

CYCOM® 2035

CYCOM® 2035 is a variable curing modified epoxy resin developed for high performance applications.

Six sigma principles have been employed to optimize the chemistry of CYCOM® 2035 to give excellent toughness and crash performance with processing ease.

CYCOM® 2035 can be initially autoclave cured between 185°F and 356°F (85°C and 180°C). Free-standing postcures can be applied following lower temperature cures to improve Tg and temperature performance.

Features and Benefits

- Versatile cure from 185°F to 356°F (85°C to 180°C)
- Excellent toughness and crash performance
- Excellent mechanical properties
- Tg of 347°F (175°C) following post cure
- Controlled flow
- Excellent cured surface finish
- Shop life of 14 days at 75°F (24°C)
- Available in a wide range of fibers and fabric weaves

SUGGESTED APPLICATIONS

- Formula 1 crash structures including nose cone, side and rear
- Highly stressed Formula 1 components such as roll hoop and suspension

CHARACTERISTICS

Table 1 | Physical Characteristics

Shelf life	1 year when stored at less than 0°F (-18°C)
Tack Life	Up to 14 days at 75°F (24°C)
Shop Life	Up to 14 days at 75°F (24°C)
Gel Time	40 minutes at 275°F (135°C)
Cured Resin Density	1.31 g/cm ³

Table 2 | CYCOM 2035-36%-M46J-140 Unidirectional Tape Tg

Cure Cycle	Tg G', °F (°C)	Tg Peak tan δ, °F (°C)
10 hours at 185°F (85°C)	216 (102)	248 (120)
10 hours at 203°F (95°C)	241 (116)	266 (130)
10 hours at 203°F (95°C) + 2 hours at 356°F (180°C) postcure	354 (179)	377 (192)
2 hours at 275°F (135°C)	297 (147)	323 (162)
2 hours at 275°F (135°C) + 2 hours at 356°F (180°C) postcure	347 (175)	369 (187)



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RESIN VISCOSITY

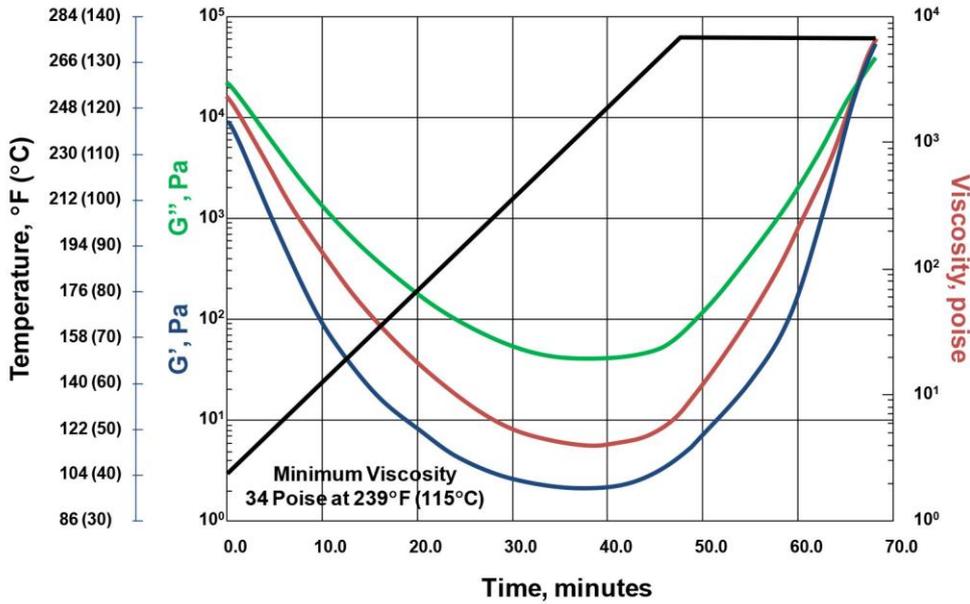


Figure 1 | Viscosity Trace of CYCOM 2035
 Ramp Rate of 4°F (2°C)/min to 275°F (135°C)

