

> CYCOM[®] 2020 EPOXY PREPREG

TECHNICAL DATA SHEET



DESCRIPTION

CYCOM[®] 2020 is a versatile curing, toughened epoxy resin that can be cured from 180°F to 350°F (80°C to 180°C), depending on service temperature requirements. This prepreg resin extracts the maximum possible performance from carbon fibers. The excellent overall balance of properties delivered by CYCOM 2020 has made it the product of choice for many Formula 1 race teams in structural applications.

CYCOM 2020 can be either autoclave or vacuum bag cured. Free-standing postcures can also be employed. A one hour cure at 275°F (135°C) gives a Tg of more than 310°F (155°C)*. The same cure cycle provides excellent mechanical properties with retention of those properties at temperature; 70% of shear strength is retained at 250°F (120°C).

CYCOM 2020 is available on both woven and unidirectional carbon, glass and aramid fiber and has a tack-life under ambient conditions in excess of four weeks, maintaining good drape and tack characteristics throughout.

FEATURES & BENEFITS

- Versatile cure from 180°F to 350°F (80°C to 180°C)
- Excellent translation of fiber properties
- Excellent retention of mechanical properties at 240°F (120°C) temperature
- High impact resistance
- Controlled flow
- Good drape and tack
- Excellent cured surface finish
- Shop life of 8 weeks at ambient temperature, 75°F (24°C)

SUGGESTED APPLICATIONS

- High stress extreme performance mast and boom applications
- Structural Formula 1 applications

* **NOTE:** Tg data is not applicable for U.S. export control classification or licensing. For export-related information please contact us.

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CHARACTERISTICS

Table 1 | Physical Characteristics

Shelf life	1 year stored at less than 10°F (-12°C)
Tack Life	4+ weeks at RT
Shop Life	8 weeks at RT
Gel Time	15 minutes at 250°F (120°C)
Cured Resin Density	1.25 g/cm ³

Viscosity Profile

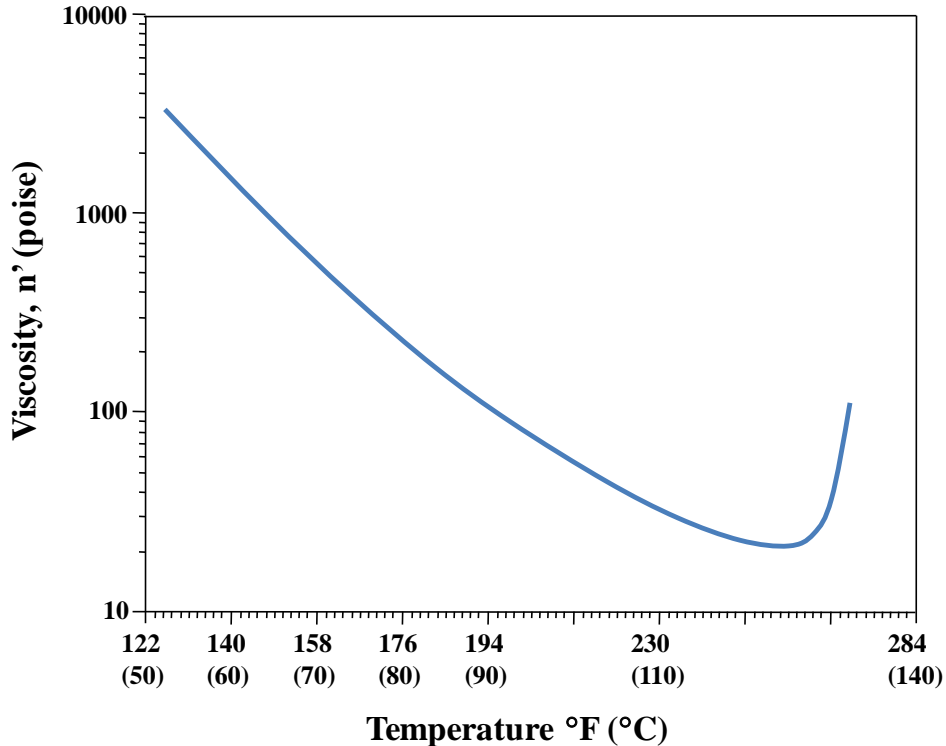


Figure 1 | CYCOM 2020 Viscosity Trace
Straight Heat-Up Cure Cycle to 275°F (135°C)
Minimum Viscosity, 21 Poise at 253°F (123°C)

