

FM[®] 73

FM[®] 73 film adhesive is a toughened, general purpose aerospace epoxy designed to provide excellent structural performance from -67°F to 180°F (-55°C to 82°C). FM[®] 73 film adhesive is formulated to provide outstanding durability in bonding metals and is also suitable for bonding many structural composite systems.

Extensive testing has proven that FM[®] 73 meets stringent environmental resistance and bonding durability requirements. To achieve maximum environmental resistance and bonding durability the use of BR[®] 127 corrosion inhibiting primer is recommended in bonding metallic components.

Applications for FM[®] 73 include metal-to-metal bonding, composite-to-composite bonding, and composite-to-metal bonding.

Features and Benefits

- Demonstrates excellent peel strength and structural performance from -67°F to 180°F (-55°C to 82°C).
- Resistant to pre-bond humidity exposure
- Good moisture and corrosion resistance in high humidity
- Shop life of 30 days at 75°F (24°C)
- Recommended for use with BR[®] 127, FM[®] 410-1, FM[®] 490A, CYCOM[®] 919, and CYCOM[®] 950

CHARACTERISTICS

FM[®] 73 is manufactured as a supported film with either knit or mat carrier, or as an unsupported film. FM[®] 73 supported with a knit carrier offers optimum mechanical performance while the random mat version, FM[®] 73 M film adhesive, provides superior handling characteristics. FM[®] 73 M can be supplied in a one-side tacky (OST) version which allows bonding of large metal parts without concerns of trapping air during lay-up. In addition, FM[®] 73M OST film adhesive can be manufactured in widths up to 72 inches (183 cm) to accommodate large part fabrication, per request.

Table 1 | Physical Properties

Shelf Life	6 months at or below 40°F (4.4°C) from date of shipment for unsupported film 12 months at or below 0°F (-18°C) from date of shipment for supported film
Shop Life	30 days at 75°F (24°C)
Volatiles ASTM D 3530	1.25% maximum 250°F (121°C)
Outgassing properties (after complete cure) ASTM E 595	TML – 0.78% CVCM – 0.06% WVR – 0.18%

Table 2 | Product Availability

Product form	Nominal Weight ¹	Nominal Thickness	Color	Carrier
	psf (gsm)	in (mm)		
FM [®] 73 film adhesive	0.045 (210) 0.060 (300) 0.085 (420)	0.007 (0.18) 0.010 (0.25) 0.015 (0.38)	Yellow Yellow Yellow	Polyester knit, both sides tacky
FM [®] 73M film adhesive	0.030 (150) 0.045 (210) 0.060 (300) 0.085 (420)	0.005 (0.13) 0.007 (0.18) 0.010 (0.25) 0.015 (0.38)	Dark Green Yellow Yellow Yellow	Polyester mat, both sides tacky
FM [®] 73M OST film adhesive	0.030 (150) 0.060 (300) 0.085 (420) ^{††}	0.005 (0.13) 0.010 (0.25) 0.015 (0.38)	Dark Green Yellow Yellow	Polyester mat, one side tacky
FM [®] 73U film adhesive	0.020 (100) ^{††} 0.030 (150) ^{††}	0.0035 (0.09) 0.005 (0.13)	Green Yellow	Unsupported

¹ Weight tolerance equals nominal weight ± 0.005 psf (± 25 gsm)

[†] Available in width of 36 in (91 cm) or 48 in (122 cm) with standard roll length 60 yds (55 m).

^{††} Not available in 48 in (122cm) width roll.

Table 3 | Product Description: BR[®] 127 Corrosion Inhibiting Primer

Shelf Life	12 months at or below 0°F (-18°C) from date of shipment
Shop Life	10 days at 90°F (32°C)
Color	Yellow
Solids	10% 1% sprayable
Density	7.3 lb/gal (875 g/L)
Recommended Primer Thickness	0.10 – 0.30 mil (0.0025 – 0.0076 mm)
Recommended Cure	Air dry 30 min in ambient conditions Cure 30 minutes at 250°F ± 10°F (121°C ± 5.5°C)