GLASS TRANSITION TEMPERATURE

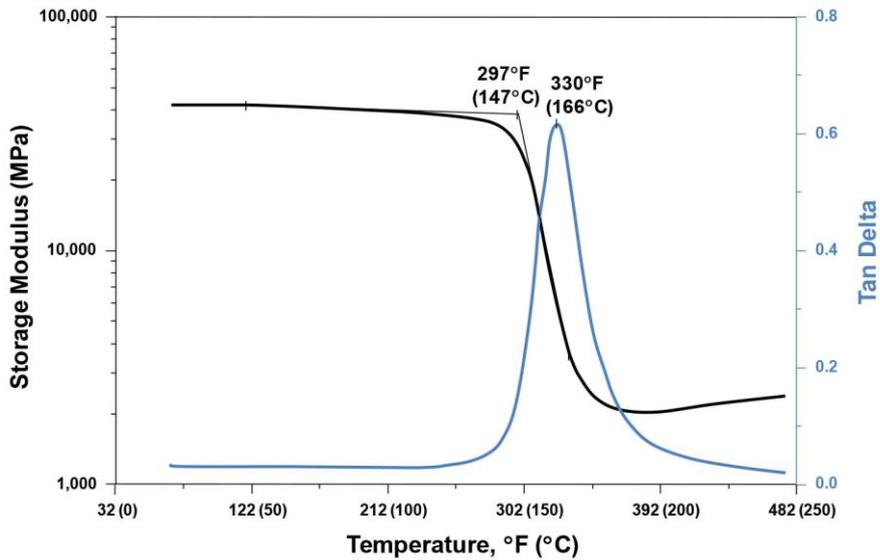


Figure 2 | DMA Trace of CYCOM 2035 M46J UD Cured for 2 hours at 275°F (135°C)



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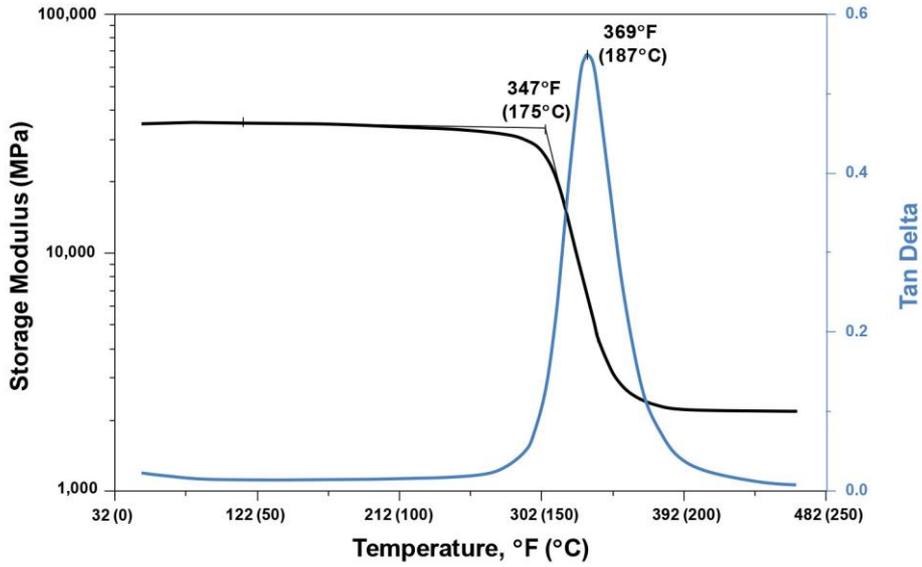


Figure 3 | DMA Trace of CYCOM 2035 M46J UD Cured for 2 hours at 275°F (135°C) and Postcured for 2 hours at 356°F (180°C)

