

3M

Scotch-Weld™

Structural Adhesive Film

AF 163-2

Technical Datasheet

November 2009

Introduction

3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2 designates a family of thermosetting modified epoxy structural adhesives in film form which are available in a variety of weights with or without a supporting carrier. Scotch-Weld AF 163-2 Films are designed for both solid panel and honeycomb sandwich constructions.

Advantages

- High bond strength from -67°F to 250°F
- High fracture toughness and peel strength
- Excellent resistance to high moisture environments before and after curing
- Short cure time at 225°F (90 minutes)
- Capable of low pressure bonding
- Vacuum cure capability
- X-ray opaque (allows use of x-ray NDI methods)
- Excellent shop open time and long shelf life
- Scotch-Weld AF 163-3M Film is a higher tack version of Scotch-Weld AF 163-2 Film
- Isolating version available (Scotch-Weld AF 163-2G108 Film) for bonding dissimilar substrates
- Unsupported versions available for reticulation (Scotch-Weld AF 163-2U Film)

Description

The following Scotch-Weld AF 163 Films are included in this data sheet:

Product	Weight (± .005) Lb/ft ²	Color	Nominal Thickness - mils
Scotch-Weld AF 163-2G108 Film	0.100	Pink	16
Scotch-Weld AF 163-2K Film	0.045	Yellow	7.5
Scotch-Weld AF 163-2K Film	0.060	Red	9.5
Scotch-Weld AF 163-2K Film	0.085	Blue	13
Scotch-Weld AF 163-2L Film	0.030	Pink	5.5
Scotch-Weld AF 163-2M Film	0.045	Yellow	7.5
Scotch-Weld AF 163-2M Film	0.060	Red	9.5
Scotch-Weld AF 163-2M Film	0.085	Blue	13
Scotch-Weld AF 163-2OST Film	0.030	Green	5.5
Scotch-Weld AF 163-2OST Film	0.045	Green	5.5
Scotch-Weld AF 163-2OST Film	0.060	Red	9.5
Scotch-Weld AF 163-2U Film	0.015	Red	2.5
Scotch-Weld AF 163-2U Film	0.030	Red	5.5
Scotch-Weld AF 163-2U Film	0.060	Red	9.5
Scotch-Weld AF 163-3M Film	0.030	Green	5.5

Code: G = fiberglass scrim
 K = knit supporting carrier
 L = light weight non-woven supporting carrier (Matte)
 M = non-woven supporting carrier (Matte)
 OST = one side tacky with non-woven carrier (Matte) on low tack surface
 U = unsupported film

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Product Performance

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

I. Typical 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2 Cured Free Film (unsupported) Properties: (cured 60 minutes at 250°F)

Property	Typical Value	Method
Glass Transition (T _g) Temperature Dry Wet (14 days in 70°C water)	226°F (108°C) 180°F (82°C)	DuPont 1090 DMA @ 5°C/min ramp
Thermal Conductivity @ 43°C	.096 $\frac{\text{btu-ft}}{\text{ft}^2 \text{ hr } ^\circ\text{F}}$	ASTM C-177
Thermal Coefficient of Expansion @ -30 to 50°C	90 x 10 ⁻⁶ $\frac{\text{in}}{\text{in } ^\circ\text{C}}$	TMA @ 5°C/min
Volume Resistivity	4.4 x 10 ¹⁴ ohm-cm	ASTM D-257
Dielectric Strength @ 1 KHz @ 75°F (23°C)	1800 volt/mil	ASTM D-149

Dielectric Constant and Dissipation Factor ASTM D 150		
Frequency	Dissipation Factor @ 75° (23°C)	Dielectric Constant @ 75° (23°C)
Scotch-Weld AF 163-2U Film		
100 Hz	.008	4.8
1 KHz	.012	4.7
10 KHz	.016	4.6
100 KHz	.026	4.5
1 MHz	.039	4.3
Scotch-Weld AF 163-2K Film		
8-12.4 GHz	.033	3.08
12.4-18 GHz	.029	3.01
Scotch-Weld AF 163-2M Film		
8-12.4 GHz	.037	2.91
12.4-18 GHz	.029	2.74

Tensile Strength and Modulus (ASTM D 638)

Cured: Free Film Strips approx. 1/4" x 3" x .01" thick

Cure: 90 minutes at 235°F

Temperature	Ultimate Strength (psi)	Modulus (psi)
-67°F	11,000	2.3 x 10 ⁵
75°F	7,000	1.6 x 10 ⁵
180°F	3,000	6 x 10 ⁴

A. 75°F Bulk Modulus, Shear Modulus, and Poisson's Ratio – knit supported

17 ply laminate ~ 0.1 inches thick (ASTM D 3039) cure – 60 minutes at 250°F

Modulus Elasticity	161 x 10 ³ psi
Shear Modulus	60 x 10 ³ psi
Poisson's Ratio	0.34

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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.

