Scotch-Weld™
Structural Adhesive Film
AF 555

Technical Data Sheet **October 2007**

Product Description

3M™ Scotch-Weld™ Structural Adhesive Film AF 555 is a thermosetting, modified epoxy adhesive film. It was designed for bonding of composites in conjunction with honeycomb or in a monolithic structure. Scotch-Weld AF 555 Film can be co-cured, co-bonded with composite prepregs, or used to bond cured composite.

Key Features

- Excellent pre-bond humidity performance on composite substrates.
- One-year out-time at ambient conditions.
- Unsupported version available for reticulation.
- Film adhesive can be cured from 300°F (150°C) up to 355°F (180°C).
- Excellent shop handling characteristics (easy to use in shop).
- Available with light-weight conductive screens for lightning strike/composite surfacing applications.

Available Constructions:

Construction	Weight (± .005) Lb/ft^2	Nominal Thickness (mils)
Scotch-Weld AF 555U Film	0.015	2.5
Scotch-Weld AF 555U Film	0.030	5.5
Scotch-Weld AF 555U Film	0.035	6.0
Scotch-Weld AF 555U Film	0.050	8.0
Scotch-Weld AF 555U Film	0.060	10.0
Scotch-Weld AF 555U Film	0.080	13.0
Scotch-Weld AF 555M Film	0.015	2.5
Scotch-Weld AF 555M Film	0.030	5.5
Scotch-Weld AF 555M Film	0.0325	5.75
Scotch-Weld AF 555M Film	0.035	6.0
Scotch-Weld AF 555M Film	0.050	8.0
Scotch-Weld AF 555M Film	0.060	10.0
Scotch-Weld AF 555M Film	0.080	13.0
Scotch-Weld AF 555K Film	0.050	8.0
Scotch-Weld AF 555K Film	0.080	13.0
Scotch-Weld AF 555K Film	0.100	16.0
Scotch-Weld AF 555L Film	0.050	8.0

Code: U = Unsupported Film
M = Non-Woven Supporting Carrier (Matte)
K = Knit Supporting Carrier
L = Lightweight Non-Woven Supporting Carrier

Scotch-Weld AF 555 films are orange in both their uncured and fully cured form.

