

## CYCOM® EP2190

This highly toughened resin is formulated with the most advanced epoxy chemistry. Optimized for structurally efficient structure with excellent resistance to impact and delamination growth under fatigue. Designed to provide excellent cure robustness and cure stability. A 177°C (350°F) curing toughened resin system with a service temperature range of -59°C to 107°C (-75°F to 225°F). Typical applications for CYCOM® EP2190 include primary and secondary aircraft structures. Recommended for both thin and thick structures.

CYCOM® EP2190 is available with carbon reinforcement in unidirectional tape, woven fabric and slit tape forms.

The following products are compatible and are suggested for use with CYCOM® EP2190: FM® 309-1 adhesives, FusePly™350, Surface Master® 905

### Features and Benefits

- Minimum 15+ days handling life at 21°C (70°F)
- 12 months storage at -12°C (10°F)
- Controlled flow
- Very high impact resistance
- 177°C (350°F) autoclave cure temperature
- Excellent cured surface finish
- Good for multiple cure cycles
- NCAMP database in development
- Thermo-chemical modelling in Raven Software
- High-rate manufacturing-ready with automated processing and reduced cure cycle time



**CHARACTERISTICS**
**Table 1: Resin Properties**

Property	Value	Test Method
Cured Density g/cm <sup>3</sup> ( lb/in <sup>3</sup> )	1.27 (0.04588)	Syensqo AN-P82-11
Tg °C (°F) Dry <sup>2/</sup>	192 (378)	DMA Storage Mod.
Tg °C (°F) Wet <sup>3/</sup>	153 (307)	DMA Storage Mod.
Tensile Strength MPa (ksi) <sup>1/</sup>	76 (11)	
Tensile Modulus GPa (Msi) <sup>1/</sup>	3.5 (0.52)	
Compression Strength MPa (ksi) <sup>1/</sup>	149 (21)	
Compression Modulus GPa (Msi) <sup>1/</sup>	3.2 (0.46)	
Flex – 3 Pt Strength MPa (ksi) <sup>1/</sup>	142 (21)	
Flex – 3 Pt Modulus GPa (Msi) <sup>1/</sup>	3.2 (0.47)	
Coefficient of Thermal Expansion (CTE) µm/m°C	65.8	ASTM E831-19

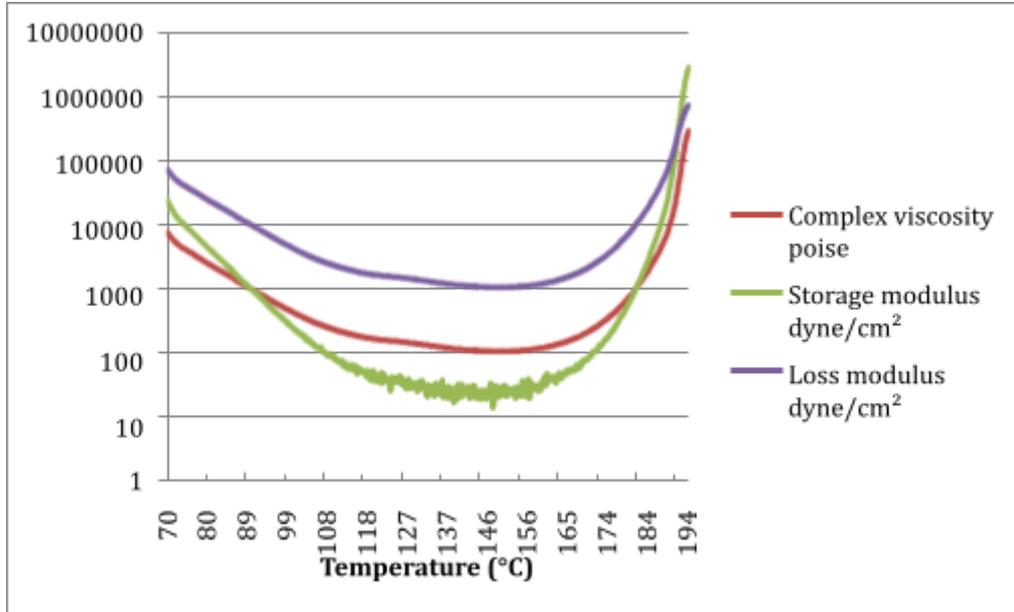
## Notes:

- 1/ At room temperature 23C (75F)
- 2/ Dry at 80C (176F) for 48 hours under vacuum
- 3/ Soak at 70C (158F) for 14 days



**Viscosity Profile**

The figure below shows a typical CYCOM® EP2190 viscosity curve.