B. Self extinguishing Characteristics: knit supported.

Method: FAR 25.853 – **Sample:** 1/4" x 1/2" x 4"

Cure: 60 minutes at 250°F

Sample Orientation	Flame Exposure Time (Seconds)	Self-Extinguishing Time (Seconds)
1. 4" length horizontal and 1/2" dimension vertical	15	0.5
2. Same as (1.)	60	3.7
3. 4" length vertical	15	6.3
4. Same as (3.)	60	70

II. Typical Cured Bond Properties

A. 75°F Fracture Toughness – 3M Test Method C-295

Cure Cycle: 235°F, 90 minutes, 35 psi, 5°F/min.

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960

Metal: 2024 T-3 Bare 1/2" thick aluminum – FPL etched and Phosphoric Acid Anodize

		3M™ Scotch-Weld™ Structural Adhesive Film			
		AF 163-2K (.06 lb/ft²)	AF 163-2OST (.03 lb/ft²)	AF 163-2OST (.06 lb/ft²)	AF 163-3M (.03 lb/ft²)
G _{IC}	$\frac{\text{IN LBS}}{\text{IN}^2}$	25	22	21	17
G _{IA}	$\frac{\text{IN LBS}}{\text{IN}^2}$	15	13	13	10

B. Thick Adherend Shear Properties – ASTM D5656

Cure Cycle: 270°F, 60 minutes, 40 psi, 1°F/min.

Adherends: 2024 T-3 Bare 0.25" thick aluminum – FPL etched

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Test Temp.	Ultimate Shear (psi)	Ultimate Elong. (in)	Yield Stress (psi)	Yield Elong. (in)	Shear Modulus (psi)
75°F	6950	.0052	5255	.00074	63,685
180°F	5780	.0114	3075	.00079	26,495

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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.

C. Metal to Metal Wide Area Blister Detection Shear Strength (psi) – 3M Test Method C-2232

Cure: 235°F, 90 minutes, 35 psi, 5°F/min.

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960

Metal: 2024 T-3 Bare .063" thick – FPL etched

Test Temp.	3M™ Scotch-Weld™ Structural Adhesive Film					
	AF 163-2OST		AF 163-2M	AF 163-2K		AF 163-3M
	.03 lb/ft²	.06 lb/ft²	.06 lb/ft²	.06 lb/ft²	.085 lb/ft²	.03 lb/ft²
-67°F	5500	4800	5200	5400	5100	5400
75°F	5400	5400	5100	5100	5000	4800
180°F	3700	3800	3700	3500	3400	3400
250°F	2400	2400	2400	2400	2200	2600

D. Metal to Metal Overlap Shear Strength (psi) – 3M Test Method C-244 or ASTM D 1002

1. Cure Cycle: 250°F, 60 minutes, 20 psi, 1°F/minute rise rate

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

Metal: 2024 T-3 ALCLAD .063" thick – unsealed Chromic Acid Anodized

Test Temp.	Scotch-Weld AF 163-2OST Film	Scotch-Weld AF 163-2M Film	Scotch-Weld AF 163-2K Film	
	.03 lb/ft²	.06 lb/ft²	.06 lb/ft²	.085 lb/ft²
-67°F	5400	6400	6200	5100
75°F	5200	5700	5800	5400
180°F	3200	3600	3800	3800

2. Cure Cycle: 250°F, 90 minutes, 25 psi, 4°F/minute rise rate

Primer: None

Metal: 2024 T-3 Bare .063" thick – FPL etched

Temperature	Scotch-Weld AF 163-2L Film .03 lb/ft²	Scotch-Weld AF 163-2K Film .085 lb/ft²
-67°F	5970	6430
75°F	5290	5990
180°F	4200	4600

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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.

E. Metal to Metal Blister Detection Shear (psi) – 3M Test Method C-265

Cure Cycle: 270°F, 60 minutes, 40 psi, 1°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal: 2024 T-3 Bare 0.063" thick – FPL etched

Temperature	3M™ Scotch-Weld™ Structural Adhesive Film	
	AF 163-2K .06 lb/ft ²	AF 163-2M .06 lb/ft ²
-67°F	6900	7000
75°F	5100	5000
180°F	3600	3600

F. Metal to Metal T-Peel Strength (piw) – 3M Test Method C-252

Cure Cycle: 250°F, 60 minutes, 20 psig, 1°F/min. rise rate

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

Metal: 2024 T-3 clad .020 in. thick aluminum – unsealed Chromic Acid Anodized

Peel Rate: 20"/min.

Test Temp.	Scotch-Weld AF 163-2OST Film	Scotch-Weld AF 163-2M Film	Scotch-Weld AF 163-2K Film	
	.03 lb/ft ²	.06 lb/ft ²	.06 lb/ft ²	.085 lb/ft ²
-67°F	25	25	33	29
75°F	29	44	45	41
180°F	24	40	38	35
250°F	20	30	28	20

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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.