3M™ Scotch-Weld™
Structural Adhesive Film
AF 555

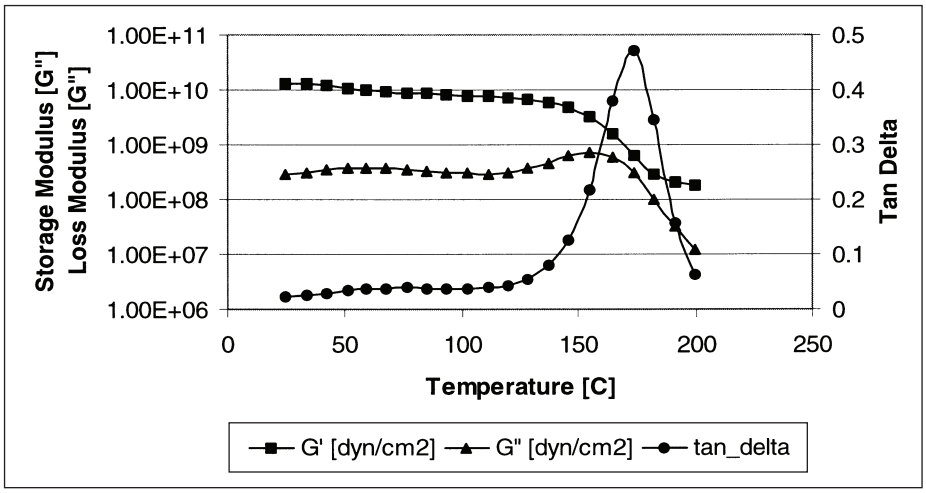
Typical Cured Physical Properties

Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

I. Torsion RDA

Test Equipment: Rheometric Dynamic Analyzer

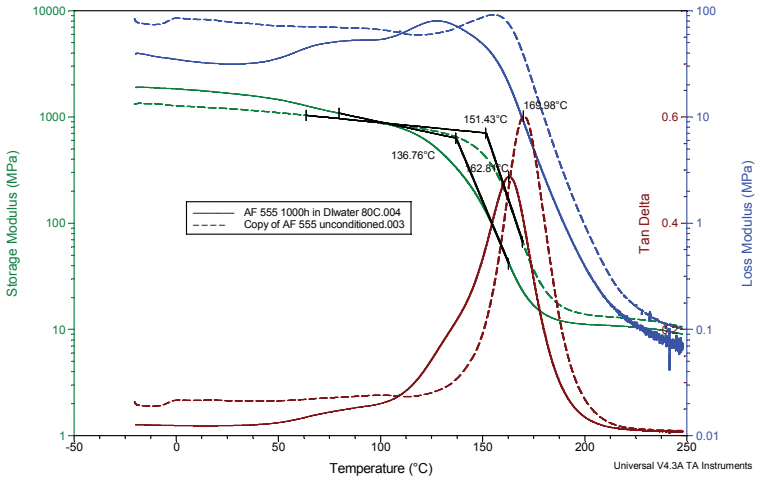
3M™ Scotch-Weld™ Structural Adhesive AF 555 Film unsupported adhesive was cured under standard conditions. Specimen size: 33.848 (L) x 12.44 (W) x 1.94 mm (T).



II. Dry / Wet Glass Transition Temperature

Cured Scotch-Weld AF 555 Film dry unconditioned vs. Scotch-Weld AF 555 Film aged in DI water for 1000 hours at 80°C.

	Onset Temp F [C]	Tan Delta Peak F [C]
Scotch-Weld AF 555 Film unconditioned	304 [151]	338 [170]
Scotch-Weld AF 555 Film aged in DI water for 1000 h @ 80°C	279 [137]	325 [163]



Typical Cured Physical Properties ***(continued)***

Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

III. Metal to Metal – Overlap Shear

Overlap Shear Specimens: 1" wide, 1/2" overlap specimen, 0.063" thick, FPL etched and phosphoric acid anodized 2024-T3 bare aluminum. Primed with 3M™ Scotch-Weld™ Structural Adhesive Primer EW-5000.

Test Temperature °F (°C)	Scotch-Weld AF 555 Film U 0.030 Wt. PSI (MPa)	Scotch-Weld AF 555 Film M 0.050 Wt. PSI (MPa)	Scotch-Weld AF 555 Film K 0.080 Wt. PSI (MPa)
-67 (-55)	4776 (33)	4850 (33)	4770 (33)
75 (23)	5416 (37)	5634 (39)	5765 (40)
277 (136)	2606 (18)	3016 (21)	4355 (30)
350 (177)	1571 (11)	1526 (11)	2252 (16)

IV. Metal to Metal – Floating Roller Peel

Floating roller peel specimens: 1/2" wide, 0.063" back panel, 0.025" skin 2024-T3 bare aluminum, FPL etched and phosphoric acid anodized. Primed with 3M™ Scotch-Weld™ Structural Adhesive Primer EW-5000.

Test Temperature °F (°C)	Scotch-Weld AF 555 Film U 0.030 Wt. PIW (N/25mm)	Scotch-Weld AF 555 Film M 0.050 Wt. PIW (N/25mm)	Scotch-Weld AF 555 Film K 0.080 Wt. PIW (N/25mm)
-67 (-55)	22 (97)	25 (111)	20 (89)
75 (23)	38 (169)	37 (165)	31 (138)
180 (177)	39 (173)	39 (173)	29 (129)

V. Metal to Honeycomb – Flatwise Tensile

All properties were measured on 2" x 2" honeycomb sandwich bonds. Primer used 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917. Tested in accordance with MIL-A-25463B and ASTM C-297.

Test Temperature		Scotch-Weld AF 555 Film 0.06M Wt. Supported, Unreticulated	
°F	°C	PSI	(MPa)
75	(23)	1117	(7.3)
277	(136)	468	(3.24)
Skin: 0.02" thick 2024-3T bare, FPL etched. Honeycomb Core: 0.50" thick, 1/4" cell, 0.004 foil, 5052 aluminum.			

Typical Cured Physical Properties ***(continued)***

Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

VI. High Temperature Durability Data – Metal to Metal Wide Area Overlap Shear

Bonds were made on FPL etched and phosphoric acid anodized 2024-3T bare 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. Primer used 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917. Tested in accordance with 3M TM C-265 (Aluminum to Aluminum Blister Detection Test).

