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3M™ Scotch-Weld™ Structural Adhesive Film AF 501

Technical Data Sheet

Note: The following technical information and data is based upon limited 3M testing conditions and are considered typical values and should not be used for specification purposes.

Introduction

3M Scotch-Weld Structural Adhesive Film AF 501 is a toughened, thermosetting epoxy adhesive film formulated to provide durability in metal and composite bonding. The properties of Scotch-Weld Structural Adhesive Film AF 501 are balanced to provide excellent performance with good shop handling characteristics.

- 250°F (121°C) curing epoxy adhesive film
- Minimum of 50 days out time at 75°F (23°C) and 50% RH (Relative Humidity)
- Unsupported version suitable for reticulation
- Compatible with a range of water-based and solvent-based primers

Product Constructions

Construction	Film Coat Weight		Nominal Thickness of Uncured Film	
	lb/ft² (± .005)	g/m²	mils	mm
AF 501 K	0.045	220	6	0.15
AF 501 K	0.06	292	8	0.20
AF 501 K	0.085	415	11	0.28
AF 501 M	0.03	147	4	0.10
AF 501 M	0.06	292	8	0.20
AF 501 OST	0.03	147	4	0.10
AF 501 OST	0.06	292	8	0.20
AF 501 U	0.015	73	2	0.05
AF 501 U	0.03	147	4	0.10
AF 501 U	0.06	292	8	0.20

Code: U = Unsupported Film
M = Non-Woven Supporting Carrier (Matte)
K = Knit Supporting Carrier
OST = Non-Woven Supporting Carrier 'One Side Tacky'
All AF 501 variants are red in color in both uncured and fully cured forms

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Typical Product Performance

Note: The following technical information and data is based upon limited 3M testing conditions and are considered typical values and should not be used for specification purposes.

a) Metal to Metal Single Overlap Shear @ -67F (-55°C)

Metal: 2024-T3 Bare Aluminum - FPL Etched and Phosphoric Acid Anodized (PAA)

Cure Cycle: 250°F (121°C) for 90 ± 10 minutes at 45 ± 5 psi (3.1 Bar) at 4.5°F/min (2.1°C/min) rise rate

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

Test Method: ASTM D1002

	AF 501 U 0.015 wt.	AF 501 U 0.060 wt.	AF 501 K 0.06 Wt.
PSI	6298	6815	7146
MPa	44	47	49

b) Metal to Metal Single Overlap Shear @ 75F (23°C)

Metal: 2024-T3 Bare Aluminum - FPL Etched and Phosphoric Acid Anodized (PAA)

Cure Cycle: 250°F (121°C) for 90 ± 10 minutes at 45 ± 5 psi (3.1 Bar) at 4.5°F/min (2.1°C/min) rise rate

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

Test Method: ASTM D1002

	AF 501 U 0.015 wt.	AF 501 U 0.060 wt.	AF 501 K 0.06 Wt.
PSI	5327	6087	6688
MPa	37	42	46

c) Metal To Metal Single Overlap Shear @ 180F (82°C)

Metal: 2024-T3 Bare Aluminum - FPL Etched and Phosphoric Acid Anodized (PAA)

Cure Cycle: 250°F (121°C) for 90 ± 10 minutes at 45 ± 5 psi (3.1 Bar) at 4.5°F/min (2.1°C/min) rise rate

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

Test Method: ASTM D1002

	AF 501 U 0.015 wt.	AF 501 U 0.060 wt.	AF 501 K 0.06 Wt.
PSI	3627	3774	4857
MPa	25	26	34

d) Floating Roller Peel (Bell Peel) @ -67F (-55°C)

Metal: 2024-T3 Bare Aluminum - FPL Etched and Phosphoric Acid Anodized (PAA)

Cure Cycle: 250°F (121°C) for 90 ± 10 minutes at 45 ± 5 psi (3.1 Bar) at 4.5°F/min (2.1°C/min) rise rate

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

Test Method: ASTM D3167

	AF 501 U 0.015 wt.	AF 501 U 0.060 wt.	AF 501 K 0.06 Wt.
PIW	85	86	84
N/25mm	379	383	374

e) Floating Roller Peel (Bell Peel) @ 75F (23C) ASTM D3167

Metal: 2024-T3 Bare Aluminum - FPL Etched and Phosphoric Acid Anodized (PAA)