G. Metal to Metal Floating Roller (Bell) Peel Strength (piw) – 3M Test Method C-260

- 1. Cure Cycle:** 270°F, 60 minutes, 50 psi, 1°F/min. rise rate
Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B
Metal: 2024 T-3 Bare FPL etched .025" to .063" aluminum
Peel Rate: 6"/min.

	3M™ Scotch-Weld™ Structural Adhesive Film	
Temperature	AF 163-2K .06 lb/ft ²	AF 163-2M .06 lb/ft ²
-67°F	78 piw	58 piw
75°F	78 piw	79 piw
180°F	76 piw	76 piw

- 2. Cure Cycle:** 250°F, 60 minutes, 30 psig, 5°F/min. rise rate
Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B
Metal: 7075-T6 clad Chromic Acid Anodize, .025" to .063" Aluminum
Peel Rate: 6"/min.

Test Temperature	Scotch-Weld AF 163-2M Film		Scotch-Weld AF 163-2K Film
	.045 lb/ft ²	.085 lb/ft ²	.045 lb/ft ²
-67°F	57	55	—
75°F	55	63	55
160°F	46	45	—

H. Metal to Metal Climbing Drum Peel Strength (in•lb/in) – 3M Test Method C-2222

- Cure Cycle:** 235°F, 90 minutes, 35 psig, 5°F/min. rise rate
Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960
Metal: 2024 T-3 Clad aluminum .020" to .040" FPL etched
Peel Rate: 3"/min. (cross head speed)
Test Temperature: 75 ± 5°F

Adhesive	Peel Strength (in•lb/in)
Scotch-Weld AF 163-2OST Film (.03 lb/ft ²)	70
Scotch-Weld AF 163-2OST Film (.06 lb/ft ²)	75
Scotch-Weld AF 163-2K Film (.06 lb/ft ²)	80
Scotch-Weld AF 163-2M Film (.06 lb/ft ²)	80
Scotch-Weld AF 163-3M Film (.03 lb/ft ²)	60

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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.

I. Metal to Honeycomb Climbing Drum Peel Strength (in•lb/in) – 3M Test Method C-245

1. Cure Cycle: 250°F, 60 minutes, 20 psi, 1°F/min. rise rate

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

Skins: 2024 T-3 0.020" thick aluminum – Chromic Acid Anodized

Core: 1/4" cell – 1/2" thick – 4 mil foil – 5052 alloy – non perforated

Test Rate: 1.0"/min. (cross head speed)

Test Temperature	Peel Strength (in•lb/in)	
	3M™ Scotch-Weld™ Structural Adhesive Film	
	AF 163-2K	AF 163-2M
	.06 lb/ft ²	.06 lb/ft ²
-67°F	20	17
75°F	23	26
180°F	18	19
250°F	9	9

2. Cure Cycle: 250°F, 60 minutes, 30 psi, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Skin and Core: Same as (1.) above

Test Rate: 1.0"/min. (cross head speed)

Test Temperature	Peel Strength (in•lb/in)		
	Scotch-Weld AF 163-2K Film	Scotch-Weld AF 163-2M Film	Scotch-Weld AF 163-2M Film
	.045 lb/ft ²	.045 lb/ft ²	.085 lb/ft ²
-67°F	–	15	33
75°F	15	15	39
160°F	–	12	34

3. Cure Cycle: 235°F, 90 minutes, 35 psig, 5°F/min.

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Skins: 2024 T-3 0.020" aluminum – FPL etched

Core: Same as (1.) above

Test Rate: 3"/min. (cross head speed)

Adhesive	75°F Peel Strength (in•lb/in)
Scotch-Weld AF 163-2K Film (.06 lb/ft ²)	22
Scotch-Weld AF 163-2K Film (.085 lb/ft ²)	35
Scotch-Weld AF 163-2M Film (.06 lb/ft ²)	24
Scotch-Weld AF 163-2M Film (.085 lb/ft ²)	35
Scotch-Weld AF 163-2OST Film (.06 lb/ft ²)	20

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

4. **Cure Cycle:** 270°F, 60 minutes, 50 psi, 1°F/min. rise rate
Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B
Skins: Same as (3.) above
Core: 3/16" cell – 1/2" thick – 5052 alloy – non perforated
Test Rate: 1.0"/min. (cross head speed)

Test Temperature	Peel Strength (in•lb/in)		
	3M™ Scotch-Weld™ Structural Adhesive Film		
	AF 163-2U		AF 163-2K
	.03 lb/ft²	.06 lb/ft²	.06 lb/ft²
-67°F	–	–	33
75°F	15	36	31
160°F	–	–	24

J. Metal to Honeycomb Flatwise Tensile (psi) – 3M Test Method C-251

1. **Cure Cycle:** 250°F, 60 minutes, 20 psig, 1°F/min. rise rate
Primer for Skins: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917
Metal: Skins: 2024 T-3 aluminum – Chromic Acid Anodized
Core: 1/4" cell – 1/2" thick – 4 mil foil – 5052 alloy – non perforated