Hours of exposure at 350°F (177°C)	Scotch-Weld AF 555 Film 0.06M Wt. Supported PSI (MPa)	
	at 75°F (23°C)	at 350°F (177°C)
0	3942 (27.2)	1981 (13.7)
240	4206 (29.0)	2066 (14.2)
864	4312 (29.7)	2115 (14.6)
1440	4193 (28.9)	2121 (14.6)

VII. High Temperature/Humidity Durability Data – Metal to Metal Wide Area Overlap Shear

3M™ Scotch-Weld™ Structural Adhesive Film AF 555 was exposed at the following temperature/humidity and loads for the number of days specified below before measuring creep. Bonds were made on FPL etched and phosphoric acid anodized 2024-T3 bare aluminum – using Scotch-Weld EC-3917 Primer and Scotch-Weld AF 555 Film 0.06M wt. supported. Specimens prepared in accordance with 3M TM C-265 (Aluminum to Aluminum Blister Detection Test).

Temperature °F	Temperature (°C)	Humidity (RH%)	Load (PSI)	Measured Creep (years)	Creep (mil)	Creep (mm)	Sustained Load (days)
140	(60)	100	2000	3	<0.5	(0.0127)	150
140	(60)	100	1500	3	<0.5	(0.0127)	150
140	(60)	100	1100	3	<0.5	(0.0127)	150
140	(60)	100	800	3	<0.5	(0.0127)	150
300	(149)		800	3	<0.5	(0.0127)	150
75	(23)	ambient	1600	3	<0.5	(0.0127)	150

VIII. Thick Adherend Shear

Scotch-Weld AF 555 Film tested on 1/2" thick FPL etched, Phosphoric Anodized 2024-T3 Aluminum primed with 3M™ Scotch-Weld™ Adhesive Primer EW-5000 AS. Full report available from 3M Technical Service upon request.

Test Temperature, °F (°C)	Ultimate Stress, psi (MPa)	Ultimate Strain, %	Shear Modulus, psi (MPa)
-65 (-54)	9660 (67)	0.309	0.171 (0.0012)
75 (24)	7610 (52)	0.556	0.063 (0.0004)
200 (93)	5220 (36)	0.935	0.041 (0.0003)
277 (136)	3790 (26)	1.344	0.011 (0.00008)

Typical Cured Physical Properties

Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

IX. Composite to Honeycomb – Short Beam Shear

All properties were measured on 3" X 6" specimens configured with three (3) plies of BMS8-256, Type IV, Class 2, Style 3K-70-PW co-cured at 350°F on each side of BMS8-124, Type I, Class1, Grade 8.0 (.50 inch thick and transverse with 6" dimension) honeycomb core with one ply of 3M™ Scotch-Weld™ Structural Adhesive Film AF 555 at each core/skin interface. Beam shear was tested in a three point configuration with a 4.00 ± 0.05" span with the tool side up (in compression) to MIL-STD-401 guidelines.

Test Temperature	Construct	lb_f	kN
75°F (24°C)	Scotch-Weld AF 555M Film .030 psf	2360	10.5
75°F (24°C)	Scotch-Weld AF 555M Film .035 psf	2316	10.3
75°F (24°C)	Scotch-Weld AF 555M Film .050 psf	2202	9.79
75°F (24°C)	Scotch-Weld AF 555K Film .050 psf	2264	10.1
75°F (24°C)	Scotch-Weld AF 555K Film .080 psf	2485	11.1

X. Composite to Composite – Flatwise Tensile

All properties were measured on 2" X 2" specimens configured with three (3) plies of BMS8-256, Type IV, Class 2, Style 3K-70-PW co-cured at 350°F on each side of BMS8-124, Type I, Class1, Grade 8.0 (.50 inch thick) honeycomb core with one ply of Scotch-Weld AF 555 Film at each core/skin interface. Flatwise Tension Test Blocks were subsequently bonded prior to testing and tested in accordance with MIL-STD-401.

