^\circ\text{F}$  ( $66$ - $71^\circ\text{C}$ ) for 12-15 minutes.

**Note:** Review and follow safety and precautionary information provided by chemical supplier prior to preparation of this etch solution.

3. Rinse – Rinse panels in clear running tap water.
4. Dry – Air dry 15 minutes; force dry 10 minutes minimum at  $140^\circ\text{F}$  ( $60^\circ\text{C}$ ) maximum.
5. If primer is to be used, it should be applied within 4 hours after surface preparation.

### B. Aluminum Honeycomb Core

1. Soak in clean Aliphatic Naphtha (TT-N-95A) for five minutes at room temperature. Dry for 10 minutes minimum at  $140^\circ\text{F}$  ( $60^\circ\text{C}$ ) maximum.
2. Optional – Immerse in FPL etching solutions for two (2) minutes at  $155 \pm 5^\circ\text{F}$ .

Rinse, air dry and force dry in similar manner to skin panels.

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#### **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 191 using the following procedure:

Spray Application: Refer to Scotch-Weld EC-3917 Primer Technical Data Sheet for equipment and technique.

#### **Primer Dry Cycle:**

Air Dry: 30 minutes minimum at ambient temperature.

Force Dry: 60 minutes at 250°F in an air circulating oven.

Primer Thickness: Approximately 0.1 mil (dry).

#### **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, apply pressure, and cure.

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**Cure Cycle** A cure of 60 minutes at 350°F and 45 ± 5 psi positive pressure is suggested when maximum performance is desired.

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

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

**Cure Cycle (Autoclave, Vacuum Bag, or Platen Press)**

1. Apply vacuum or pressure to keep assembled parts in place.
2. If using autoclave: Apply positive pressure slowly until 14 psi positive pressure is applied. Once reached, dump vacuum bag.
3. If using vacuum bag only, limit vacuum to 5-10 inches of mercury. This is necessary to prevent frothing in the bondline.
4. Increase bondline temperature rise rate.
5. Increase bonding pressure.
6. Cure.
7. Cool.
8. Decrease pressure when temperature is below 200°F.

**Recommended  
Cure Cycle**  
4-5°F/min.  
45 ± 5 psi  
350 ± 10°F  
5-10°F/min.

**3M™ Scotch-Weld™ Structural Adhesive Film AF 191 Low Temperature  
Cure Data**

Cure Cycle	OLS (psi) at Test Temperature					Bell Peel at 75°F
	-67°F	72°F	250°F	300°F	350°F	
1 hr, 350°F, 45 psi	4217	5285	–	3613	2833	35 piw
1 hr, 300°F, 45 psi	1767	5357	–	1133	857	55 piw
90 min., 300°F, 25 psi	2510	5480	2490	–	–	39 piw
2 hr, 300°F, 45 psi	4200	5636	–	2873	2003	50 piw
2 hr, 275°F, 45 psi	1767	5163	–	1093	613	67 piw
3 hr, 275°F, 45 psi	3533	5793	–	2243	1207	51 piw

**Storage** Storage Stability – Storage at 0°F (-18°C) or below is recommended for Scotch-Weld AF 191 Film to obtain maximum storage life.

**Shelf Life** Standard shelf life of Scotch-Weld AF 191 Film at 0°F (-18°C) is 6 months from date of shipment.

**Note:** Scotch-Weld AF 191 Film 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).

# 3M™ Scotch-Weld™ Structural Adhesive Film AF 191 Technical Datasheet

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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, please visit [www.3M.com/msds](http://www.3M.com/msds) or call 1-800-364-3577 or (651) 737-6501.

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## For Additional Information

In the U.S., call toll free 1-800-235-2376, or fax 1-800-435-3082 or 651-737-2171. For U.S. Military, call 1-866-556-5714. If you are outside of the U.S., please contact your nearest 3M office or one of the following branches:

<b>Australia</b> 61-2-498-9711 tel 61-2-498-9710 fax	<b>Austria</b> 01-86686-298 tel 01-86686-229 fax	<b>Brazil</b> 55 19 3838-7876 tel 55 19 3838-6892 fax	<b>Canada</b> 800-410-6880 ext. 6018 tel 800-263-3489 fax
<b>China</b> 86-21-62753535 tel 86-21-62190698 fax	<b>Denmark</b> 45-43-480100 tel 45-43-968596 fax	<b>France</b> 0810-331-300 tel 30-31-6195 fax	<b>Germany</b> 02131-14-2344 tel 02131-14-3647 fax
<b>Italy</b> 02-7035-2177 tel 02-7035-2125 fax	<b>Japan</b> 03-3709-8245 tel 03-3709-8743 fax	<b>Korea</b> 02-3771-4114 tel 02-786-7429 fax	<b>Netherlands</b> 31-71-5-450-272 tel 31-71-5-450-280 fax
<b>South Africa</b> 11-922-9111 tel 11-922-2116 fax	<b>Spain</b> 34-91-321-6000 tel 34-91-321-6002 fax	<b>Switzerland</b> 01-724-9114 tel 01-724-9068 fax	<b>United Kingdom</b> (0) 161-237-6174 tel (0) 161-237-3371 fax

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## Technical Information

The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

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## Product Use

Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. Given the variety of factors that can affect the use and performance of a 3M product, user is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application.

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This product was manufactured under a 3M quality standard registered under AS9100 standards.



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