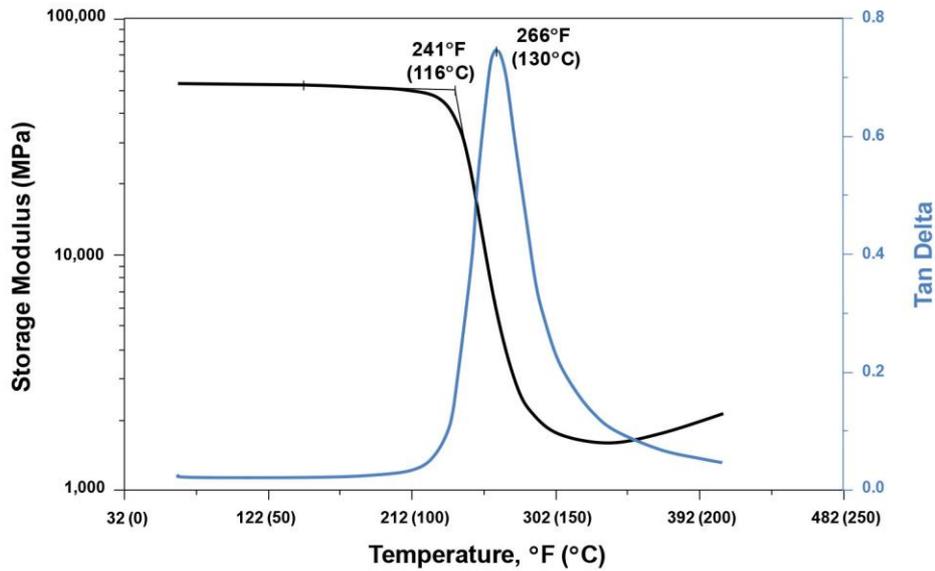


Figure 4 | DMA Trace of 2035 M46J UD Cured for 10 hours at 203°F (95°C)



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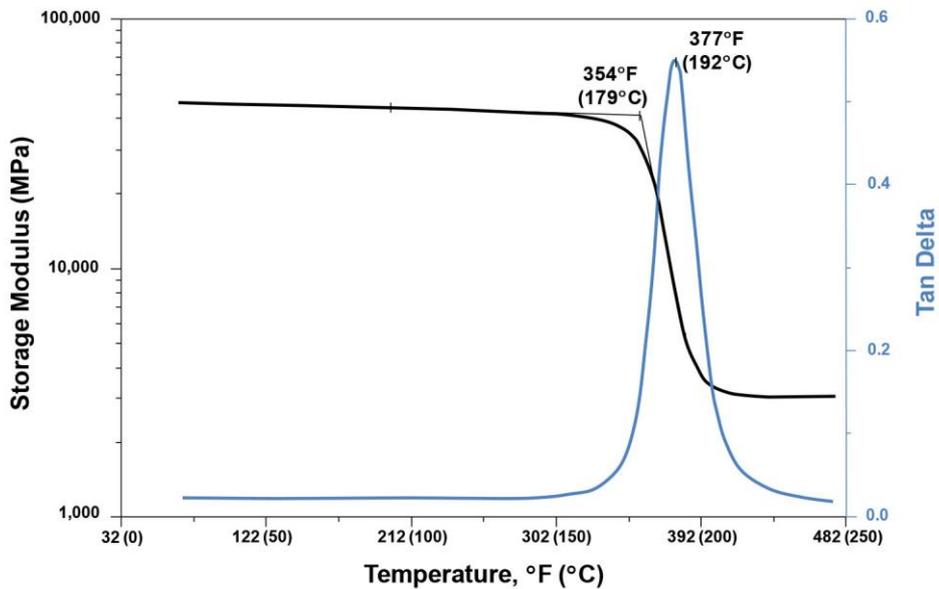


Figure 5 | DMA Trace of 2035 M46J UD Cured for 10 hours at 203°F (95°C) and Postcured for 2 hours at 356°F (180°C)