Test Temperature	Construct	PSI	MPa
-65 °F (-55 °C)	Scotch-Weld AF 555M Film .030 psf	1156	7.97
75 °F (24 °C)	Scotch-Weld AF 555M Film .030 psf	1170	8.07
160 °F (71 °C)	Scotch-Weld AF 555M Film .030 psf	1000	6.89
-65 °F (-55 °C)	Scotch-Weld AF 555M Film .035 psf	1087	7.49
75 °F (24 °C)	Scotch-Weld AF 555M Film .035 psf	1062	7.32
160 °F (71 °C)	Scotch-Weld AF 555M Film .035 psf	949	6.54
-65 °F (-55 °C)	Scotch-Weld AF 555K Film .050 psf	849	5.85
75 °F (24 °C)	Scotch-Weld AF 555K Film .050 psf	1092	7.53
160 °F (71 °C)	Scotch-Weld AF 555K Film .050 psf	1129	7.78
-65 °F (-55 °C)	Scotch-Weld AF 555M Film .080 psf	1174	8.09
75 °F (24 °C)	Scotch-Weld AF 555M Film .080 psf	1266	8.73
160 °F (71 °C)	Scotch-Weld AF 555M Film .080 psf	1137	7.84

Typical Cured Physical Properties

Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

XI. Composite to Composite Overlap Shear

All properties were measured on 1" wide, 1/2" overlap specimen cut from epoxy/graphite fiber, ten ply unidirectional composite. Composite panels were cured using ten plies of carbon fiber prepreg, available as "Toray 3900-2/T800S", having an areal weight of 190 grams/meter^2 and a resin content of 35% (from Toray™ Carbon Fibers America, Incorporated, Decatur, Alabama). Tested in accordance with ASTM D3165.

Test Temperature		3M™ Scotch-Weld™ Structural Adhesive Film AF 555 0.06M Wt.	
°F	°C	PSI	(MPa)
75	(23)	5224	(36.0)
277	(136)	2938	(20.3)

XII. Composite Double Cantilever Beam (DCB) Test Per BMS 8-276

Mechanical Test to determine strength after Glasochrom Pencil Markings

Composite Material Spec BMS 8-276
Adhesive Scotch-Weld™ AF 555 Film 0.05M Wt. Supported
Test Condition 75ºF

	Width in	Crack Length in	Area in^2	Energy in*lbf	G1c in*lbf/in^2
Lot # A	0.498	4.227	2.1071	9.466	4.490
Lot # B	0.497	3.856	1.9164	8.038	4.213
Lot # C	0.497	7.839	3.8959	19.182	4.924
Lot # D	0.500	5.074	2.87	14.972	5.901
Lot # E	0.498	6.384	3.1792	16.040	5.050
Lot # F	0.497	7.332	3.6440	18.035	4.949

XIII. Out Time: Room Temperature Exposure

Scotch-Weld AF 555 Film was exposed at 77F (23C) / ambient humidity for the number of months specified prior to bonding. Primer used was 3M™ Scotch-Weld™ Structural Adhesive Primer EW-5000. Overlap shear was tested in accordance with ASTM D1002. Floating Roller Peel was tested in accordance with ASTM D3167-97.

Overlap Shear Specimens: 1" wide, 1/2" overlap specimen, 0.063" thick, FPL etched and phosphoric acid anodized 2024-T3 bare aluminum. Primed with Scotch-Weld EW-5000 Primer.

Scotch-Weld AF 555U Film 0.030 wt., Overlap Shear vs. Out Time

Test Temperature	0 Month PSI (MPa)	6 Months PSI (MPa)	12 Months PSI (MPa)
75 F (23C)	5416 (37)	5243 (36)	5005 (35)
277 F (136C)	2606 (18)	3277 (23)	3208 (22)
350 F (177C)	1571 (11)	1499 (10)	1410 (10)

Typical Cured Physical Properties

Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

XIII. Continued – Out Time: Room Temperature Exposure

Scotch-Weld AF 555M Film 0.050 wt., Overlap Shear vs. Out Time

Test Temperature	0 Month PSI (MPa)	6 Months PSI (MPa)	12 Months PSI (MPa)
75 F (23C)	5634 (39)	5099 (35)	5164 (36)
277 F (136C)	3016 (21)	3459 (24)	3855 (27)
350 F (177C)	1526 (11)	1650 (11)	1654 (11)

