TECHNICAL DATASHEET

FM® 1000 Adhesive Film

Description

FM 1000 is a modified polyamide-epoxy unsupported adhesive film and is especially developed for bonding metals, structural plastic laminates and various composite structural plastic sandwiches. FM 1000 adhesive film is serviceable over a temperature range of -423° to 200°F (-250° to 95°C).

Primers are not generally required for use with FM 1000 adhesives to increase strength; however, two primers are available for use where processing requires “tacking” of the FM 1000 film in place or for protection of clean details. BR® 1009-8 tack primer is used for room temperature tacking while BR 1009-49 tack primer is used for “heat-tacking” at 175°F (80°C).

FM 1000 adhesive film, with and without primer, has been tested extensively against the requirements of Federal Specification MMM<A-132. A typical cure is 60 minutes at 340° ± 10°F (170° ± 6°C) at 40 psi (0.28 MPa).

Features and benefits

- **High lap shear and peel strength**
- **Wide service temperature range; -423°F to +200°F**
- **Designed for bonding metals, plastic laminates and composites**
- **Qualified to MMM-A-132, Type I, Class 1**
- **Designed for use in metal-to-metal and honeycomb sandwich structures**

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Product decription

FM 1000 adhesive film

Form: Unsupported white elastomeric film.

WEIGHT		NOMINAL THICKNESS	
psf (± 0.005)	kg/m² (± 0.025)	inch	mm
0.015	0.075	0.003	0.075
0.025	0.125	0.004	0.12
0.030	0.15	0.005	0.13
0.040	0.195	0.007	0.18
0.050	0.25	0.009	0.23
0.060	0.29	0.010	0.27
0.080	0.39	0.014	0.36

Shelf life .04 psf (.20 kg/m^2) and lighter — four months from date of shipment at recommended storage.
.045 psf (.22 kg/m^2) and heavier — six months from date of shipment at recommended storage.

Storage Store at or below 85°F (30°C)

BR® 1009-8 tack primer

Solids 10% and 20%

Viscosity Sprayable

Shelf life Six months from date of shipment at recommended storage.

Storage Store at or below 85°F (30°C) —DO NOT REFRIGERATE

BR® 1009-49 tack primer

Solids 10% and 20%

Viscosity Sprayable

Thinner BR® 1009-49 thinner

Shelf life Six months from date of shipment at recommended storage.

Storage Store at or below 85°F (30°C) —DO NOT REFRIGERATE

Important

Both primers will gel on exposure to low temperature. The material may be returned to fluid state as follows:

1. Loosen lid on primer container. Replace lid without tightening.

2. Place container in 120°F (50°C) preheated water bath and hold until primer becomes fluid.

3. Stir primer for 15 minutes using slotted cover to reduce solvent loss.

Metal surface preparation (aluminum)

A clean, dry, grease-free surface is required for optimum performance. A recommended procedure for cleaning aluminum skins prior to priming or bonding is:

1. Vapor degrease, alkaline clean, rinse and check for water break.

2. Immerse in sodium dichromate-sulfuric acid solution at 155° ± 5T (68" ± 3'C). Clad–10 minutes; bare–5 minutes.

   Chromic acid is highly corrosive; all contact with skin and tissues must be prevented. Wear impervious apron, boots, and gloves, as well as splashproof goggles and face shield when preparing and/or using chromic acid solutions. If air-borne concentrations of chromic acid exceed the 8-hr TWA+ established by OSHA, respirators approved by NIOSH must be worn.

   Chromic acid solutions should be prepared and handled only in fume hoods and other adequately ventilated areas even when the TWA is not exceeded; traces of chromyi chloride may occur in the vapors above heated chromic acid solutions prepared from chlorinated water.

   To prepare this solution:
   Dissolve sodium dichromate (Fed-0-S-595A)–34 grams, In water–700 mL. Add sulfuric acid (Fed-O-A-11 5, Class A, Grade 2)–304 grams. Mix well and add additional water to make 1 liter. Dissolve 1.5 grams of 2024 clad per liter.

4. Immerse in cold water and repeat spray rinse.

5. Check for water break and dry in vented oven below 150°F (65°C).

* Product of Devilbiss Company, Toledo, Ohio + Time Weighted Average

Typical physical properties

FM 1000 adhesive film, .06 psf (.29 kg/m^2) metal bonds tested in conformance with Federal Specification MMM-A-132, Type I, Class I

Cure – 60 minutes at 350°F (175°C), 25 psi (.17 MPa)