DMA Trace

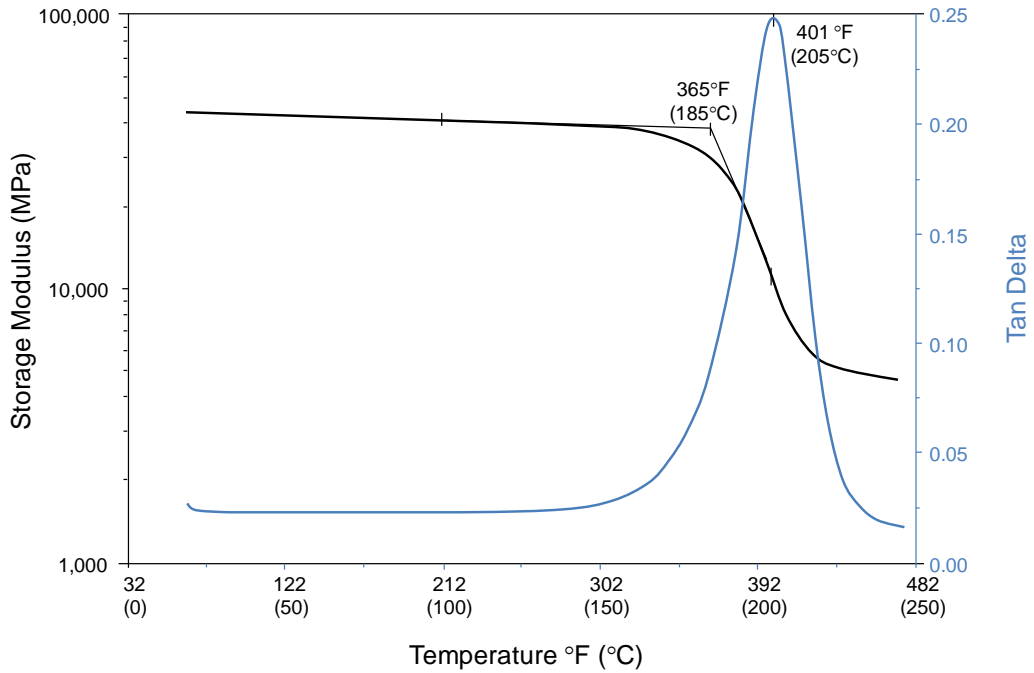
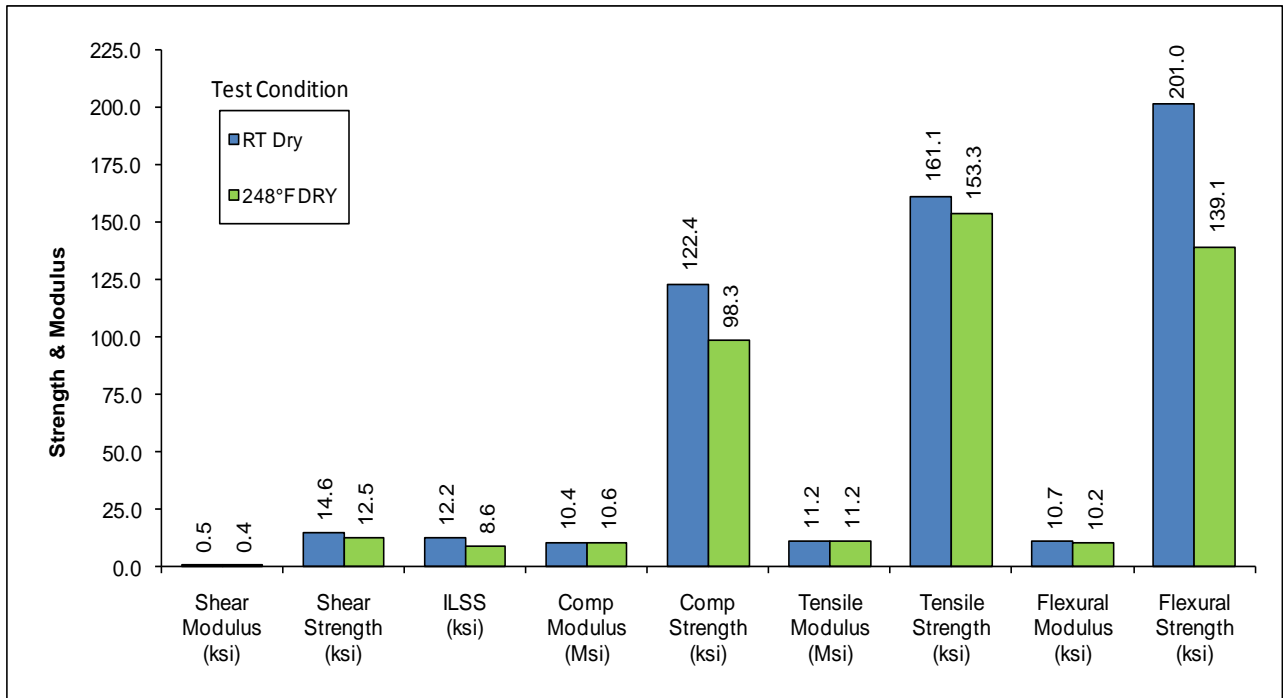