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PROPERTIES

Table 3 | Mechanical Properties of CYCOM 2035 Unidirectional Tape

Properties	2035-36%-M46J-140				2035-36%-T800-140	
	RT DRY Actual 55.9% VF	RT DRY Normalized 60% VF	248°F (120°C) DRY Actual 55.9% VF	248°F (120°C) DRY Normalized 60% VF	RT DRY Actual 56.3% VF	RT DRY Normalized 60% VF
0° Tensile						
Strength, ksi (MPa)	272 (1877)	291 (2009)	298 (2054)	319 (2199)	403 (2778)	429 (2960)
Modulus, msi (GPa)	34.0 (235)	36.4 (251)	34.1 (235)	36.5 (252)	22.2 (153)	23.7 (163)
90° Tensile						
Strength, ksi (MPa)	7.6 (52)	-	7.0 (48)	-	13.4 (92)	-
Modulus, msi (GPa)	1.0 (7.2)	-	0.8 (5.7)	-	1.3 (8.8)	-
0° Compression						
Strength, ksi (MPa)	117 (810)	126 (867)	109 (752)	117 (805)	225 (1553)	240 (1655)
Modulus, msi (GPa)	30.6 (211)	32.7 (226)	29.9 (206)	32.0 (221)	20.1 (139)	21.4 (148)
90° Compression						
Strength, ksi (MPa)	35.5 (245)	-	20.3 (140)	-	38.8 (267)	-
Modulus, msi (GPa)	1.3 (8.7)	-	1.1 (7.3)	-	1.4 (9.5)	-
0° Flexural						
Strength, ksi (MPa)	-	-	-	-	292 (2017)	312 (2149)
Modulus, msi (GPa)	-	-	-	-	25.1 (173)	26.7 (184)
90° Flexural						
Strength, ksi (MPa)	-	-	-	-	23.3 (161)	-
Modulus, msi (GPa)	-	-	-	-	1.5 (10.1)	-
Poisson's Ratio						
0°	-	-	-	-	0.25	-
90°	-	-	-	-	0.02	-
±45°	-	-	-	-	0.78	-
Interlaminar Shear						
Strength, ksi (MPa)	15.0 (103)	-	8.1 (56)	-	14.9 (103)	-
In Plane Shear						
±45 Strength, ksi (MPa)	-	-	-	-	22.4 (155)	-
Modulus, msi (GPa)	-	-	-	-	0.7 (4.6)	-
Compression Strength After Impact (CSAI),						
ksi (MPa)	25 (174)	-	-	-	-	-

Cure Cycle: 2 hours at 275°F (135°C)



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Table 4 | Mechanical Properties of CYCOM 2035-36%-M46J-140 Unidirectional Tape

Properties	Room Temperature, DRY		350°F (177°C), DRY	
	Actual 55.7% VF	Normalized 60% VF	Actual 55.7% VF	Normalized 60% VF
0° Tensile				
Strength, ksi (MPa)	264 (1821)	283 (1949)	263 (1817)	282 (1945)
Modulus, msi (GPa)	34.5 (238)	37.2 (257)	34.8 (240)	37.2 (256)
90° Tensile				
Strength, ksi (MPa)	4.8 (33)	-	1.8 (12.4)	-
Modulus, msi (GPa)	1.0 (6.9)	-	0.2 (1.4)	-
0° Compression				
Strength, ksi (MPa)	135 (933)	145 (999)	50 (348)	54 (372)
Modulus, msi (GPa)	29.2 (201)	31.3 (216)	31.1 (214)	33.3 (230)
90° Compression				
Strength, ksi (MPa)	35.9 (248)	-	17.6 (121)	-
Modulus, msi (GPa)	1.2 (8.4)	-	0.9 (6.3)	-
Interlaminar Shear				
Strength, ksi (MPa)	14.9 (103)	-	5.1 (35)	-
Compression Strength After Impact, ksi (MPa)	24.1 (166)	-	-	-

Cure Cycle: 2 hours at 275°F (135°C) plus 2-hour postcure at 356°F (180°C)

Table 5 | Interlaminar Shear Strength of CYCOM 2035-36%-M46J-140 Unidirectional Tape After Various Cure Cycles