Test # Property and test conditions	Specification average requirement	FM 1000 adhesive film average
Tensile shear, psi (MPa)		
1 75° ± 5'F (24° ± 3'C)	5000 (34.47)	7090 (48.88)
10 minutes at:		
2 180' ± 5°F (82' t: 3°C)	2500 (17.25)	3670 (25.30)
t 250° ± 5'F (120- ± 3'C)	None	2200 (15.17)
7 -67'' ± 5°F (-55* ± 3°C)	5000 (34.47)	7400 (51.02)
Fatigue strength		
8 75' ± 5'F (24' ± 3'C)	600 (4.14) 10^7 cycles	No failure
Creep-rupture 1600 psi (11.04 MPa) 192 hours		
9 75° ± 5'F (24' ± 3°C)	0.015 in. max. (.38 mm)	0.004 in. max. (.102 mm)
Creep-rupture 800 psi (5.52 MPa) 192 hours		
10 180° ± 5°F (82° ± 3°C)	0.015 in. max. (.38 mm)	0 003 in. max. (.076 mm)
Tensile shear, psi (MPa)		
75° ± 5°F (24° ± 3°C):		
13 30 days salt water spray	3600 (24.82)	6150 (42.40)
14 30 days @ 120'± 5°F (50° + 3'C)		Refer to other
95% - 100% R.H.	3600 (24.82)	R.H. test
15 7 days immersion in JP-4 fuel (MIL-J-5624)	3600 (24.82)	6410 (44.20)
7 days immersion in anti-icing fluid (MIL-F-5566)	3600 (24.82)	6625 (45.68)
7 days immersion in hydraulic oil (MIL-H-5606)	3600 (24.82)	6220 (42.89)
7 days immersion in hydrocarbon (TT-S-735)	3600 (24.82)	6690 (46.13)
30 days immersion in tap water	3600 (24.82)	5490 (37.85)
t 30 days in Skydrolt+500 at 160*F (70'C)	None	5440 (37.51)
t 30 days @ 165° ± 5'F (74° + 3°C) 95% - 100% R.H.	None	4195 (28.92)
T-peel Ib/in (kN/m)		
16 75- ± 5°F (24- ± 3°C)	50 (8.76)	60 (10.51)
Blister detection, tensile shear, psi (MPa)		
17 75' ± 5'F (24° ± 3'C)	3600 (24.82)	6295 (43.40)

tData in addition to requirements of MMM-A-132, Type I, Class I.

tt Product of Monsanto Company

Typical physical properties, cont.

Metal-to-metal peel – climbing drum	
75"F (24°C)	In excess of 200 in lb/in (890 Nm/m)
-67°F (-55°C)	102 in lb/in (454 Nm/m)
Sandwich peel – (per MIL-A-25463A)	
.06 psf (.29 kg/m^2)	175 in lb/3' width (260 Nm/m)
.08 psf (.391 kg/m^2)	270 in lb/3' width (400 Nm/m)
Flatwise tension, psi (MPa) – (per MIL-A-25463A)	
Face to core	1200 (8.27)

Bonds under varying curing schedules

Effect of curing temperature

Cure temperature F° (C°)	Lap shear, psi (MPa) 75F° (24°C)	Lap shear, psi (MPa) 180F° (82-C)
315 (157)	6880 (47.44)	3770 (25.99)
335 (168)	7000 (48.26)	4120 (28.41)
350 (175)	7090 (48.88)	4210 (29.03)

Effect of heat-up rate, .06 psf (.29 kg/m^2)

Heat-up time minutes	Lap shear, psi (MPa) 75T (24°C)	Lap shear, psi (MPa) 180°F (82-C)	Sandwich peel, in lb/3 in (Nm/m) per MIL-A-25463
0	7100 (48.95)	4020 (27.72)	210 (311)
30	7200 (49.68)	3900 (26.89)	185 (274)
60	7080 (48.81)	4300 (29.65)	190 (282)

Effect of air dry time

Physical properties of BR 1009-8 tack primer with FM 1000 adhesive film, .06 psf (.29 kg/m^2)

Cure:	30 minutes to 350°F (175°C) 60 minutes at 350°F (175°C) 25 psi (.17 MPa)	
Metal:	T-peel	,020' (.51 mm) 2024-T3 Alclad
	Sandwich peel	Faces: .020' (.51 mm) 2024-T3 Alclad Core: 7.9-1/4-.004N-5052
	Tensile shear	.064" (1.63 mm) 2024-T3 Alclad

Air dry of BR 1009-8	T-peel lb/in (kN/m)	Sandwich peel in lb/3' (Nm/m)	Shear psi (MPa)	
			75T (24°C)	180T (82°C)
10 min.	67 (11.73)	190 (282)	7290 (50.26)	3620 (24.96)
30 min.	80 (14.01)	180 (267)	7200 (49.64)	3500 (24.13)
60 min.	71 (12.43)	190 (282)	7430 (51.23)	3740 (25.79)

Typical physical properties with BR 1009-8 tack primer

FM 1000 adhesive film, .06 psf (.29 kg/m^2) with BR 1009-8 tack primer
Metal bonds tested in conformance with federal spec. MMM-A-132, Type I, Class I

Primer air dried 30 minutes at 75F° (24°C) – Room temperature tack
Cure – 30 minutes to 350°F (175°C), 60 minutes at 350T (175°C), 25 psi (.17 MPa)