Test Temperature	Flatwise Tensile Strength (psi)	
	Scotch-Weld AF 163-2K Film	
	.06 lb/ft²	.085 lb/ft²
-67°F	1700	1800
75°F	1200	1400
180°F	700	800
250°F	260	290

2. **Cure Cycle:** 250°F, 60 minutes, 30 psig, 5°F/min. rise rate
Primer for Skins: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B
Metal & Core: same as (1.) above

Test Temperature	Flatwise Tensile Strength (psi)		
	Scotch-Weld AF 163-2M Film		
	.045 lb/ft²	.06 lb/ft²	.085 lb/ft²
-67°F	1400	–	1900
75°F	935	1150	1500
160°F	625	750	990

3. **Cure Cycle:** 235°F, 90 minutes, 35 psig, 5°F/min. rise rate
Primer for Skins: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960
Metal: Skins; 2024 T-3 aluminum – FPL etched
Core: same as (1.) above

Test Temperature	Flatwise Tensile Strength (psi)				
	Scotch-Weld AF 163-2U Film		Scotch-Weld AF 163-2K Film		Scotch-Weld AF 163-20ST Film
	.03 lb/ft²	.06 lb/ft²	.06 lb/ft²	.085 lb/ft²	.06 lb/ft²
75°F	800	1200	1150	1350	1150
180°F	500	700	650	800	625
250°F	–	–	250	275	250

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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.

K. Metal to Honeycomb Beam Flexure Strength (lbs) – 3M Test Method C-250

Cure Cycle: 250°F, 60 minutes, 30 psi, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal: 2024 T-3 Bare 0.063" thick aluminum – Chromic Acid Anodized

Core: 1/4" cell – 1/2" thick – 5052 Alloy – 4 mil foil – non perforated

Test Temperature	Scotch-Weld AF 163-2M Film		
	.045 lb/ft ²	.06 lb/ft ²	.085 lb/ft ²
-67°F	3050	3150	3200
75°F	2850	3160	3200
160°F	2100	2600	2860

L. Typical Metal to Metal Fatigue Resistance:

1. Wide Area Blister Shear Type Specimens (psi) –

3M Test Method C 2232 (1/4" overlap)

Cure Cycle: 235°F, 90 minutes, 35 psi, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960

Metal: 2024 T-3 Bare .063" thick aluminum – FPL etched

Max. Stress: 1500 psi **Stress Ratio:** 0.1 **Rate:** 1800 cycles/min.

Test Temperature: 75 ± 5°F

Results: Under these conditions Scotch-Weld AF 163-2 Films have yielded greater than 10⁷ cycles without adhesive failure

2. Double Lap Strap: 6, 4 Titanium Specimens

Cure Cycle: 250°F, 60 min., 20 psig, 1°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3917 **Adhesive:** 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2K (.06 lb/ft²)

Metal: 6, 4 Titanium alloy – phosphate fluoride etched

Center Adherends 1" x 4⁵/₈" x 0.125"

Straps 1" x 1⁵/₈" x .063"

Stress Ratio = 0.1 **Rate** = 1800 cycles/min. **Test temp.** = 75°F ± 5°F

Shear Area – 1.5 in²

Max. Stress (psi)	Avg. Life (Cycles)
4500	1.58 x 10 ⁴
4000	5.28 x 10 ⁴
3500	4.75 x 10 ⁵
3000	2.67 x 10 ⁶
2200	1.03 x 10 ⁷ + (No failure; test discontinued)

M. Typical Creep Resistance

1. Metal to Metal Wide Area Shear Specimens (psi) – 3M Test Method C-2232

Cure Cycle: 235°F, 90 minutes, 35 psig, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960

Metal: 2024 T-3 Bare .063" thick aluminum – FPL etched

Adhesive		Creep after 192 hours	
		75°F @ 1600 psi	180°F @ 800 psi
Scotch-Weld F 163-2K Film	.06 lb/ft ²	Less than 0.0003"	< .0012"
	.085 lb/ft ²	Less than 0.0003"	< .0015"
Scotch-Weld AF 163-2OST Film	.03 lb/ft ²	Less than 0.0003"	Less than 0.0003"
	.06 lb/ft ²	Less than 0.0003"	Less than 0.0003"

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

2. Metal to Metal Overlap Shear Specimens (psi) – 3M Test Method C-244

Cure Cycle: 250°F, 60 minutes, 30 psi, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal: 7075 T-6 Clad .063" thick aluminum – Chromic Acid Anodized

Adhesive	Creep after 192 hours	
	75°F @ 1600 psi	160°F @ 1200 psi
Scotch-Weld AF 163-2M Film .085	Less than 0.0003"	Less than 0.0003"

3. Metal to Honeycomb Creep Deflection in Flexure – (Mil-A-25463 method)

Cure Cycle: 250°F, 60 minutes, 30 psig, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal: 2024 T-3 Bare 0.063" thick aluminum – Chromic Acid Anodized