Figure 2 | CYCOM 2020-M46J After 1 Hour Cure at 275°F (135°C) plus 2 Hours Postcure at 356°F (180°C)

PROPERTIES



**Figure 3 | CYCOM 2020 T800-6K 5H 280 42% Resin Content 5-Harness Satin Fabric
Mechanical Properties as a Function of Temperature, Standard Cure Cycle**

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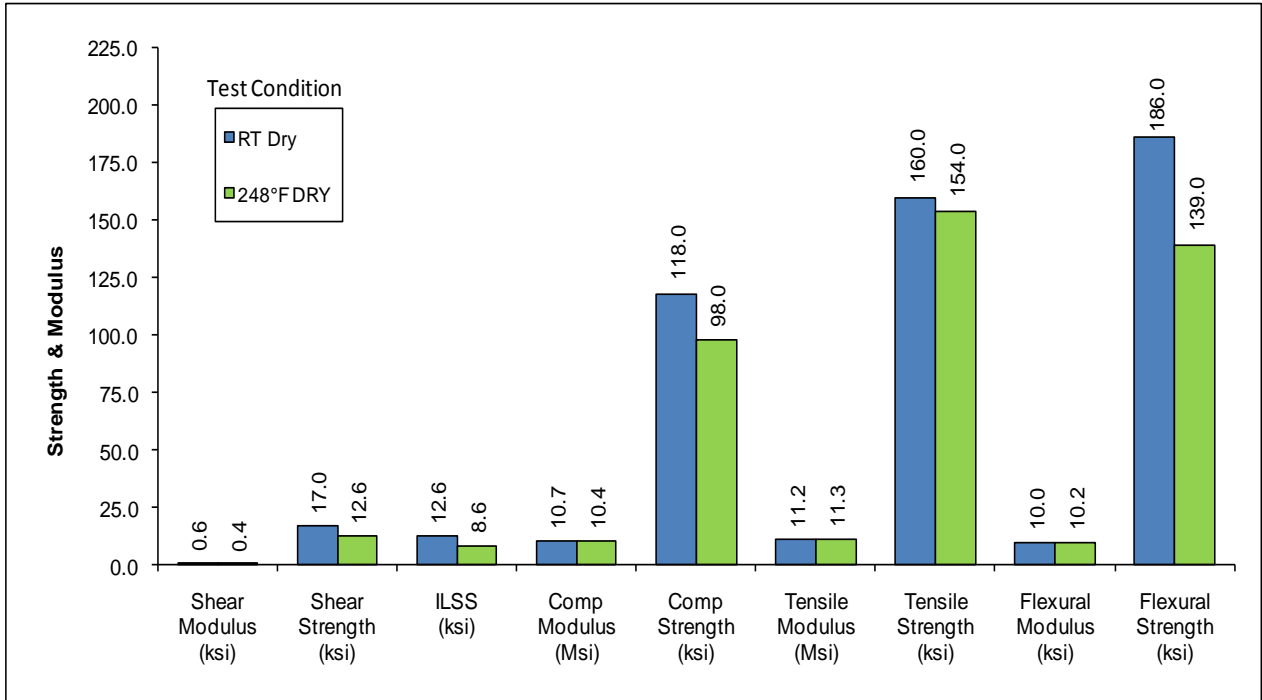
Table 2 | Mechanical Properties CYCOM 2020 T800-6K 5H 280 42% Resin Content 5-Harness Satin Fabric