PROPERTIES

Metal Bonding

Table 4 | Metal Bonding: Mechanical Properties: Metal-To-Metal¹

Property	Test temperature	FM 73 M 0.03 psf (150 gsm)	FM 73 M OST 0.03 psf (150 gsm)	FM 73 M 0.06 psf (300 gsm)	Substrate
Lap Shear ASTM D 1002	°F (°C)	psi (MPa)			0.063 in. (1.60 mm) 2024-T3 clad aluminum
	-67 (-55) 75 (24) 180 (82)	5890 (40.6) 5770 (39.8) 4050 (27.9)	6130 (42.3) 6200 (42.8) 3760 (25.9)	6340 (43.7) 6680 (46.1) 4400 (30.4)	
	Wide Area Lap Shear ASTM D 3165	-67 (-55) 75 (24) 180 (82)	5290 (36.5) 4860 (33.5) 3650 (25.2)	5100 (35.2) 4700 (32.4) 3580 (24.7)	
Climbing Drum Metal-to-Metal Peel ASTM D 1781	°F (°C)	in-lb/in (Nm/m)			0.020 in (0.51 mm); 0.040 in (1.03 mm) 2024-T3 clad aluminum
	-67 (-55) 75 (24) 180 (82)	55 (240) 66 (290) 85 (380)	61 (270) 73 (320) 91 (410)	68 (300) 87 (390) 130 (580)	
	Floating Roller Peel ASTM D 3167	°F (°C)	lb/in (kN/m)		
-67 (-55) 75 (24) 180 (82)		56 (9.8) 64 (11.2) 55 (9.6)	51 (8.9) 63 (11.0) 49 (8.6)	44 (7.7) 73 (12.8) 76 (13.3)	

¹ Typical average results with BR[®] 127 primer and recommended cure cycle

FPL etch was used for cleaning aluminum skins prior to bonding

Table 5 | Metal Bonding: Mechanical Properties: Metal-To-Metal (continued)¹

Property	Test temperature	FM 73 M OST 0.06 psf (300 gsm)	FM 73 0.06 psf (300 gsm)	FM 73 0.085 psf (425 gsm)	Substrate
Lap Shear ASTM D 1002	°F (°C)	psi (MPa)			0.063 in. (1.60 mm) 2024-T3 clad aluminum
	-67 (-55) 75 (24) 180 (82)	6680 (46.1) 6580 (45.4) 4540 (31.3)	6650 (45.9) 6500 (44.9) 4340 (30.0)	6770 (46.7) 6840 (47.2) 4770 (32.9)	

Wide Area Lap Shear ASTM D 3165	-67 (-55) 75 (24) 180 (82)	5420 (37.4) 4900 (33.8) 4350 (30.0)	5460 (37.7) 5100 (35.2) 4080 (28.2)	5290 (36.5) 5050 (34.8) 4120 (28.4)	0.064 in (1.63 mm) 2024-T3 bare aluminum		
Climbing Drum Metal-to-Metal Peel ASTM D 1781	°F (°C) -67 (-55) 75 (24) 180 (82)	in-lb/in (Nm/m) 65 (290) 83 (370) 130 (580)			73 (320) 95 (420) 130 (580)	88 (390) 150 (670) 160 (710)	0.020 in (0.51 mm); 0.040 in (1.03 mm) 2024-T3 clad aluminum
Floating Roller Peel ASTM D 3167	°F (°C)	lb/in (kN/m)			0.025 in (0.64 mm); 0.063 in (1.60 mm) 2024-T3 bare aluminum		

1 Typical average results with BR[®] 127 primer and recommended cure cycle

FPL etch was used for cleaning aluminum skins prior to bonding

*All products without designated carrier featured on knit carrier

Table 6 | Metal Bonding: Mechanical Properties: Metallic Structural Sandwich¹

Property	Test temperature	FM 73 M 0.06 psf (300 gsm)	FM 73 M OST 0.06 psf (300 gsm)	FM 73 0.06 psf (300 gsm)	Substrate
Honeycomb Sandwich Peel ASTM D 1781	°F (°C)	in-lb/3in (Nm/m)			Skin: 0.02 in (0.50 mm) 2024-T3 clad aluminum; Core: 0.25 in (6.35 mm) 0.004 NP 5052
	-67 (-55) 75 (24) 180 (82)	50 (74) 86 (130) 38 (56)	46 (68) 83 (127) 33 (49)	53 (79) 95 (141) 41 (61)	
Flatwise Tensile ASTM C 297	°F (°C)	psi (MPa)			Skin: 0.02 in (0.50 mm) 2024-T3 clad aluminum; Core: 0.25 in (6.35 mm) 0.004 NP 5052

1 Typical average results with BR[®] 127 primer and recommended cure cycle

FPL etch was used for cleaning aluminum skins prior to bonding

*All products without designated carrier featured on knit carrier.