Core: 1/4" cell – 1/2" thick – 5052 Alloy – 4 mil foil – non perforated

Adhesive Load:	Deflection after 192 hours					
	75°F Test		160°F Test		180°F Test	
	970 lbs.	1500 lbs.	970 lbs.	1500 lbs.	970 lbs.	1500 lbs.
Scotch-Weld AF 163-2M Film (.045 lb/ft ²)	.0005"	–	.003"	–	.005"	–
(.085 lb/ft ²)	–	0.0011"	–	.006"	–	.017"

N. Typical Bond Strengths on Other Substrates

Adhesive: 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2M Wt. .045

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Cure Cycle: 250°F, 60 minutes, 30 psig, 5°F/min. rise rate

	3M Test Method C-244 L/T = 8 Shear (psi)	3M Test Method C-260 6"/min. Floating Roller Bell Peel (piw)
Substrates	75°F 180°F	75°F
7575 T6 Clad	.063" Thick Metal	.025" Thick Metal Peel Skin
FPL - Etch	6050 3500	65
6, 4 Titanium	.063" Thick Metal	.014" Thick Metal Peel Skin
Phosphate Fluoride Etch	6825 3650	45
301 Stainless Steel	.063" Thick Metal	.020" Thick Metal Peel Skin
Phosphate Fluoride Etch	6260 3750	60
Epoxy FRP ("Scotchply" Brand Type 116)	0.150" Thick Skin	–
Abrade & degrease - unprimed	4300* 2300*	–

*Interlaminar adherend failure

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

O. MMM-A-132B Type I Test Data

Cure Cycle: 250°F – 90 minutes – 25 psig – 4 to 5°F per minute rise rate.

MMM-A-132B Test	MMM-A-132B Type I Class 2 Requirements	Scotch-Weld AF 163-2U Film (.06 lb/ft ²) with Scotch-Weld EC-3960 Primer
75°F shear	3500 psi	6377 psi
180°F shear	2000 psi	4003 psi
-67°F shear	3500 psi	6600 psi
75°F shear after 30 days at 120°F and 95-100% RH	3500 psi	6067 psi
75°F shear after immersion		
a.) 7 days in MIL-H-83282	3250 psi	6067 psi
b.) 7 days in MIL-T-5624	3250 psi	6190 psi
75°F Fatigue	750 psi 10 ⁶	No Failure
75°F creep, 1600 psi – 192 hours	0.015" maximum	0
180°F creep, 800 psi – 192 hours	0.015" maximum	0.0002"
Blister Detection @ 75°F	3250 psi	5057 psi
T-Peel @ 75°F	20 lb/in	38 lb/in

P. MIL-A-25463B Type I Test Data

Description Test Number	MIL-A-25463B Type I Class 2 Requirements	Scotch-Weld AF 163-2U Film (.06 lb/ft ²) with Scotch-Weld EC-3960 Primer
Sandwich Peel (in•lb/in) Normal Temp. 180 ± 2°F -67 ± 2°F	12.5 10 10	27.6 23.8 24.0
Flatwise Tensile Strength (psi) Normal Temp. 180 ± 5°F -67 ± 2°F	750 400 800	1408 743 1858
Flexural Strength (lbs) Normal Temp. 180 ± 5°F -67 ± 2°F	2100 1275 2150	3202 2263 3163
Flexural Strength after 192 hours Exposure (lbs) 180 ± 5°F	1500	2648
Creep Deflection flexure when loaded for max. 192 hours max. deflection (inch) Normal Temp. 1000 lbs. load (inch) 180 ± 5°F/800 lbs. load (inch)	0.025 0.05	0.006 0.0033
Flexure Strength after 30 days exposure (lbs) To 95 to 100% RH at 120 ± 2°F To turbine fuel JP-4 of MIL-T-5624	1800 1800	3082 3162

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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.

III. Typical Performance after Environmental Exposure

A. Metal to Metal Overlap Shear Strength (psi) – 3M Test Method C-244

Cure Cycle: 250°F, 60 minutes, 30 psig, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal: 7075 T-6 Clad 0.063" thick – Chromic Acid Anodized

Adhesive: 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2M
(.085 lb/ft²)

Specimens: Precut to 1" width prior to exposure

Test Temperature: 75°F

Environmental Exposure	Shear Strength (psi)
1. Control (No Exposure)	6345
2. 7 day immersion in JP-4	6570
3. 7 day immersion in Mil-F-5566	6365
4. 7 day immersion in Mil-H-5606	6465
5. 7 day immersion in Type III Hydrocarbon	6510
6. 30 day water immersion	5860
7. 30 day 5% Salt Spray Exposure	5930
8. Cyclic Humidity Exposure a) 15 Cycles b) 30 Cycles c) 45 Cycles	6245 5510 5655

*Each Cycle: 16 hours @ 125°F at 95-100% RH followed by 8 hours at -67°F.