Properties	Test Method	Cure Cycle	RT DRY	248°F (120°C) DRY	351°F (177°C) DRY
0° Tensile Strength, ksi (MPa) Modulus, msi (GPa)	ASTM D3039	Standard Cure Cycle 1 hour at 275°F (135°C)	161 (1111) 11.2 (77)	153 (1057) 11.2 (77)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	133 (914) 11.3 (78)
0° Compression Strength, ksi (MPa) Modulus, msi (GPa)	ASTM D695	Standard Cure Cycle 1 hour at 275°F (135°C)	122 (844) 10.4 (72)	98 (678) 10.6 (73)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	54 (369) 9.8 (68)
In-Plane Shear ±45 Strength, ksi (MPa) Modulus, ksi (MPa)	ASTM D3518	Standard Cure Cycle 1 hour at 275°F (135°C)	14.6 (101) 0.5 (3.7)	12.5 (86) 0.4 (3.0)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	8.3 (57) 0.2 (1.1)
Interlaminar Shear (Short Beam Shear) Strength, ksi (MPa)	ASTM D2344	Standard Cure Cycle 1 hour at 275°F (135°C)	12.2 (84)	8.6 (59)	-
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	-	-	5.4 (37)
0° Flexural Strength, ksi (MPa) Modulus, ksi (MPa)	ASTM D790	Standard Cure Cycle 1 hour at 275°F (135°C)	201 (1386) 10.7 (74)	139 (959) 10.2 (70)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	72 (495) 8.3 (57)
Compression Strength After Impact, ksi (MPa)	ASTM D7136 /D7137	Standard Cure Cycle 1 hour at 275°F (135°C)	32 (220)	-	-

** Data Normalized 55% Fiber Volume

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**Figure 4 | CYCOM 2020 T800-6K 2X2T Twill 200 42% Resin Content
Mechanical Properties as a Function of Temperature, Standard Cure Cycle**

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Table 3 | Mechanical Properties CYCOM 2020 T800-6K 2X2T Twill 200 42% Resin Content

Properties	Test Method	Cure Cycle	RT DRY	248°F (120°C) DRY	351°F (177°C) DRY
0° Tensile Strength, ksi (MPa) Modulus, msi (GPa)	ASTM D3039	Standard Cure Cycle 1 hour at 275°F (135°C)	160 (1106) 11.2 (77)	154 (1059) 11.3 (78)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	128 (880) 11.3 (78)
0° Compression Strength, ksi (MPa) Modulus, msi (GPa)	ASTM D695	Standard Cure Cycle 1 hour at 275°F (135°C)	118 (813) 10.7 (74)	98 (673) 10.4 (72)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	54 (373) 11.2 (77)
In-Plane Shear ±45 Strength, ksi (MPa) Modulus, ksi (MPa)	ASTM D3518	Standard Cure Cycle 1 hour at 275°F (135°C)	17.0 (117) 0.6 (3.8)	12.6 (87) 0.4 (3.0)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	8.4 (58) 0.2 (1.0)
Interlaminar Shear (Short Beam Shear) Strength, ksi (MPa)	ASTM D2344	Standard Cure Cycle 1 hour at 275°F (135°C)	12.6 (87)	8.6 (59)	-
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	-	-	5.8 (40)
0° Flexural Strength, ksi (MPa) Modulus, ksi (MPa)	ASTM D790	Standard Cure Cycle 1 hour at 275°F (135°C)	186 (1285) 10.0 (69)	139 (960) 10.2 (70)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	67 (464) 7.7 (53)
Compression Strength After Impact, ksi (MPa)	ASTM D7136 /D7137	Standard Cure Cycle 1 hour at 275°F (135°C)	32 (218)	-	-

