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3M™ Scotch-Weld™ Structural Adhesive Film AF 191

Technical Data Sheet

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.

Key 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

NOTE: All technical data and information in this data sheet should be considered representative or typical only and should not be used for specification purposes.

Product	**Scotch-Weld AF 191K Film**		**Scotch-Weld AF 191M Film**			**Scotch-Weld AF 191U Film**		
Film Weight: ± .005 lb/ft² (± 24.4 g/m²)	.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	Nylon Knit		Nylon Matte			Unsupported		
Recommended Cure Temperature	350°F (177°C)*		350°F (177°C)*			350°F (177°C)*		
Recommended Cure Time	1 Hour*		1 Hour*			1 Hour*		
Volatile Content	Less than 1%		Less than 1%			Less than 1%		
Color	Tan		Tan			Tan		

* See alternate cure cycle information.

Product Performance

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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/ft²) — 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 Scotch-Weld EC-3917 Primer		Scotch-Weld AF 191M Film Scotch-Weld EC-3917 Primer			Scotch-Weld AF 191U Film Scotch-Weld EC-3917 Primer		
	.100 lb/ft² (488 g/m²)	.08 lb/ft² (390 g/m²)	06 lb/ft² (293 g/m²)	.035 lb/ft² (170 g/m²)	.030 lb/ft² (146 g/m²)	.05 lb/ft² (244 g/m²)	.035 lb/ft² (170 g/m²)	.015 lb/ft² (73 g/m²)
-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 .08 lb/ft² (390 g/m²) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191U Film .05 lb/ft² (244 g/m²) Scotch-Weld EC-3917 Primer	Scotch-Weld AF 191M Film .03 lb/ft² (146 g/m²) Scotch-Weld EC-3917 Primer
-67°F (-55°C)	15 piw (66 N/25 mm)	–	21 piw (92 N/25 mm)
75°F (23°C)	40 piw (175 N/25 mm)	30 piw (131 N/25 mm)	45 piw (197 N/25 mm)
250°F (121°C)	–	–	30 piw (131 N/25 mm)
350°F (177°C)	–	–	24 piw (105 N/25 mm)

Product Performance cont.

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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.

Test Temperature °F (°C)	Climbing Drum Peel 3M™ Scotch-Weld™ Structural Adhesive Film AF 191 / 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917			
	AF 191K .08 lb/ft² (390 g/m²)		AF 191U .05 lb/ft² (244 g/m²)	
	In•lb/3"	(cm•N/cm)	In•lb/3"	(cm•N/cm)
-67°F (-55°C)	39	(57.8)	–	–
75°F (23°C)	43	(63.8)	40*	(59.3)*
250°F (121°C)	24	(35.6)	–	–
350°F (177°C)	17	(25)	–	–
Skin: .020" thick 2024-T3 bare aluminum. **Core:** .50" thick, 1/4" cell, 4 mil foil, 5052 aluminum.				

* Reticulated on Core

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)
Skin: .020" thick 2024-T3 bare aluminum. **Honeycomb Core:** .50" thick, 1/4" cell, 4 mil foil, 5052 aluminum.				

* Reticulated on Core

Product Performance cont.

NOTE: All technical data and information in this data sheet 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/ft²) 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 106 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	MMM-A-25463B Type II Requirements	3M™ Scotch-Weld™ Structural Adhesive Film AF 191K (0.080 lb/ft²) 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917
Sandwich Peel in•lb/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 (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

Product Performance cont.

NOTE: All technical data and information in this data sheet 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.

Exposure at 350°F (177°C)	Overlap Shear 3M™ Scotch-Weld™ Structural Adhesive Film AF 191K 0.08 lb/ft² (390 g/m²)/ 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917			
	Test Temperature			
	75°F	(23°C)	350°F	(177°C)
Hours	**psi**	**(MPa)**	**psi**	**(MPa)**
0	5150	(35.5)	2367	(16.3)
1,000	3967	(27.4)	2960	(20.4)
2,500	3606	(24.9)	3046	(21.0)
6,000	3050	(21.0)	3020	(20.8)
11,000	2973	(20.4)	2920	(20.1)
17,120	2740	(18.9)	2760	(19.0)
26,000	2480	(17.1)	2470	(17.0)
34,320	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/ft² (390 g/m²) 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 (psi) SW EC-3917 Primer	75°F 300°F	4800 2726	4666 2543	4666 2646	4646 2773	4433 2633	4406 2573
Floating Roller Peel (pwi) SW EC-3917 Primer	75°F	27	26	23	21	20	17
Honeycomb Peel (in•lb)/3" 3/8" cell	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/ft² (170 g/m²) 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
Wide Area Lap Shear	75°F (23°C) 300°F (177°C)	3300 psi (22.8 MPa) 2326 psi (16.0 MPa)	3413 psi (23.5 MPa) 2357 psi (16.3 MPa)	3326 psi (22.9 MPa) 2200 psi (15.2 MPa)
Flatwise Tensile	75°F (23°C) 300°F (177°C)	836 psi (5.8 MPa) 272 psi (1.9 MPa)	811 psi (5.6 MPa) 297 psi (2.0 MPa)	– –

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.