B. Metal to Metal Blister Detection Shear (psi) – 3M Test Method C-265

Cure Cycle: 270°F, 40 psi, 60 minutes, 1°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal: 2024 T-3 Base .063" thick aluminum – FPL etch

Adhesive: Scotch-Weld AF 163-2K Film (.06 lb/ft²)

Specimens: Precut to 1.0" width and notched prior to exposure

Test Temperature: 75°F

Environmental Exposure	Shear Strength (psi)
1. Control (No Exposure)	5095
2. 7 day immersion in JP-4	5065
3. 7 day immersion in Mil-F-5606	5050
4. 7 day immersion in Mil-L-7808	5005
5. 30 day Exp. 120°F – 95 to 100% RH	4980
6. 30 day Exp. to 5% Salt Spray	5030

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Structural Adhesive Film AF 163-2

Technical Datasheet

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.

C. Metal to Metal Floating Roller (Bell) Peel (piw) – 3M Test Method C-260

Cure Cycle: (same as B.)

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal: 2024 T-3 Bare .025" thick to .063" thick aluminum – FPL etched

Adhesive: 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2K (.06 lb/ft²)

Specimens: Precut to 1" wide before exposure

Test Temperature: 75°F

Peel Rate: 6"/min.

Environmental Exposure	Peel Strength (piw)
1. Control (No Exposure)	82
2. 7 day immersion in JP-4	83
3. 7 day immersion in Mil-H-5606	85
4. 7 day immersion in Mil-L-7808	85
5. 30 day Exposure 120°F and 95 to 100% RH	80
6. 30 day 5% Salt Spray Exposure	82

D. Metal to Metal Wide Area Blister Detection Shear (psi) – 3M Test Method C-2232

Cure Cycle: 235°F, 90 minutes, 35 psi, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960

Metal: 2024 T-3 Bare .063" thick – FPL etched

Specimens: Precut to 1" width and notched prior to exposure

Test Temperature: 75°F

Environmental Exposure	Shear Strength (psi)			
	Scotch-Weld AF 163-2OST Film		Scotch-Weld AF 163-2K Film	
	.03 lb/ft²	.06 lb/ft²	.06 lb/ft²	.085 lb/ft²
1. Control (No Exposure)	5405	5280	5105	5115
2. 7 day JP-4 minimum (75°F)	5345	5255	5225	5079
3. 7 day Type III Hydrocarbon immersion (75°F)	5340	5315	5255	5160
4. 7 day Skydrol 500B immersion (150°F)	5400	5470	5214	5135
5. 30 day 5% Salt Spray	5330	5105	4865	4635
6. 30 day 120°F 95-100% RH	5360	5200	4940	4735

E. Metal to Metal G_{ISCC} – Crack Extension at 140°F and 95-100% RH – 3M Test Method C-295

Cure Cycle: 235°F, 90 minutes, 35 psig, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960

Metal: 2024 T-3 Bare 0.5" thick aluminum – phosphoric acid anodized

Specimen: DCB specimen precut to 1" width prior to exposure

Exposure	(in•lb/in²)			
	Scotch-Weld AF 163-2OST Film		Scotch-Weld AF 163-2K Film	
Film Weight (lb/ft²)	.03	.06	7.2	8.5
2500 hours	6.4	7.5	7.2	8.5

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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.

F. Metal to Honeycomb Beam Flexure Strength (lb) – 3M Test Method C-250

Cure Cycle: 250°F, 60 minutes, 30 psi, 5°F/min.

Primer for Skins: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal Skins: 2024 T-3 Bare .063" thick aluminum – Chromic Acid Anodized

Core: 1/4" cell – 1/2" thick – 4 mil foil – 5052 Alloy – non perforated

Adhesive: 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2M (.045 lb/ft²)

Environmental Exposure	75°F Flexural Strength (lb)
1. Control (No Exposure)	2850
2. 30 day immersion in Type III Hydrocarbon	2800
3. 30 day 5% Salt Spray	2800
4. *Cyclic Exposure – 45 Cycles	2900

G. Metal to Honeycomb Flatwise Tensile Strength – 3M Test Method C-251 conditions as per (F.) above

Environmental Exposure	75°F Flatwise Tensile Strength (psi)
1. Control (No Exposure)	935
2. Cyclic Exposure: 15 Cycles*	865
45 Cycles*	870

*Each Cycle: 16 hours at 125°F and 95-100% RH followed by 8 hours at -67°F.

IV. Typical Performance after Open Time at 90°F and 75% RH

Cure Cycle: 250°F, 60 minutes, 30 psig, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Metal Skin Prep: Chromic Acid Anodize

Core: 1/4" cell – 1/2" thick – 4 mil foil – 5052 Alloy – non-perforated

Exposure Method: Adhesive applied to Primed Skin with liners removed and exposed open face

A. 75°F Overlap Shear on 7075-T6 Clad .063" Thick – 3M Test Method C-244

Exposure Time	Scotch-Weld AF 163-2M Film (.045 lb/ft²)
0	6300 psi
7 days	6400 psi
15 days	6500 psi

B. Floating Roller (Bell) Peel on 7075 T-6 Clad .025" to .063" aluminum – 3M Test Method C-260

Exposure Time	Scotch-Weld AF 163-2M Film (.045 lb/ft²)		
	-67°F Test	75°F Test	160°F Test
0	57 piw	55 piw	46 piw
7 days	55 piw	61 piw	50 piw
15 days	59 piw	55 piw	44 piw

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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.