** Data Normalized 55% Fiber Volume

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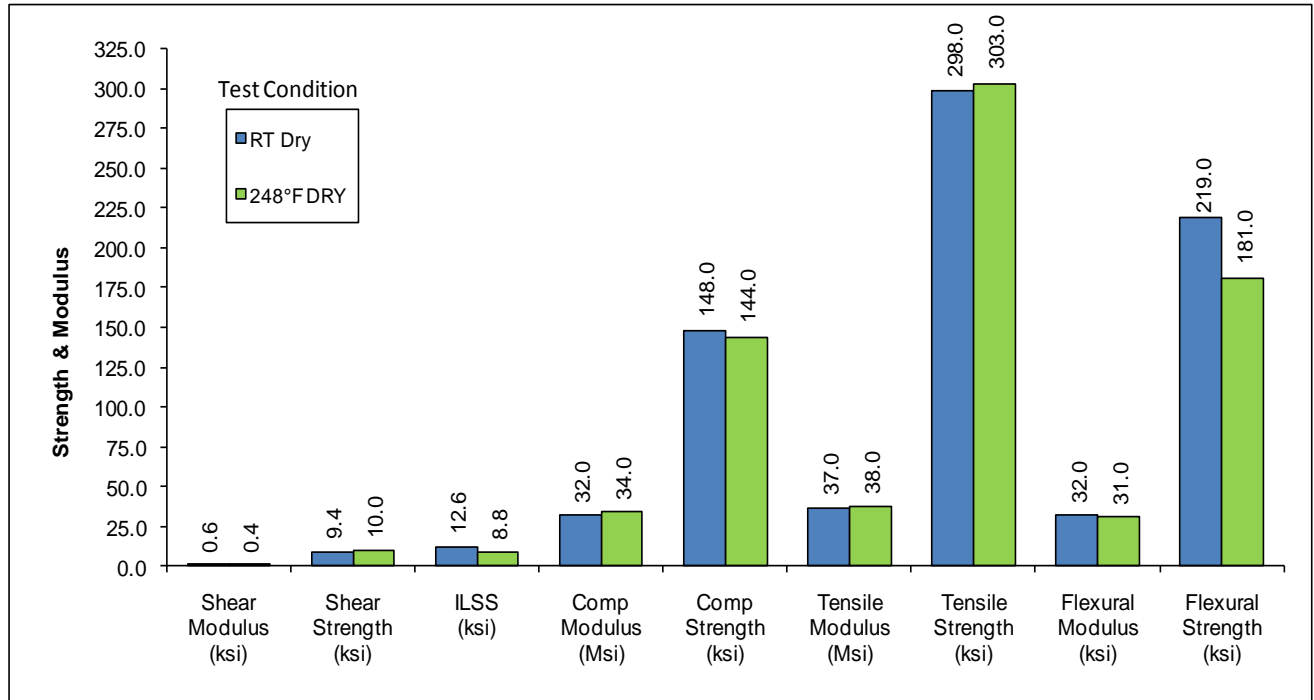


Figure 5 | CYCOM 2020 M46J 140 36% Resin Content Unidirectional Tape Mechanical Properties as a Function of Temperature, Standard Cure Cycle

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Table 4 | Mechanical Properties CYCOM 2020 M46J 140 36% Resin Content Unidirectional Tape

Properties	Test Method	Cure Cycle	RT DRY	248°F (120°C) DRY	351°F (177°C) DRY
0° Tensile Strength, ksi (MPa) Modulus, msi (GPa)	ASTM D3039	Standard Cure Cycle 1 hour at 275°F (135°C)	298 (2057) 37 (255)	303 (2092) 38 (259)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	252 (1736) 38 (259)
0° Compression Strength, ksi (MPa) Modulus, msi (GPa)	ASTM D695	Standard Cure Cycle 1 hour at 275°F (135°C)	148 (1017) 32 (218)	144 (991) 34 (231)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	84 (579) 34 (235)
In-Plane Shear ±45 Strength, ksi (MPa) Modulus, ksi (MPa)	ASTM D3518	Standard Cure Cycle 1 hour at 275°F (135°C)	9.4 (65) 0.6 (3.9)	10.0 (69) 0.4 (2.8)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	7.0 (48) 0.1 (0.7)
Interlaminar Shear (Short Beam Shear) Strength, ksi (MPa)	ASTM D2344	Standard Cure Cycle 1 hour at 275°F (135°C)	12.6 (87)	8.8 (61)	-
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	-	-	5.9 (41)
0° Flexural Strength, ksi (MPa) Modulus, ksi (MPa)	ASTM D790	Standard Cure Cycle 1 hour at 275°F (135°C)	219 (1511) 32 (218)	181 (1248) 31 (213)	- -
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	- -	- -	127 (877) 28 (193)
Poisson's Ratio ±45	-	Standard Cure Cycle 1 hour at 275°F (135°C)	0.85	0.95	-
		1 hour at 275°F (135°C) plus 2 hours P/C at 356°F (180°C)	-	-	0.96

** Data Normalized 60% Fiber Volume

SUGGESTED PROCESSING PARAMETERS

Cure Cycle

The baseline cure cycle for CYCOM 2020 is listed below. This cure cycle was used to generate the test results in this data sheet unless stated:

- Apply full vacuum from start
- Ramp temperature at 3.6°F/minute (2°C/minute) to 275°F (135°C)
- Apply 80 psi (0.55 MPa) pressure and maintain full vacuum
- Hold at 275°F (135°C) for 1 hour
- Cool autoclave to below 140°F (60°C) at 3.6°F/minute (2°C/minute)
- Cool under vacuum to ambient

ALTERNATE CURES

CYCOM 2020 can be cured at various temperatures depending on the service requirements. An evaluation of various cure cycles has been completed, with Tg values provided in Table 5.