Product Performance cont.

NOTE: All technical data and information in this data sheet 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^2) 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

	Test Temperature							
Hours Exposed at 400°F (204°C)	**-67°F psi**	**(-55°C) (MPa)**	**75°F psi**	**(23°C) (MPa)**	**350°F psi**	**(177°C) (MPa)**	**400°F psi**	**(204°C) (MPa)**
Control (0 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°)	**-67°F psi**	**(-55°C) (MPa)**	**75°F psi**	**(23°C) (MPa)**	**350°F psi**	**(177°C) (MPa)**	**400°F psi**	**(204°C) (MPa)**
Control (0 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 @ 75°F (23°C)

	Honeycomb Peel		Floating Roller Peel	
Hours Exposed at 400°F (204°C)	**in•lb/3"**	**(cm•N/cm)**	**piw**	**(N/25 mm)**
Control (0 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°)	**in•lb/3"**	**(cm•N/cm)**	**piw**	**(N/25 mm)**
Control (0 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)

Product Performance cont.

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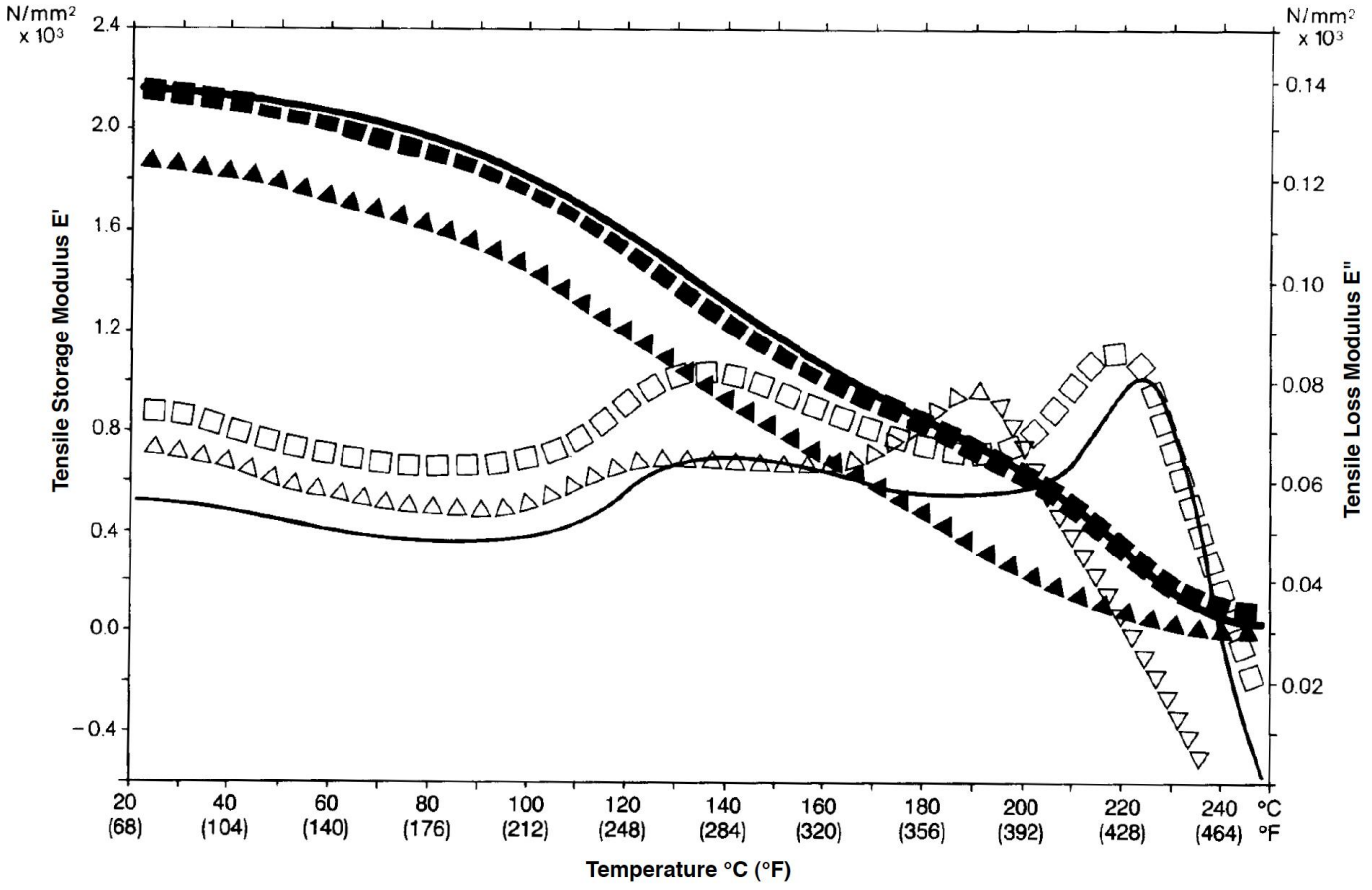
12. Dynamic Mechanical Analysis

3M™ Scotch-Weld™ Structural Adhesive Film AF 191U .035 lb/ft^2 (170 g/m^2) 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 Temperature**	**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" △△△△△△△△△△

Product Performance cont.