Table 7 | Metal Bonding: Mechanical Properties: Metallic Structural Sandwich (Cont.)¹

Property	Test temperature	FM 73 M 0.085 psf (425 gsm)	FM 73 M OST 0.085 psf (425 gsm)	FM 73 0.085 psf (425 gsm)	Substrate
Honeycomb Sandwich Peel ASTM D 1781	°F (°C)	in-lb/3in (Nm/m)			Skin: 0.02 in (0.50 mm) 2024-T3 clad aluminum; Core: 0.25 in (6.35 mm) 0.004 NP 5052
	-67 (-55) 75 (24) 180 (82)	70 (103) 120 (178) 40 (59)	75 (111) 128 (190) 55 (82)	87 (129) 145 (215) 65 (96)	

Flatwise Tensile ASTM C 297	°F (°C)	psi (MPa)		Skin: 0.02 in (0.50 mm) 2024-T3 clad aluminum; Core: 0.25 in (6.35 mm) 0.004 NP 5052

1 Typical average results with BR[®] 127 primer and recommended cure cycle
FPL etch was used for cleaning aluminum skins prior to bonding
*All products without designated carrier featured on knit carrier

Table 8 | Metal Bonding: Mechanical Properties: Environmental Exposure¹

Property	FM 73 M 0.03 psf (150 gsm)	FM 73 M 0.06 psf (300 gsm)	FM 73 0.06 psf (300 gsm)	Substrate
Wide Area Lap Shear after: ASTM D 3165	psi (MPa)			0.063 in (1.60 mm) 2024-T3 clad aluminum
30 days at 120°F (50°C) and 95 – 100% R.H.	4960 (34.2)	4990 (34.4)	5140 (35.5)	
30 days salt spray	4790 (33.1)	4940 (33.9)	5240 (36.1)	
7 days immersion in JP-4 fuel (MIL-J-5624)	4780 (33.0)	4980 (34.4)	5270 (36.3)	
7 days immersion in hydrocarbon fluid (TT-S- 735)	4880 (33.6)	5040 (34.8)	5230 (36.1)	
7 days in Skydrol 500*	4770 (32.9)	5060 (34.9)	5140 (35.5)	

1 Fluid exposure coupons are individual blister detection coupons with cut edges exposed and tested at 75 ± 5°F (24 ± 3°C)
* Product of Solutia Inc.
**All products without designated carrier featured on knit carrier

Table 9 | Metal Bonding: Mechanical Properties: KGR-1 Stress Strain Data For FM[®] 73M Film Adhesive, 0.06 psf (300 gsm) with BR 127 Corrosion Inhibiting Primer with no Prebond or Postbond Exposure ASTM D 5656

[f = Shear Stress, psi (MPa), Σ = Shear Strain, in/in, G = Shear Modulus, psi (Mpa)]

Test Temp	Linear Limit (LL)			Knee (KN)		Ultimate Failure (UL)	
	°F (°C)	f	Σ	G	f	Σ	f
-67 (-55)	3350 (23.1)	0.026	131,000 (904)	7220 (49.8)	0.097	8080 (55.7)	0.447
75 (24)	2510 (17.3)	0.021	122,000 (842)	4690 (32.4)	0.062	5930 (40.9)	0.873
140 (60)	1460 (10.1)	0.022	65,900 (455)	2620 (18.1)	0.073	5060 (34.9)	1.430
180 (82)	980 (6.8)	0.028	37,800 (261)	1600 (11.0)	0.064	5150 (35.5)	1.623