Table 5 | CYCOM 2020 Tg as a Function of Cure Cycle *

Cure Cycle	Tg G', °F (°C)	Tg Peak tan δ, °F (°C)
10 hour at 176°F (80°C)	212 (100)	248 (120)
4 hours at 212°F (100°C)	259 (126)	302 (150)
0.5 hour at 275°F (135°C)	304 (151)	351 (177)
1 hour at 275°F (135°C)	307 (153)	351 (177)
1 hour at 302°F (150°C)	338 (170)	374 (190)
1 hour at 275°F (135°C) plus 2 hours at 356°F (180°C)	365 (185)	401 (205)

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Debulking

Vacuum debulking cycles to eliminate trapped air in the layup should be performed after the initial ply and then every 3 to 5 plies of the layup. Avoid compaction of the ply edges during the debulks by placing a hard edge around the part perimeter or by using breathable edge dams as illustrated in Figure 6.

Vacuum Requirements

Prior to heating, a vacuum hold at full vacuum (minimum 28 in Hg or 711 torr at sea level) is required. Full vacuum should be within 2 in Hg (50 torr) of absolute vacuum for the given altitude.

Vacuum hold times will depend on the part size and complexity, but general recommendations are 4 hours minimum hold for any uniform thickness parts smaller than 2 ft x 2 ft (0.6 m x 0.6 m) and 16 hours minimum hold for larger or more complex parts.

Leak Check

A vacuum leak check should be performed prior to cure and heat-up. The test should not show more than a 2 in Hg (50 torr) vacuum loss in 5 minutes.

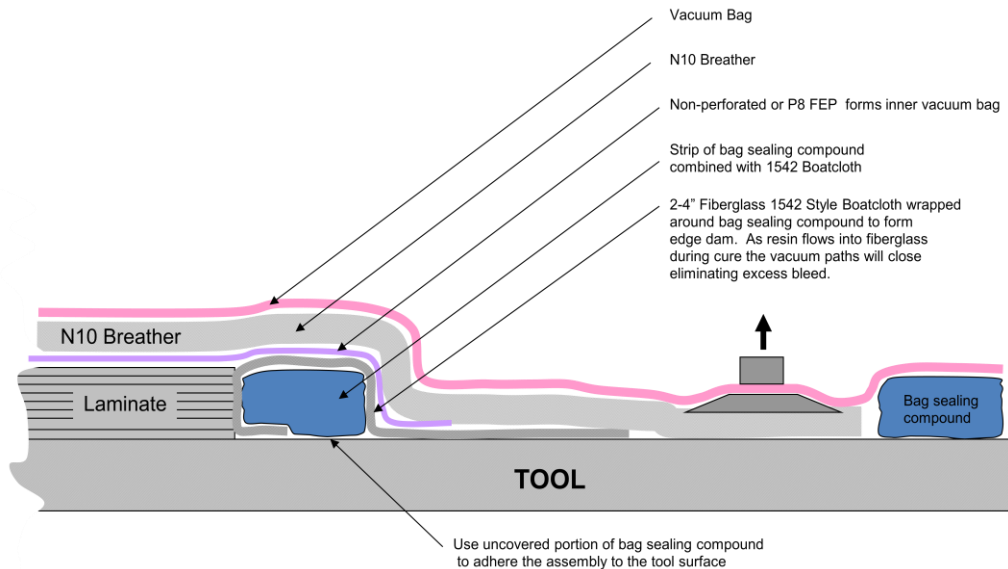


Figure 6 | Vacuum Bag Method

Bagging Material Notes

- Any industry standard breather material can be used provided it effectively removes air and can withstand cure temperatures.
- Use non perforated FEP or perforated at 2 inch (5cm) centers.
- Alternative layups can be used. All layup methods should perform the following functions:
 - a. Prevent pinching off of the laminate edge
 - b. Allow air to easily be removed from the laminate perimeter
 - c. Prevent resin loss during cure

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PRODUCT HANDLING AND SAFETY

Cytec Engineered Materials recommends wearing clean, impervious gloves when working with epoxy 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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