Cure Cycle: 250°F (121°C) for 90 ± 10 minutes at 45 ± 5 psi (3.1 Bar) at 4.5°F/min (2.1°C/min) rise rate

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

Test Method: ASTM D3167

	AF 501 U 0.015 wt.	AF 501 U 0.060 wt.	AF 501 K 0.06 Wt.
PIW	92	102	110
N/25mm	410	454	490

f) Honeycomb Sandwich Flatwise Tensile @ 180F (82°C)

Metal: 2024-T3 Bare Aluminum - FPL Etched and Phosphoric Acid Anodized (PAA)

Cure Cycle: 250°F (121°C) for 90 ± 10 minutes at 40 ± 5 psi (3.1 Bar) at 4.5°F/min (2.1°C/min) rise rate

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

Test Method: ASTM C297

	AF 501 U 0.015 wt.	AF 501 K 0.06 Wt.
PSI	314	537
MPa	2	4

g) Honeycomb Climbing Drum Peel @ 75F (23°C)

Metal: 2024-T3 Bare Aluminum - FPL Etched and Phosphoric Acid Anodized (PAA)

Cure Cycle: 250°F (121°C) for 90 ± 10 minutes at 40 ± 5 psi (3.1 Bar) at 4.5°F/min (2.1°C/min) rise rate

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

Test Method: ASTM D1781-98

	AF 501 K 0.060 Wt.
IP3IW	58
mN/75mm	6

h) T-Peel @ 75F (23°C)

Metal: 2024-T3 Bare Aluminum - FPL Etched and Phosphoric Acid Anodized (PAA)

Cure Cycle: 250°F (121°C) for 60 ± 10 minutes at 25 ± 5 psi (3.1 Bar) at 1.5°F/min (0.8°C/min) rise rate

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

Test Method: ASTM D1876

	AF 501 K 0.060 Wt.
PIW	59
mN/75mm	7

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 any intended use.

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: FPL Etch and Phosphoric Anodization is recommended but other industry accepted surface preparation methods may also provide acceptable level of durability for bonded joints.

B. Aluminum Honeycomb Core

1. For aluminum honeycomb core preparation, use the cleaning and surface treatment practices recommended by the core manufacturer to ensure compatibility with adhesive bonding.
2. Aluminum honeycomb core should be clean, dry, and free of contaminants before adhesive application

C. 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-5005, EW-5000AS, EC-3917, EC-3924B, and EC-3910 have all been successfully used with 3M Scotch-Weld Structural Adhesive Film AF 501. For suggested application techniques, refer to the respective technical data sheets.

D. 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:

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 apply heat and pressure to cure.

Cure Conditions & Characteristics

3M Scotch-Weld Structural Adhesive Film AF 501 is designed to provide short cure times in the 200 to 250°F (93 to 121°C) temperature range.

A. Cure Time and Temperature

A cure time of 60-120 minutes at 250 +/- 5°F (121°C) is suggested.

1. For temperatures from 200 to 225°F, a minimum cure time of 120 minutes at temperature is suggested.
2. For temperatures between 225 and 250°F, a minimum cure time of 60 - 90 minutes at temperature is suggested.

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

B. Heat Up Rate

Bond line temperature rise rates between 1°F/min. and 10°F/min. have been used successfully with 3M Scotch-Weld Structural Adhesive Film AF 501.

C. Cure Pressure

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 (1.38 to 5.52 bar) have been used successfully with Scotch-Weld Structural Adhesive Film AF 501. 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 15 psi (1 bar) positive pressure. For problem assemblies, maintain the vacuum during the heat up cycle to about 130°F to further assist in providing void free bonds.

Storage and Stability

The expected standard shelf life of 3M Scotch-Weld Structural Adhesive Film AF 501 is 12 months from the date of shipment when stored at 0°F (-18°C) or below in the original unopened container. Storage at 0°F (-18°C) or below is recommended for AF 501 film to obtain maximum storage life. AF 501 has a minimum of 50 days out time at room temperature (75° F/23° C) and 50% RH (Relative Humidity).

Note: 3M Scotch-Weld Structural Adhesive Film AF 501 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.)

Precautionary Information
Refer to Product Label and Safety Data Sheet for health and safety information before using this product. For additional health and safety information, call 1-800-364-3577 or (651) 737-6501, and visit www 3M.com/sds.

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.

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