Properties	Test Temperature °F (°C)	Cure Cycle			
		10 hours at 203°F (95°C)	10 hours at 203°F (95°C) + 2 hours at 356°F (180°C) Postcure	2 hours at 275°F (135°C)	2 hours at 275°F (135°C) + 2 hours at 356°F (180°C) Postcure
Interlaminar Shear Strength, ksi (MPa)	75 (23)	14.5 (100)	14.2 (98)	14.9 (103)	14.9 (103)
	176 (80)	9.6 (66)	13.1 (90)	-	-
	248 (120)	-	9.9 (68)	8.1 (56)	-
	302 (150)	-	8.0 (55)	-	-
	350 (177)	-	5.7 (39)	-	5.1 (35)



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Table 6 | Mechanical Properties of CYCOM 2035 Fabric

Properties	2035-42%-T800-2x2T-200				2035-42%-M46J-2x2T-200	
	RT DRY Actual 50.0% VF	RT DRY Normalized 55% VF	248°F (120°C) DRY Actual 55.6% VF	248°F (120°C) Normalized 60% VF	RT DRY Actual 49.6% VF	RT DRY Normalized 55% VF
0° Tensile						
Strength, ksi (MPa)	160 (1104)	176 (1214)	151 (1039)	166 (1143)	100 (687)	110 (762)
Modulus, msi (GPa)	10.0 (69)	11.0 (76)	10.1 (70)	11.1 (76)	15.7 (108)	17.4 (120)
90° Tensile						
Strength, ksi (MPa)	141 (971)	155 (1068)	130 (893)	142 (982)	86 (594)	95 (658)
Modulus, msi (GPa)	10.4 (72)	11.5 (79)	10.3 (71)	11.5 (79)	14.7 (101)	16.3 (112)
Poisson's Ratio						
0°	0.01	-	0.02	-	0.02	-
90°	0.02	-	0.07	-	0.04	-
±45°	0.76	-	0.76	-	0.79	-
0° Compression						
Strength, ksi (MPa)	110 (759)	121 (835)	85 (587)	94 (645)	70 (483)	78 (535)
Modulus, msi (GPa)	9.1 (63)	10.0 (69)	9.1 (63)	10.0 (69)	12.8 (88)	14.1 (97)
90° Compression						
Strength, ksi (MPa)	110 (757)	121 (832)	82 (566)	90 (623)	67 (463)	74 (513)
Modulus, msi (GPa)	9.1 (63)	10.0 (69)	9.1 (63)	10.0 (69)	12.6 (87)	14.0 (97)
0° Flexural						
Strength, ksi (MPa)	171 (1179)	188 (1296)	122 (843)	134 (927)	129 (891)	143 (988)
Modulus, msi (GPa)	10.0 (69)	11.0 (76)	9.7 (67)	10.7 (74)	16.7 (115)	18.6 (128)
90° Flexural						
Strength, ksi (MPa)	169 (1164)	186 (1281)	118 (813)	130 (895)	124 (858)	138 (951)
Modulus, msi (GPa)	9.4 (65)	10.4 (72)	9.3 (64)	10.3 (71)	15.2 (105)	16.8 (116)
0° Interlaminar Shear						
Strength, ksi (MPa)	14.6 (101)	-	7.5 (52)	-	10.4 (72)	-
90° Interlaminar Shear						
Strength, ksi (MPa)	13.8 (95)	-	7.7 (53)	-	10.4 (72)	-
In Plane Shear						
±45 Strength, ksi (MPa)	19.9 (137)	-	12.3 (85)	-	14.2 (98)	-
Modulus, msi (GPa)	0.7 (4.7)	-	0.4 (3.1)	-	0.6 (4.3)	-
Compression Strength After Impact (CSAI), quasi, ksi (MPa)	36.7 (253)	-	-	40.3 (278)	-	-
Bearing Strength, quasi, ksi (MPa)	NT	-	-	-	-	-