C. 75°F Honeycomb Peel 2024 T-3 Bare .020 Aluminum Skins (in•lb/in) – 3M Test Method C-245

Exposure Time	3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2M	
	.045 lb/ft ²	.085 lb/ft ²
0	15 in•lb/in	39 in•lb/in
7 days	15 in•lb/in	31 in•lb/in
15 days	11 in•lb/in	26 in•lb/in

D. 75°F Honeycomb Flatwise Tensile 2024 T-3 Bare Aluminum Skins (psi) – 3M Test Method C-251

Exposure Time	Scotch-Weld AF 163-2M Film	
	.045 lb/ft ²	.085 lb/ft ²
0	935	1500
7 days	1050	1600
15 days	1000	1570

V. Typical Metal to Metal 200°F Cure Performance:

Cure Cycle: 200° ± 5°F, 50 psi, 1°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3924B

Cure Time	Scotch-Weld AF 163-2K Film (.06 lb/ft ²)		
	Blister Detection Shear 3M Test Method C-265	Floating Roller (Bell) Peel 3M Test Method C-260	
	75°F	180°F	75°F
A. 2 hours	4120 psi	1750 psi	68 piw
B. 4 hours	4580 psi	2880 psi	76 piw
C. 6 hours	4700 psi	3280 psi	77 piw

VI. Typical Vacuum Cure Performance

Cure: 250°F, 60 minutes, 5°F/min. rise rate

Primer: 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3960

Overlap Shear: 3M Test Method C-244: 2024 T-2 .063" thick aluminum

Honeycomb Peel: 3M Test Method C-245: 1/4" cell Core – 2024 T-3 .020" thick aluminum skins

Peel Rate: 3"/min. (cross head speed)

Pressure or Vacuum	Scotch-Weld AF 163-2K Film .06		Scotch-Weld AF 163-2M Film .06		Scotch-Weld AF 163-2OST Film .03
	Overlap Shear 75°F (psi)	Honeycomb Peel 75°F (in•lb/3")	Overlap Shear 75°F (psi)	Honeycomb Peel 75°F (in•lb/3")	Overlap Shear 75°F (psi)
A. 25 psig positive pressure	5700	77	6200	74	5600
B. 9-11 Inches Hg	5700	65	6000	75	5200
C. 16-18 Inches Hg	3800	54	6000	67	5500
D. 24-26 Inches Hg	3300	45	4800	59	5200

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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.

VII. Effect of rise rate on Typical Metal to Metal Properties

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

Metal Prep: Chromic Acid Anodize

Metal: T-Peel 3M Test Method C-252: 2024 T-3 Clad .020" aluminum
OLS 3M Test Method C-244: 2024 T-3 Clad .063" aluminum

T-Peel Rate: 20"/min.

Adhesive: 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2K .06

Cure Temperature	250°F	250°F	250°F
Cure Time	60 min	60 min	60 min
Cure Pressure	20 psig	20 psig	50 psig
Rise Rate	1°F/min	8°F/min	20°F/min
75°F Overlap Shear	5760 psi	5840 psi	5460 psi
75°F T-Peel	45 piw	46 piw	45 piw

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.

I. Surface Preparation

A thoroughly cleaned, dry, grease-free surface is essential for maximum performance. Cleaning methods which will 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® Aluminum Cleaner 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).

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.

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Product Application *(continued)*

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.

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 $155 \pm 5^\circ\text{F}$. Rinse, air dry and force dry in a similar manner to skins.

C. Titanium CP or 6Al 4V both Turco® 5578-L and improved phosphate fluoride processing have been used successfully with 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2.

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 $185 \pm 5^\circ\text{F}$ in the following bath:
Turco® 5578-L – 420 grams
Distilled water – Balance to make 1 liter
4. Immerse for 1 minute in $170 \pm 5^\circ\text{F}$ distilled water.
5. Spray rinse for 5 minutes in hot tap water $\sim 130^\circ\text{F}$.
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.

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 $75 \pm 5^\circ\text{F}$ 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 Scotch-Brite™ Pad (do not cut through resin into reinforcing fibers).
2. Degrease using acetone or MEK/MIBK* or equivalent type solvent using an unsized cheesecloth pad.
3. Air dry for two hours minimum.

***Note:** When using solvents, extinguish all ignition sources, and follow manufacturers directions and precautions for use.

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Product Application (continued)

II. 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 EC-3924B, EC-3960, EC-3980 and EC-3917 have all been successfully used with 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2. Because of its characteristics which allow both spray and brush application methods, Scotch-Weld EC-3924B Primer is normally suggested for use with Scotch-Weld AF 163-2 Films. For suggested application techniques, refer to the respective primer data sheets.

