

> FM[®] 680-1 POLYIMIDE FILM ADHESIVE

TECHNICAL DATA SHEET



DESCRIPTION

FM[®] 680-1 polyimide adhesive is a non-metallic version of FM 680 film adhesive designed for continuous service at temperature up to 700°F (371°C).

FM 680-1 adhesive was specifically developed for radar transparent applications requiring extreme environmental durability.

FM 680-1 adhesive is capable of bonding composite laminates and a wide variety of high temperature metallic substrates such as stainless steel and titanium while maintaining thermal oxidative stability.

FM 680-1 adhesive is an excellent candidate for aircraft engine applications or for the bonding of new composite materials requiring co-cure or consolidation temperature up to 735°F (391°C).

This adhesive is processible under standard manufacturing operations at temperatures as low as 600°F (316°C) and can handle freestanding post-cure up to 735°F (391°C).

To achieve maximum performance in bonding prepared metallic details the use of BR[®] 680 primer is recommended.

FM 680-1 adhesive is a non-aluminum-filled, condensation polyimide supported on fiberglass cloth. It is available in film, foam and paste forms.

FM 680-1 adhesive utilizes the NR-150 B2 chemistry developed by DuPont.

FEATURES & BENEFITS

- Radar transparent
- 700°F (371°C) service temperature capability
- Superior thermal oxidative stability
- Condensation-type polyimide
- 600°F (316°C) processing under standard manufacturing operations
- Co-curable with Avimid[®] N and other polyimide composite materials

SUGGESTED APPLICATIONS

- Titanium bonding
- Stainless steel bonding
- Polyimide composite bonding

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CHARACTERISTICS

Table 1 | Product Description: FM 680-1 polyimide film adhesive

Volatiles	18% maximum
Color	Brown
Shop life	15 days at 75°F (24°C) and 50% RH
Shelf life	6 months from date of shipment at recommended storage conditions
Recommended Storage	0°F (-18°C)
Available Weight	0.100 ± 0.010 psf (490 ± 50 g/m ²)

Table 2 | Product Description: BR 680 primer

Color	Brown
Solids	10 ± 2%
Shop life	15 days at 75°F (24°C) and 50% RH
Shelf life	6 months from date of shipment at recommended storage conditions
Recommended Storage	0°F (-18°C)

PROPERTIES

Table 3 | Tensile Shear Strength: FM 680-1 film adhesive, 0.10 psf (490 gsm)

Condition	6Al-4V Titanium 0.05 in. (1.27 mm)		Avimid N Laminate 0.10 in. (2.54 mm)
	Post-cure 16 hours at 600°F (316°C)	Post-cure 16 hours at 700°F (371°C)	Post-cure 16 hours at 700°F (371°C)
Tensile Shear Strength, psi (MPa)			
Tested at:			
-67°F (-55°C)	3550 (24.5)	2960 (20.4)	3450 (23.8)
75°F (24°C)	3020 (20.8)	2280 (15.7)	3380 (23.3)
350°F (177°C)	2800 (19.3)	2200 (15.0)	3000 (20.7)
500°F (260°C)	2930 (20.2)	-	-
550°F (288°C)	2300 (15.9)	1780 (12.2)	2600 (17.9)
600°F (316°C)	2030 (14.0)	1750 (12.1)	-
640°F (337°C)	1530 (10.5)	-	2200 (15.2)
650°F (343°C)	-	1600 (11.0)	-
680°F (360°C)	1400 (9.7)	1030 (7.1)	-
700°F (371°C)	900 (6.2)	1050 (7.2)	1200 (8.3)
735°F (391°C)	625 (4.3)	725 (5.0)	750 (5.2)

Processing

Surface Preparation: Sandblast, solvent wipe
 Cure Cycle: Open press bond at 600°F (316°C) and 100 psi (0.69 MPa)
 Post Cure: As indicated

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Table 4 | Tensile Shear Strength after Humidity and Fluid Exposure: FM 680-1 film adhesive, 0.10 psf (490 gsm)

Conditioning	Tensile Shear Strength psi (MPa)
30 days at 160°F (71°C) and 100% RH Tested at: -67°F (-55°C) 75°F (24°C)	1630 (11.2) 975 (6.7)
30 days immersion in JP-4 fuel at 120°F (49°C) Tested at: -67°F (-55°C) 75°F (24°C)	2080 (14.3) 900 (6.2)

Materials and Processing

Substrate: 6 Al-4V titanium, 0.05 in (1.29 mm) thick
 Surface Prep: Sandblast/Turco 5578 alkaline cleaner
 Cure Cycle: Open press bond at 600°F (316°C) and 100 psi (0.69 MPa)
 Post Cure: 16 hours at 700°F (371°C)

Table 5 | Tensile Shear Strength after Thermal Exposure: FM 680-1 film adhesive, 0.10 psf (490 gsm)