**Typical Cycom EP2190 Viscosity Curve**



**Table 2: Prepreg Properties**

Property	Test Condition	IM Tape (145gsm)	T650 PW Fabric	Test Method
CPT mm (in)	---	0.14 (0.0056)	0.20 (0.0079)	
0° Tensile (Norm) Strength MPa (ksi) <sup>3/</sup> / Modulus GPa (Msi)	-55C (-67F) Amb 24C (75F) Dry <sup>2/</sup> 24C (75F) Amb 82C (180F) Wet <sup>4/</sup> 121C (250F) Amb 121C (250F) Wet <sup>4/</sup>	2875 (417) / 153 (22.2) 2889 (419) / 156 (22.6) 3034 (440) / 156 (22.6) 2765 (401) / 158 (22.9) 2765 (401) / 157 (22.8) 2537 (368) / 158 (22.9)	793 (115) / 66 (9.5) 869 (126) / 65 (9.4) 883 (128) / 66 (9.5) 896 (130) / 67 (9.7) 827 (120) / 69 (10) 827 (120) / 66 (9.5)	ASTM D3039
90° Tensile (Norm) Strength MPa (ksi) <sup>3/</sup> / Modulus GPa (Msi)	-55C (-67F) Amb 24C (75F) Dry <sup>2/</sup> 24C (75F) Amb 82C (180F) Wet <sup>4/</sup> 121C (250F) Amb 121C (250F) Wet <sup>4/</sup>	57 (8.3) / 10 (1.4) --- 77 (11.2) / 9 (1.3) 39 (5.7) / 8 (1.1) 59 (8.6) / 8 (1.1) 26 (3.7) / 5 (0.70)	758 (110) / 66 (9.5) 945 (137) / 66 (9.6) 841 (122) / 64 (9.3) 745 (108) / 64 (9.3) 786 (114) / 69 (10) 689 (100) / 62 (9.0)	ASTM D3039
0° Compression (Norm) Strength MPa (ksi) / Modulus GPa (Msi)	-55C (-67F) Amb 24C (75F) Amb 82C (180F) Wet <sup>4/</sup> 121C (250F) Amb 121C (250F) Wet <sup>4/</sup>	1696 (246) / 137 (19.8) 1344 (195) / 136 (19.7) 1193 (173) / 141 (20.4) 1131 (164) / 138 (20.0) 731 (106) / 163 (23.7)	889 (129) / 59 (8.5) 765 (111) / 59 (8.6) 600 (87) / 60 (8.7) 503 (73) / 58 (8.4) 421 (61) / 59 (8.5)	ASTM D695 Modified
	24C (75F) Dry <sup>2/</sup> 82C (180F) Wet <sup>1/</sup> 121C (250F) Wet <sup>1/</sup>	1600 (232) / 134 (19.5) 1117 (162) / 135 (19.6) 703 (102) / 143 (20.8)	738 (107) / 58 (8.4) --- ---	ASTM D6641
90° Compression Strength MPa (ksi) <sup>3/</sup> / Modulus GPa (Msi)	-55C (-67F) Amb 24C (75F) Amb 82C (180F) Wet <sup>4/</sup> 121C (250F) Amb 121C (250F) Wet <sup>4/</sup>	359 (52) / 11 (1.6) 290 (42) / 10 (1.5) 200 (29) / 9 (1.3) 214 (31) / 8 (1.2) 172 (25) / 8 (1.2)	855 (124) / 58 (8.4) 772 (112) / 59 (8.5) 600 (87) / 59 (8.6) 552 (80) / 59 (8.6) 434 (63) / 57 (8.2)	ASTM D695 Modified
	24C (75F) Dry <sup>2/</sup> 121C (250F) Dry <sup>2/</sup>	--- ---	731 (106) / 59 (8.6) 538 (78) / 62 (9.0)	ASTM D6641