III. Primer Coverage

For the primers noted above, the optimum mechanical property test performance with Scotch-Weld AF 163-2 Film will normally be found with a uniform primer coverage in the 1-3 g/m² range (dry weight). This is approximately 0.1 mils as measured by an isometer or equivalent thin film measuring instrument. 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.

IV. Primer Dry

The following cycle is suggested for these primers when used with Scotch-Weld AF 163-2 films:

Air dry: 60 minutes followed by a

Force dry: 60 minutes at 250° to 300°F.

Normally optimum performances will be found at the higher end of the force dry temperature range when used with Scotch-Weld AF 163-2 Films.

Note: Use of these primers without a force dry is not recommended in conjunction with Scotch-Weld AF 163-2 Films and is subject to very strict limitations. Consult your 3M Sales Representative.

V. 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 163-2U, 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.

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Product Application (continued)

B. 3M™ Scotch-Weld™ Structural Adhesive Film AF 163-2OST

Scotch-Weld OST Films are designed to facilitate the removal of air from large area solid panel construction. Application of vacuum to the assembly prior to and during the initial heat cycle is normally required (see cure conditions below).

1. Cut a portion of film sufficient for the application with the liner in place.
2. Remove the protective liner and apply the high tack side of the film against the substrate (high tack side is adjacent to the liner).
3. Position the film and rub out all air between the adhesive and the substrate (use of a rubber and roller will facilitate this process).
4. Complete assembly and cure.

VI. Cure Conditions & Characteristics

Scotch-Weld AF 163-2 Films are designed to provide short cure times in the 225 to 300°F temperature range. While performance outside this cure temperature range has not been fully investigated, limited results suggest that cure temperatures as high as 350°F may be used as well as longer cure times at 200°F (6 hrs.) to obtain useful performance.

A. Weight Loss During Cure (3M Test Method C-274): Less than 1%
(60 min at 250°F)

B. Gel Time: The following times are typically required to convert the Scotch-Weld AF 163-2 Film resin system to a low strength, rubbery solid on a pre-heated stage.

Temperature	Gel Time
200°F	103 minutes
225°F	47.5 minutes
250°F	20.5 minutes
275°F	10 minutes
300°F	5.5 minutes

C. Flow During Cure (3M Test Method C-261):

The following levels are typical averages for Scotch-Weld AF 163-2 and Scotch-Weld AF 163-3M Films using a cure of 235°F, 30 minutes, 35 psig, 5°F/min rise rate

Adhesive	% Flow (area increases)
Scotch-Weld AF 163-3M Film (.03 lb/ft ²)	250%
Scotch-Weld AF 163-2OST Film (.03 lb/ft ²)	225%
Scotch-Weld AF 163-2K Film (.06 lb/ft ²)	350%
Scotch-Weld AF 163-2M Film (.06lb/ft ²)	400%
Scotch-Weld AF 163-2K Film (.085 lb/ft ²)	450%

D. Cure Time and Temperature

1. For temperatures from 250°F to 300°F, a cure time of 60 minutes at temperature is suggested.
2. For temperatures between 225°F and 250°F, a cure time of 90 minutes at temperature is suggested.
3. A cure temperature of 350°F for 2 hours did not result in an overcure (gave equivalent performance to a 1 hour at 250°F cure).

Following cure, it is suggested that pressure be maintained until the assembly has been cooled to 150°F or below.

E. Heat up rate

Bond line temperature rise rates between 1°F/min. and 20°F/min. have been used successfully with Scotch-Weld AF 163-2 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.

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Product Application (continued)

F. 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 163-2. For very small area bonds, however, pressures at the higher end of this range may produce 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. For problem assemblies, maintain the vacuum during the heatup cycle to about 130°F to further assist in providing void free bonds.

Note: When using Scotch-Weld AF 163-2OST Films it is essential that these suggested vacuum application steps be included to gain the full effect of the air removal potential of the OST construction.

2. Vacuum Curing

Scotch-Weld AF 163-2 Films can be successfully cured using vacuum cure techniques. For performance comparable to positive pressure cures, Scotch-Weld AF 163-2K Films should be cured using a vacuum level in the range of 8-12 inches of mercury. Higher vacuum levels yield excessive porosity and corresponding strength reductions. Scotch-Weld AF 163-2M and OST Film versions have shown a high level of performance retention across the 10-25 inches of mercury vacuum level range.

Storage

Storage Stability – Storage at 0°F or below is recommended for Scotch-Weld AF 163-2 Films to obtain maximum storage life. Scotch-Weld AF 163-2 Films can be left out of cold storage (80°F maximum) for 20 days without adversely affecting its performance.

Shelf Life

Standard shelf life of Scotch-Weld AF 163-2 Film at 0°F or below is 12 months from date of shipment in the original unopened container.

Note: Scotch-Weld AF 163-2 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).

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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 or call 1-800-364-3577 or (651) 737-6501.

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:

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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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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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