Test #	Property and test conditions	Specification average requirement	FM 1000 adhesive film average
Tensile shear, psi (MPa)			
1	75° ± 5T (24° ± 3°C)	5000 (34.47)	7200 (49.64)
2	10 min. at ISO" ± 5°F (82° ± 3°C)	2500 (17.24)	3500 (24.13)
7	10 min at -67° ± 5°F (-55° ± 3°C)	5000 (34.47)	6840 (47.16)
Fatigue strength			
8	75° ± 5°F (24° ± 3°C)	600 (4.14) 10^7 cycles	No failure
Creep-rupture 1600 psi (11.04 MPa) 192 hours			
9	75° ± 5°F (24° ± 3°C)	0.01 5 in. max. (.38 mm)	Less than 0.015' (.38 mm)
Creep-rupture 800 psi (5.52 MPa) 192 hours			
10	180°± 5°F (82° ± 3°C)	0.015 in. max. (.38 mm)	Less than 0.015" (.38 mm)
Tensile shear, psi (MPa)			
13	75° ± 5°F (24° ± 3°C):		
	30 days salt water spray	2250 (15.51)	6215 (42.85)
14	aft er 30 days at 120' ± 5°F (50° ± 3°C)		Refer to R.H. Test
	95% - 100% R.H.	3600 (24.82)	at 165°F (74°C)
15	7 days immersion in JP-4 fuel (MIL-J-5624)	3600 (24.82)	6980 (48.13)
	7 days immersion in anti-icing fluid (MIL-F-5566)	3600 (24.82)	6695 (46.16)
	7 days immersion in hydraulic oil (MIL-H-5606)	3600 (24.82)	6960 (47.99)
	7 days immersion in hydrocarbon (TT-S-735)	3600 (24.82)	6995 (48.23)
	30 days immersion in tap water	3600 (24.82)	6095 (42.02)
+	30 days in Skydrol 500 at 160°F (70°C)	None	5025 (34.65)
+	30 days at 16 5°F (74°C) - 100% R.H.	None	5360 (36.96)

tData in addition to requirements of MMM-A-132, Type I, Class

Typical physical properties with BR 1009-49 tack primer

FM 1000 adhesive film, .06 psf (.29 kg/m^2) with BR 1009-49 tack primer
Metal bonds tested in conformance with federal spec. MMM-A-132, type I, class I

Cure – 60 minutes at 350°F (175'C), 25 psi (.17 MPa).

Test# Property and test conditions		Specification average requirement	FM 1000 adhesive film average
Tensile shear, psi (MPa)			
1	75° ± 5°F (24° ± 3°C)	5000 (34.47)	6590 (45.44)
2	10 min. at 180° + 5°F (82° ± 3"C)	2500 (17.24)	3400 (23.44)
7	10 min at -67° ± 5°F (-55° ± 3°C)	5000 (34.47)	6740 (47.47)
Fatigue strength			
8	75° ± 5°F (24° ± 3°C)	600 (4.14) 10^7 cycles	600 (4.14) over 10^7 cycles
Creep-rupture 1600 psi (11.04 MPa) 192 hours			
9	75° ± 5°F (24° ± 3°C)	0.015 in. max. (.38 mm)	Less than 0.015" (.38 mm)
Creep-rupture 800 psi (5.52 MPa) 192 hours			
10	180° ± 5°F (82° ± 3°C)	0.015 in. max. (.38 mm)	Less than 0.015" (.38 mm)
Tensile shear, psi (MPa)			
13	75° ± 5°F (24° ± 3°C):		
	30 days salt water spray	3600 (24.82)	6185 (42.64)
14	30 days at 120° ± 5°F (50° ± 3°C) 95% - 100% R.H.	3600 (24.82)	Refer to R.H. test at 165°F (74°C)
15	7 days immersion in JP-4 fuel (MIL-J-5624)	3600 (24.82)	5985 (41.26)
	7 days immersion in anti-icing fluid (MIL-F-5566)	3600 (24.82)	5895 (40.64)
	7 days immersion in hydraulic oil (MIL-H-5606)	3600 (24.82)	6345 (43.75)
	7 days immersion in hydrocarbon (TT-S-735)	3600 (24.82)	6120 (42.20)
	30 days immersion in tap water	3600 (24.82)	6125 (42.23)
+	30 days in Skydrol 500 at 160°F (70°C)	None	5810 (40.06)
+	30 days at 165° ± 5°F (74° ± 3°C) 95% - 100% R.H.	None	5165 (35.61)

tData in addition to requirements of MMM-A-132, Type I, Class

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FM 1000 adhesive film .06 psf (.29 kg/m^2)

with BR 1009-49 tack primer tested at 75°F (24°C)

Sandwich climbing drum peel (in lb/3 in.) (Nm/m)	
Average:	175 (259)
Range:	145 - 210 (215 - 311)
Metal-to-metal t-peel (lb/in.) (kN/m)	
Average:	105 (18.39)
Range:	92 - 124 (16.11 - 21.72)
Metal:sandwich peel	Faces: .020' (.51 mm) 2024-T3 Alclad Core: 7.9-1/4-.004N-5052
Metal-to-metal t-peel	.020- (.51 mm) 2024-T3 Alclad

Important notice

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CREATING A MATERIAL ADVANTAGE