For fabric 0° is warp direction, 90° is weft or fill direction



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SUGGESTED PREPARATION AND PROCESSING PARAMETERS

Laminate Preparation

- Cut the prepreg for the laminate
- Lay up the laminate onto the tool or caul plate that has been treated with release agent or film, in the desired configuration, taking care not to distort the material
- As each ply of material is positioned, work out any entrapped air using light pressure with a paddle or roller before removing the release paper or poly film from that ply
- Apply vacuum bag using standard release films, breathers and bagging materials
- Insert at least two vacuum stems through the bag, connecting one to the vacuum source and the other at a point on the part furthest from the source to a calibrated vacuum gage

Debulking

Vacuum debulking cycles are not required to eliminate voids for flat or mildly contoured parts. Vacuum debulking should be performed only as necessary to eliminate wrinkles and bridging of materials in highly contoured or very thick parts.

Vacuum Requirements

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

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 vacuum loss in 5 minutes.

Cure Cycle

The recommended cure cycle for CYCOM2035 products is as follows (refer to Figure 6):

- Apply full vacuum from start
- Heat up at a rate of 4°F/minute (2°C/minute) to 275°F (135°C)
- Apply 100 psi (689 kPa) pressure
- Hold at 275°F (135°C) for 120 minutes
- Cool autoclave to below 140°F (60°C) at 6°F/minute (3°C/minute)

CYCOM 2035 has a high degree of versatility with respect to cure temperature. A number of different cycles have been evaluated as below:

- 10 hours at 185°F (85°C)
- 4 hours at 230°F (110°C)
- 2 hours at 356°F (180°C) – removes the requirement for separate post cure

Please contact a Technical Service Representative for further details specific to your application.



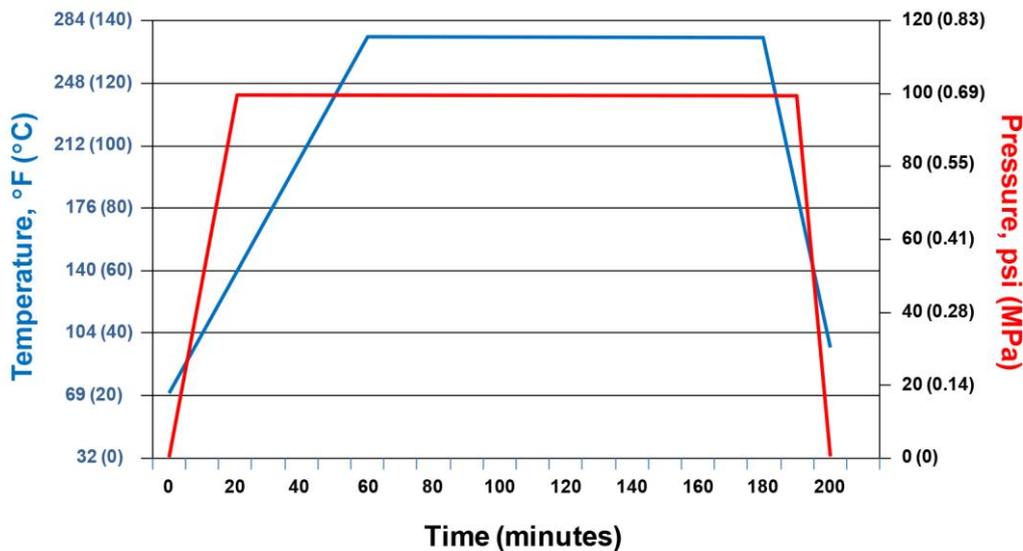


Figure 6 | Typical CYCOM 2035 Cure Cycle

POST CURE CYCLE

The recommended post cure cycle for CYCOM 2035 is as follows:

- Ramp temperature at 4°F/minute (2°C/minute) to 356°F (180°C)
- Hold at 356°F (180°C) for 120 minutes
- Cool oven to below 140°F (60°C) at 6°F/minute (3°C/minute)

DISPOSAL OF SCRAP MATERIAL

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

HEALTH & SAFETY

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