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

Tests per ASTM D 150 and ASTM D 3380.

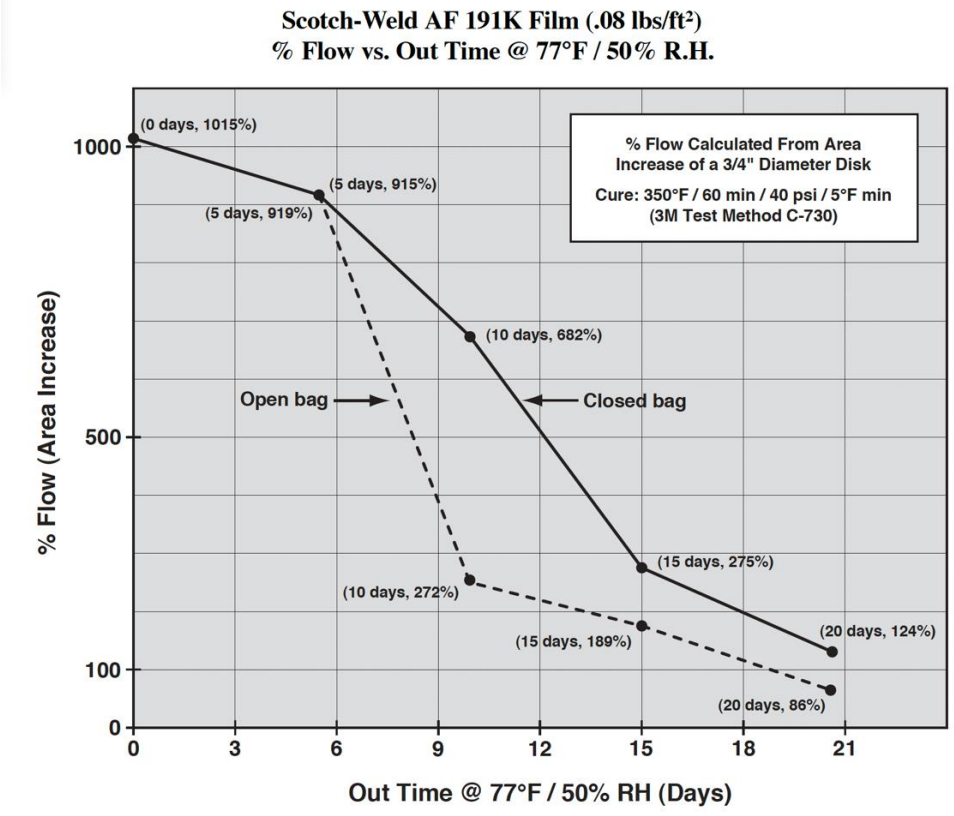
	Frequency	Dielectric Constant	Dissipation Factor
Scotch-Weld AF 191K Film	1 MHz	3.56	2.4×10^{-2}
Scotch-Weld AF 191U Film	1 MHz	4.75	2.7×10^{-2}

14. 3M™ Scotch-Weld™ Structural Adhesive Film AF 191U 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^2	3/16"	225°F	.5" of H_2O	375°F	6"	6"/min.
	1/4"	235°F	.5" of H_2O	350°F	6"	6"/min.

15. Scotch-Weld AF 191 Film Flow



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.

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 ± 10°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 2	87.9 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 66–71°C (150 –160°F). Dissolve1.5 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 to 160°F (66 to 71°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°F (60°C) maximum.

5. If primer is to be used, it should be applied within 4 hours after surface preparation.

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°F (60°C) maximum.

2. Optional — Immerse in FPL etching solutions for two (2) minutes at 155 ± 5°F.
3. Rinse, air dry and force dry in similar manner to skin panels.

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.

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, ensuring that no air is trapped between film and panel.
5. Remove second protective liner.
6. Assemble parts, apply pressure, and cure.

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.

Cure Cycle cont.

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 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 condition

Authorization to Use

Ensure products meet all applicable specifications, standards, and maintenance manual requirements for the platform being worked on and validate all aircraft approvals against current technical documentation.

These products are manufactured under a 3M Quality Management System registered to the AS9100 standard.

Automotive and Aerospace Solutions Division
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