Scotch-Weld AF 555K Film 0.080 wt., Overlap Shear vs. Out Time

Test Temperature	0 Month PSI (MPa)	6 Months PSI (MPa)	12 Months PSI (MPa)
75 F (23C)	5765 (40)	5410 (37)	5840 (40)
277 F (136C)	4355 (30)	3519 (24)	4009 (28)
350 F (177C)	2252 (16)	1819 (13)	1981 (14)

Floating roller peel specimens: 1/2" wide, 0.063" back panel, 0.025" skin 2024-T3 bare aluminum, FPL etched and phosphoric acid anodized. Primed with 3M™ Scotch-Weld™ Adhesive Primer EW-5000.

Scotch-Weld AF 555U Film 0.030 wt., Floating Roller Peel vs. Out Time

Test Temperature	0 Month PIW (N/25mm)	6 Months PIW (N/25mm)	12 Months PIW (N/25mm)
-67F (23C)	22 (97)	20 (89)	24 (107)
75 F (136C)	38 (169)	35 (156)	30 (133)
180 F (177C)	39 (173)	38 (169)	40 (178)

Scotch-Weld AF 555M Film 0.050 wt., Floating Roller Peel vs. Out Time

Test Temperature	0 Month PIW (N/25mm)	6 Months PIW (N/25mm)	12 Months PIW (N/25mm)
-67F (23C)	25 (111)	27 (120)	20 (89)
75 F (136C)	37 (165)	36 (160)	36 (160)
180 F (177C)	39 (173)	40 (178)	40 (178)

Scotch-Weld AF 555K Film 0.080 wt., Floating Roller Peel vs. Out Time

Test Temperature	0 Month PIW (N/25mm)	6 Months PIW (N/25mm)	12 Months PIW (N/25mm)
-67F (23C)	20 (89)	21 (93)	24 (107)
75 F (136C)	31 (138)	32 (142)	36 (160)
180 F (177C)	29 (129)	40 (178)	41 (178)

Typical Cured Physical Properties

Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

XIV. Out Time: RDA vs. Room Temperature Exposure

Test Equipment: Rheometric Dynamic Analyzer.
Frequency = 1 Hz
Heat-up Rate = 5°C/min.
Strain = 0.2%
Data Collection Frequency = 30 sec.
Construct = 3M™ Scotch-Weld™ Structural Adhesive Film AF 555 0.05 wt.

Scotch-Weld AF 555U Film 0.030 Wt.

	Minimum Viscosity (Pa*s)	Temperature @ Minimum Viscosity F (C)	Time @ Minimum Viscosity (Min.)
Initial	1.44	332 (167)	29
3 Months	1.22	336 (169)	29
6 Months	1.85	332 (167)	28
9 Months	1.66	329 (165)	28
12 Months	1.85	332 (167)	28

Scotch-Weld AF 555M Film 0.050 Wt.

	Minimum Viscosity (Pa*s)	Temperature @ Minimum Viscosity F (C)	Time @ Minimum Viscosity (Min.)
Initial	8.86	338 (170)	29
3 Months	7.96	336 (169)	29
6 Months	11 .27	332 (167)	29
9 Months	11 .05	336 (169)	28
12 Months	7.85	338 (170)	29

Scotch-Weld AF 555K Film 0.080 Wt.

	Minimum Viscosity (Pa*s)	Temperature @ Minimum Viscosity F (C)	Time @ Minimum Viscosity (Min.)
Initial	4.53	332 (167)	29
3 Months	4.78	329 (165)	28
6 Months	4.36	327 (164)	28
9 Months	5.17	327 (164)	28
12 Months	5.84	324 (162)	27

Typical Cured Physical Properties

Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

XV. Out Time: 90°F / 50% RH Exposure

DSC vs. Out Time @ 90°F (32°C) / 50% RH

Samples of 3M™ Scotch-Weld™ Structural Adhesive Film AF 555U 0.035 wt. and AF 555M 0.050 wt. were conditioned @ 90°F (32°C) / 50% RH for 60 days.
Equipment: Perkin Elmer DSC 7
Ramp Rate: 10°C/min.