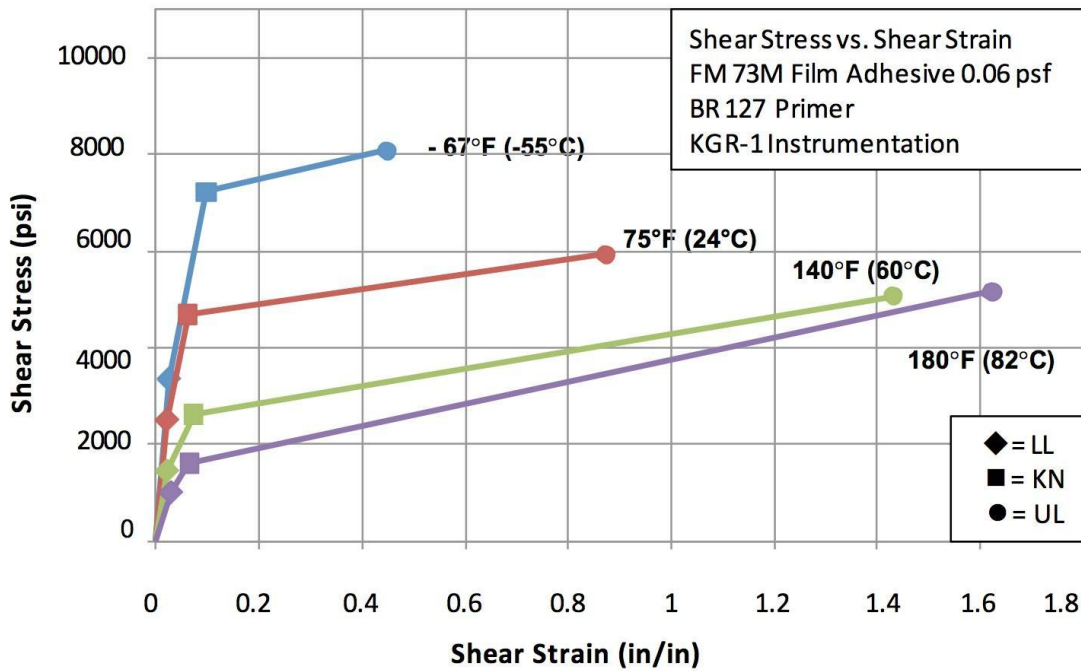
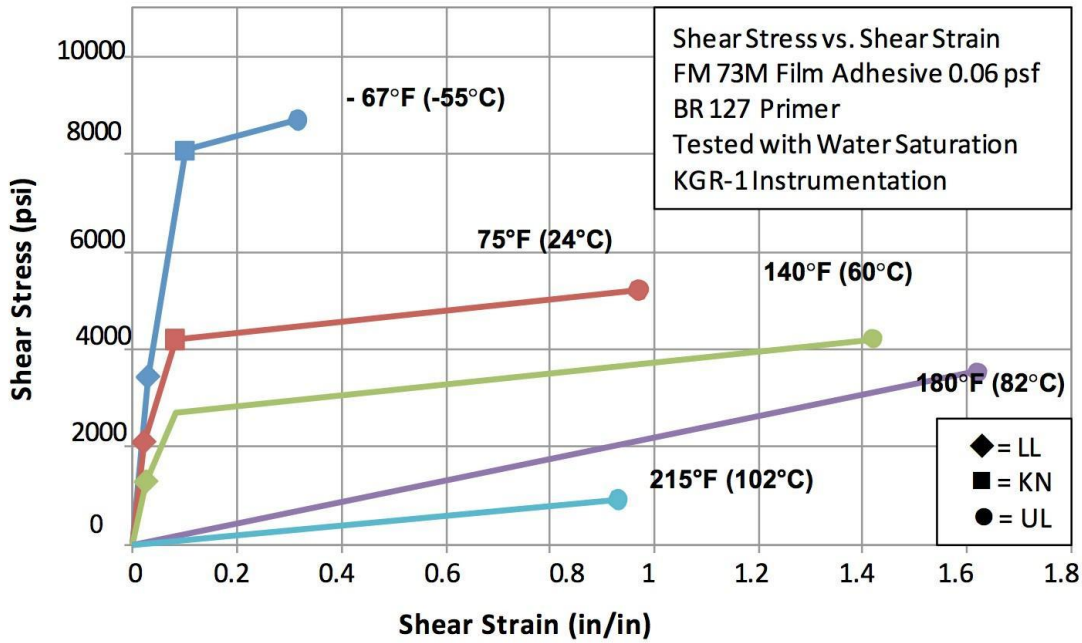