Thermal Exposure at 500°F (260°C)	Tensile Shear Strength psi (MPa)	Thermal Exposure at 600°F (316°C)	Tensile Shear Strength psi (MPa)
575 hours, tested at: 75°F (24°C) 500°F (260°C)	2550 (17.6) 2330 (16.0)	250 hours, tested at: 75°F (24°C) 600°F (316°C)	2130 (14.7) 1600 (11.0)
1000 hours, tested at: 75°F (24°C) 500°F (260°C)	2680 (18.5) 2250 (15.5)	500 hours, tested at: 75°F (24°C) 600°F (316°C)	2240 (15.5) 1850 (12.8)
2000 hours, tested at: 75°F (24°C) 500°F (260°C)	2350 (16.2) 2380 (16.4)	1100 hours, tested at: 75°F (24°C) 600°F (316°C)	1850 (12.8) 1230 (8.5)
		2000 hours, tested at: 75°F (24°C) 600°F (316°C)	1650 (11.4) 1650 (11.4)

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Table 6 | Tensile Shear Strength after Thermal Exposure: FM 680-1 film adhesive, 0.10 psf (490 gsm), continued

Thermal Exposure at 650°F (343°C)	Tensile Shear Strength psi (MPa)	Thermal Exposure at 700°F (371°C)	Tensile Shear Strength psi (MPa)
125 hours, tested at: 75°F (24°C) 650°F (343°C)	2100 (14.5) 1650 (11.4)	75 hours, tested at: 75°F (24°C) 640°F (338°C) 700°F (371°C)	950 (6.6) 650 (4.5) 650 (4.5)
250 hours, tested at: 75°F (24°C) 650°F (343°C)	1100 (7.6) 1130 (7.8)		
500 hours, tested at: 75°F (24°C) 650°F (343°C)	1200 (8.3) 775 (5.3)		

Processing Surface Preparation: Sandblast, solvent wipe
Cure Cycle: Open press bond at 600°F (316°C) and 100 psi (0.69 MPa)
Post-cure: 16 hours at 600°F (316°C) for 500 – 600°F (260 – 316°C) exposure
16 hours at 700°F (371°C) for 650 – 700°F (343 – 371°C) exposure

APPLICATION NOTES

Preparation of Titanium

A recommended chemical surface preparation is as follows:

1. Mechanically abrade the bonding area
2. Vapor degrease
3. Rinse in water
4. Dissolve 3.5 lbs (420 g/l) of Turco 5578 in one gallon of deionized water
5. Immerse part in Turco 5578 solution at 180 to 200°F (82 to 93°C) for 5 minutes
6. Spray rinse with tap water at 160 to 180°F (71 to 82°C) for 5 minutes
7. Rinse with a 5% by volume nitric acid solution
8. Spray rinse with deionized water at 180°F (82°C)

Primer Application

Although not mandatory, BR 680 primer is recommended for use with FM 680-1 film adhesive on prepared metal surfaces. BR 680 primer, 10% solids, should be spray coated onto clean surfaces. The primer is dried for 30 minutes at each of the following temperatures: 75°F (24°C), 300°F (149°C), 400°F (204°C). An additional 30 minute dry at 600°F (316°C) is optional. A cured thickness of 0.1 to 0.3 mils (0.003 to 0.008 mm) is desirable.

Curing Procedure

While there are a number of different cure cycles that can be used for FM 680-1 film adhesive, the following have been found to give consistent results:

Open Press Bonding: Apply 100 psi (0.69 MPa) pressure
Ramp at 3.5°F (2°C) per minute to 600°F (316°C)
Hold for 120 minutes at 600°F (316°C)
Cool at 5°F (3°C) per minute to 200°F (93°C)
Release Pressure

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Autoclave Bonding: Apply 5 inches Hg vacuum
 Ramp at 2°F (1°C) per minute to 250°F (121°C)
 Apply full vacuum and 100 psi (0.69 MPa) pressure
 Ramp at 3.5°F (2°C) per minute to 600°F (316°C)
 Hold for 120 minutes at 350 to 600°F (177 to 316°C)
 Cool at 5°F (3°C) per minute to 200°F (93°C)
 Release vacuum and pressure

For optimal performance a 16 hour post-cure at a temperature between 600 and 735°F (316 to 391°C) is needed. This can be accomplished free standing. In most cases the post-cure temperature should be at or above the maximum expected service temperature. A recommended post-cure cycle is as follows:

Post-cure: Ramp at 5°F (3°C) per minute to 600 to 735°F (316 to 391°C)
 Hold for 16 hours at 600 to 735°F (316 to 391°C)
 Cool at 5°F (3°C) per minute to 75°F (24°C)

PRODUCT HANDLING AND SAFETY

Cytec Engineered Materials recommends wearing clean, impervious gloves when working with polyimide resin systems to reduce skin contact and to avoid contamination of the product.

Materials Safety Data Sheets (MSDS) and product labels are available upon request and can be obtained from any Cytec Engineered Materials Office.

DISPOSAL OF SCRAP MATERIAL

Disposal of scrap material should be in accordance with local, state, and federal regulations.

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