Scotch-Weld AF 555U Film 0.035 wt. Unsupported

	Onset Temperature °F [°C]	Delta H [J/g]	Peak Exotherm Temperature °F [°C]
initial	315 [157]	289	334 [168]
14 days	315 [157]	296	331 [166]
21 days	313 [156]	280	336 [169]
39 days	313 [156]	302	331 [166]
60 days	311 [155]	290	331 [166]

Scotch-Weld AF 555M Film 0.05 wt. Supported

	Onset Temperature °F [°C]	Delta H [J/g]	Peak Exotherm Temperature °F [°C]
initial	315 [157]	289	340 [171]
14 days	313 [156]	287	336 [169]
21 days	315 [157]	287	336 [169]
39 days	315 [157]	290	336 [169]
60 days	307 [153]	300	331 [166]

Typical Cured Physical Properties

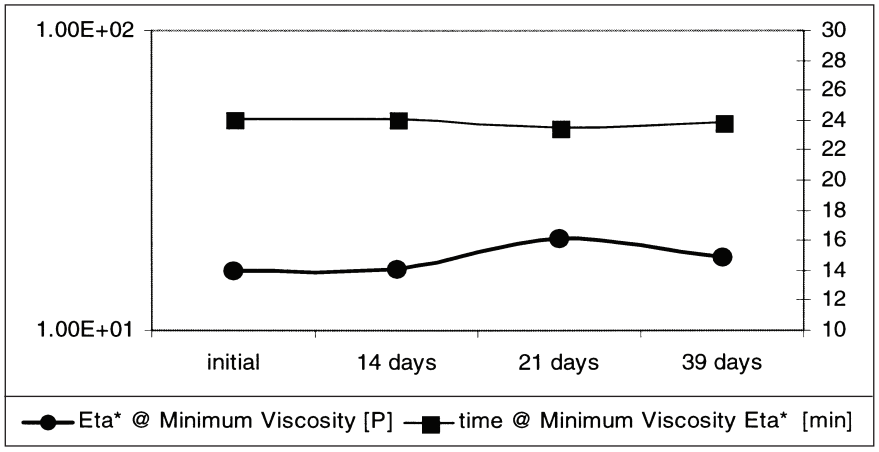
Note: The following technical information and data is based on limited 3M testing conditions and should not be used for specification purposes.

XV. Continued – Out Time: 90°F / 50% RH Exposure

Open Time Data – Minimum viscosity vs. out-time at 90°F (32°C) / 50% RH

Test Equipment: Rheometric Dynamic Analyzer.
Frequency = 1 Hz
Heat-up Rate = 5°C/min.
Strain = 0.2%
Data Collection Frequency = 30 sec.
Construct = 3M™ Scotch-Weld™ Structural Adhesive Film AF 555 0.05 wt.

	Time to Minimum Viscosity (min)	Eta* @ Minimum Viscosity (P)
Initial	24.133	1.58E+01
14 days	24.133	1.60E+01
21 days	23.467	2.02E+01
39 days	23.9	1.75E+01



Product Application

Note: While this information is provided as a general application guideline based upon typical conditions, it is recognized that no two applications are identical due to differing assemblies, method of heat and pressure application, production equipment and other limitations. It is therefore suggested that experiments be run, within the actual constraints imposed, to determine optimum conditions for your specific application and to determine suitability of product for particular intended use.

XVI. Surface Preparation

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

A. Aluminum: Phosphoric acid anodize (3M Test Method C-2780), Chromic acid anodize with or without a chromate seal (3M Test Methods C-2801 or C-2782) are preferred for maximum joint durability in moist environments. Optimized FPL Etch has also demonstrated improved durability performance. Optimized FPL Etch – 3M Company (3M Test Method C-2803 or ASTM D 2651)

1. Alkaline degrease – Oakite* 164 solution 9-11 oz./gallon of water at 190° ± 10°F for 10 to 20 minutes. Rinse immediately in large quantities of cold running water (3M Test Method C-2802).
   *Available from Chemetall Oakite, Berkeley Heights, NJ.
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

   Note: Review and follow safety and precautionary information provided by chemical supplier prior to preparation of this etch 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°F (150 to 160°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.