Table 10 | Metal Bonding: Mechanical Properties: KGR-1 Stress Strain Data for FM[®] 73M Film Adhesive, 0.06 psf (300 gsm) with BR 127 Corrosion Inhibiting Primer with Postbond Exposure of 100% R.H. at 140° F (60°C) until Saturated, ASTM D 5656

[f = Shear Stress, psi (MPa), Σ = Shear Strain, in/in, G = Shear Modulus, psi (Mpa)]

Test Temp °F (°C)	Linear Limit (LL)			Knee (KN)		Ultimate Failure (UL)	
	f	Σ	G	f	Σ	f	Σ
-67 (-55)	3440 (23.7)	0.028	123,000 (849)	8070 (55.7)	0.100	8700 (60.0)	0.315
75 (24)	2100 (14.5)	0.022	95,000 (655)	4200 (29.0)	0.081	5210 (35.9)	0.970
140 (60)	1290 (8.9)	0.026	53,200 (368)	-	-	4210 (29.0)	1.420
180 (82)	-	-	-	-	-	3540 (24.4)	1.620
215 (102)	-	-	-	-	-	910 (6.3)	0.930



PROCESSING

Recommended Cure Cycle

Cure Cycle	Apply full vacuum, 24 in Hg (0.081 MPa) minimum. Apply 30- 45 psi (0.21 – 0.31 MPa) pressure, vent vacuum at 20 psi (0.14 MPa). Heat from 75°F (24°C) to 250°F (121°C) at 2-5°F (1-3°C)/minute. Hold at 250°F (121°C) for 60 minutes. Cool down under pressure below 140°F (60°C) at 2-5°F (1-3°C)/minute.
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Surface Preparation

Aluminum Skins

A clean, dry, grease-free surface is required for bonding. FM[®] 73 is used with standard cleaning techniques involving a four step procedure of solvent degreasing, alkaline cleaning, chemical deoxidizing (etching), and phosphoric acid anodizing*. General guidance for etching and phosphoric acid anodizing can be found in ASTM 2651 and ASTM 3433, respectively. Best results for aluminum feature priming after appropriate surface preparation, with BR[®] 6747-1, BR[®] 6747-1 NC or BR[®] 127 primer.

*Boeing patent 4,085,012. April 1978. Phosphoric acid anodizing is now being used by a large number of aircraft manufacturers due to the improved surface bond durability it provides.

Primer Application

Although not mandatory, BR[®] 127 corrosion inhibiting primer is recommended for use with FM[®] 73 film adhesive in bonding of aluminum details. BR[®] 127 primer offers superior durability and resistance to hostile environments within the bond line and also may be used as a protective coating outside the bonded areas. Apply BR[®] 127 as follows:

1. Allow BR[®] 127 material to warm to room temperature [75°F (24°C)] prior to opening container.
2. Thoroughly mix before application and agitate during application.
3. Spray a dry primer thickness of 0.0001 to 0.0003 inches (0.0025 to 0.0076 mm) for optimum mechanical properties.
For protective coating applications, increase primer thickness to 0.0004 to 0.0010 inches (0.0102 to 0.025 mm).
4. Air dry 30 minutes minimum prior to placing in an oven.
5. Oven cure 30 minutes at 250 ± 10°F (120 ± 5.5°C).

Aluminum Core

No cleaning is necessary unless the core has been contaminated by foreign matter, in which case degrease with MEK or vapor degrease.

LAY-UP PROCEDURE

1. When FM[®] 73 is removed from refrigerator storage, the adhesive must be allowed to reach room temperature before the roll is unpackaged. Note that the film adhesive is sandwiched between release paper and polyliner.
2. Remove either of the interliners and place the adhesive against the surface to be bonded. Care should be taken to prevent air entrapment between the film adhesive and substrate, especially in large area bonds.
3. If additional tack is desired, the adhesive may be heated to as high as 140°F (60°C) for up to 30 minutes without altering the adhesive properties. Before heat tacking, ensure the film is properly positioned, otherwise removal will be difficult.
4. Complete the assembly after removing the other interliner.

HEALTH & SAFETY

Please refer to the product SDS for safe handling, personal protective equipment recommendations and disposal considerations.

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