   To FPL etch panels, place them in the above solution at 150 to 160°F (66 to 71°C) for 12 to 15 minutes.
3. Rinse immediately in large quantities of clear running tap water.
4. Dry – Air dry approximately 15 minutes followed by a force dry at 140°F (maximum).
5. Current theory suggests that both surface structure and chemistry play a significant role in determining the strength and permanence of bonded structure. It is therefore advisable to bond or prime freshly cleaned surfaces as early as possible after preparing to avoid contamination and/or mechanical damage.

XVI. Continued – Surface Preparation

B. Aluminum Honeycomb Core

1. Soak in clean aliphatic naphtha (conforming to TT-N-95A) for five minutes at room temperature. Dry 10 minutes at 140°F (maximum).
2. Optional – Immerse in etching solution above for 2 minutes 155 ± 5°F. Rinse, air dry and force dry in a similar manner to skins.

C. Titanium CP or 6AI 4V both Turco® 5578-L* and improved phosphate fluoride processing have been used successfully with 3M™ Scotch-Weld™ Structural Adhesive Film AF 555.

1. Vapor hone 140 grit in water – rinse thoroughly with clear running tap water.
2. Degrease – solvent or alkaline process.
3. Immerse for 15 minutes at 185 ± 5°F in the following bath:
   Turco® 5578-L – 420 grams
   Distilled water – Balance to make 1 liter
4. Immerse for 1 minute in 170 ± 5°F distilled water.
5. Spray rinse for 5 minutes in hot tap water ~ 130°F.
6. Air dry for 10 to 20 minutes.
7. Force dry for 15 minutes at 140°F (maximum).
8. It is advisable to bond or prime freshly cleaned surfaces within four hours.

*Available from Henkel North America.

D. Stainless Steel – Type 301

1. Vapor hone 140 grit in water.
2. Rinse thoroughly in clear running tap water.
3. Alkaline degrease – see procedure above.
4. Rinse thoroughly in clear running tap water.
5. Immerse for 10 minutes at 75 ± 5°F in the following bath:
   Distilled Water 73-95 oz/gal
   Nitric Acid 42° Be 30-50 oz/gal
   Hydrofluoric Acid 70% 3-5 oz/gal
6. Rinse thoroughly in clear running tap water.
7. Air dry for 10-20 minutes.
8. Force dry for 15 minutes at 150°F.
9. Bond or prime within four hours after preparing.

E. Cured fiberglass or carbon fiber reinforced epoxy resin based reinforced plastic.

1. Abrade with 180 grit paper or 3M™ Scotch-Brite™ Scour Pad (do not cut through resin into reinforcing fibers).
2. Degrease using acetone or using an unsized cheesecloth pad.
3. Air dry for two hours minimum.

XVII. Primers

For most applications, use of a corrosion inhibiting primer is suggested to obtain maximum bond durability in moist, corrosive environments. 3M™ Scotch-Weld™ Structural Adhesive Primers EW-5000, EW-5000AS, and EC-3917 have all been successfully used with 3M™ Scotch-Weld™ Structural Adhesive Film AF 555. Because of its characteristics which allow both spray and brush application methods, either Scotch-Weld EW-5000 or EW-5000AS are normally suggested for use with Scotch-Weld AF 555 films. For suggested application techniques, refer to the respective primer data sheets.

Primer Coverage

For the primers noted above, the optimum mechanical property test performance with Scotch-Weld AF 555 Film will normally be found with uniform primer coverage in the 1-3 g/m^2 range (dry weight). This is approximately 0.1 mils as measured by an Isometer*. As the primer weight is increased a gradual decrease in low temperature peel strength will be found along with increasing levels of cohesive fracture in the primer layer (exception: properly controlled 180° T-Peel does not normally show this effect). Where specific tests and required strength levels are involved, a few simple experiments with varied primer coverage will be required to establish an allowable primer coverage range. Further applications can then be controlled by correlating color or thickness standards for the acceptable range.
*Isometer from Forster Instruments, Ontario, Canada.

Scotch-Weld EW5000 & EW5000 AS Primers Application

The following cycle is suggested for these primers when used with Scotch-Weld AF 555 films:

	EW5000 & EW5000 AS	**EC-3917:**
Cured Thickness	0.10-0.28 mils	0.10-0.20 mils
Air Dry	30 minutes	60 minutes
Force Dry	180 ± 5ºF for 30 ± 5 minutes	250 ± 5ºF for 60 ± 5 minutes

XVIII. Adhesive Film Application

Care should be taken during application to avoid contamination of the adhesive and substrates by any substances which will interfere with the wetting action of the adhesive.

Layup:

A. Scotch-Weld AF 555 U, M, or K Films

1. Cut a portion of film sufficient for the assembly from the stock roll with protective liner(s) in place.
2. If the film has one protective liner, place the exposed adhesive against the substrate using the liner as a protective cover. If two liners are present, remove one and follow as above.
3. Position film and rub out all air between the adhesive and the substrate. Use of a rubber roller will facilitate this process.
4. Remove protective liner.
5. Complete assembly being careful to avoid trapping air and cure.

XIX. Cure Conditions & Characteristics

3M™ Scotch-Weld™ Structural Adhesive Film AF 555 is designed to provide short cure times in the 300 to 355°F temperature range. While performance outside this cure temperature range has not been fully investigated, limited results suggest that cure temperatures as high as 375°F may be used as well as longer cure times at 200°F (6 hrs.) to obtain useful performance.

A. Standard Cure Cycle for Positive Pressure (Autoclave) Cure

- 4.5ºF/min. rise rate to 355 ± 5ºF.
- Vacuum bag target: 28 inches Hg.
- Release (vent) vacuum bag pressure when positive pressure reaches a level of 15 psi.
- Positive pressure target: 15-20 psi. Pressures as high as 45 psi can be used. If 45 psi pressure is being used to cure overlap shear specimens, shimming must be used to optimize bond line thickness.
- Soak time: 120 minutes ± 5 min. @ 355ºF bond line temperature.
- Cool down @ 10ºF/min. to 75ºF.
- Release positive pressure when bond line temperature reaches 100ºF.

B. Weight Loss During Cure (3M Test Method C-274):

Less than 1% (60 min at 250°F)

C. Cure Time and Temperature

For temperatures from 325 to 355°F, a cure time of 120 minutes at temperature is suggested. **Following cure, it is suggested that pressure be maintained until the assembly has been cooled to 100°F or below.**

D. Heat up rate

Bond line temperature rise rates between 1°F/min. and 20°F/min. have been used successfully with Scotch-Weld AF 555 films. It must be noted that hot entry cures at 300°F and above can be expected to produce reduced performance due to formation of bond line porosity.

E. Cure Pressure

1. Positive Pressure Cures

During cure, pressure is required to keep parts in alignment and to overcome distortions and thermal expansion of the adherends. When bonding honeycomb assemblies with non-perforated core, pressure is required to overcome the thermal expansion of air in the honeycomb cells. Positive pressure between 20 and 80 psi have been used successfully with 3M™ Scotch-Weld™ Structural Adhesive Film AF 555. For very small area bonds, however, pressures at the higher end of this range may produces excessive squeeze out and adhesive bond line starvation. For large solid panel constructions which are autoclave cured, application of vacuum for 15 to 20 minutes prior to application of heat and pressure is suggested to assist in removing any residual air trapped in the assembly. Normally, the vacuum is released following application of positive pressure @ 15-20 psi. For problem assemblies, maintain the vacuum during the heatup cycle to about 130°F to further assist in providing void free bonds.

2. Vacuum Curing

Scotch-Weld AF 555 films can be successfully cured using vacuum cure techniques. For performance comparable to positive pressure cures, Scotch-Weld AF 555 films should be cured using a vacuum level in the range of 8-22 inches of mercury. Higher vacuum levels yield excessive porosity and corresponding strength reductions. Scotch-Weld AF 555M versions have shown a high level of performance retention across the 10-25 inches of mercury vacuum level range.

3M™ Scotch-Weld™
Structural Adhesive Film
AF 555

XX. Complimentary 3M Products for use with Scotch-Weld AF 555 Film

3M™ Scotch-Weld Adhesive Primer EW-5000
3M™ Scotch-Weld Adhesive Primer EW-5000 AS
3M™ Scotch-Weld Adhesive Primer EC-3917
3M™ Scotch-Weld Core Splice Adhesive AF-3024
3M™ Scotch-Weld Void Filling and Edge Sealing Compound EC-3524 B/A

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

Additional Information or To Order

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:

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