Property	Test Condition	IM Tape (145gsm)	T650 PW Fabric	Test Method
In-plane Shear Strength MPa (ksi) / Modulus GPa (Msi)	-55C (-67F) Amb	165 (23.9) / 6 (0.85)	---	ASTM D3518
	24C (75F) Dry <sup>2/</sup>	136 (19.7) / 4 (0.59)	139 (20.1) / 4 (0.60)	
	24C (75F) Amb	132 (19.2) / 5 (0.68)	---	
	82C (180F) Wet <sup>4/</sup>	82 (11.9) / 4 (0.51)	---	
	121C (250F) Dry <sup>2/</sup>	--	95 (13.8) / 3 (0.45)	
	121C (250F) Amb	86 (12.5) / 4 (0.53)	---	
In-plane Shear – V Notch Strength MPa (ksi) / Modulus GPa (Msi)	-55C (-67F) Amb	---	186 (27) / 5 (0.7)	ASTM D5379
	24C (75F) Amb	---	152 (22) / 5 (0.7)	
	82C (180F) Wet <sup>4/</sup>	---	110 (16) / 3 (0.5)	
	121C (250F) Amb	---	131 (19) / 3 (0.4)	
Short Beam Shear MPa (ksi)	-55C (-67F) Amb	114 (16.6)	102 (14.8)	ASTM D2344
	24C (75F) Dry <sup>2/</sup>	108 (15.6)	84 (12.2)	
	24C (75F) Amb	103 (15.0)	83 (12.1)	
	82C (180F) Wet <sup>1/</sup>	62 (9.0)	---	
	82C (180F) Wet <sup>4/</sup>	48 (6.9)	54 (7.8)	
	121C (250F) Amb	56 (8.1)	52 (7.5)	
0 Flexural Strength MPa (ksi)	24C (75F) Amb	1841 (267)	1041 (151)	ASTM D790 (32:1)
	121C (250F) Amb	1358 (197)	772 (112)	
	121C (250F) Wet <sup>4/</sup>	938 (136)	---	
90 Flexural Strength MPa (ksi)	24C (75F) Amb	---	1076 (156)	ASTM D790 (32:1)
	121C (250F) Amb	---	745 (108)	
Unnotched Tensile Strength MPa (ksi) / Modulus GPa (Msi)	-55C (-67F) Amb	689 (100) / 57 (8.3)	662 (96) / 48 (7.0)	ASTM D3039
	24C (75F) Amb	883 (128) / 57 (8.3)	662 (96) / 47 (6.8)	
	82C (180F) Wet <sup>4/</sup>	883 (128) / 57 (8.3)	627 (91) / 46 (6.7)	
	121C (250F) Amb	1041 (151) / 57 (8.2)	621 (90) / 46 (6.7)	
	121C (250F) Wet <sup>4/</sup>	896 (130) / 54 (7.9)	579 (84) / 43 (6.2)	
Open Hole Tensile Strength MPa (ksi) <sup>3/</sup>	-55C (-67F) Dry	490 (71)	338 (49)	ASTM D5766
	24C (75F) Dry	510 (74)	359 (52)	
	24C (75F) Amb	510 (74)	338 (49)	
	121C (250F) Dry	---	365 (53)	
	121C (250F) Amb	531 (77)	345 (50)	
	82C (180F) Wet <sup>1/</sup>	538 (78)	345 (50)	
	82C (180F) Wet <sup>4/</sup>	531 (77)	359 (52)	
	121C (250F) Wet <sup>1</sup>	565 (82)	345 (50)	
	121C (250F) Wet <sup>4/</sup>	572 (83)	352 (51)	
Filled Hole Tensile Strength MPa (ksi)	-55C (-67F) Dry	---	372 (54)	ASTM D5766
	24C (75F) Amb	---	372 (54)	
	121C (250F) Amb	---	379 (55)	
	82C (180F) Wet <sup>4/</sup>	---	379 (55)	
	121C (250F) Wet <sup>4/</sup>	---	372 (54)	



Unnotched Compression Strength MPa (ksi) / Modulus GPa (Msi)	-55C (-67F) Amb 24C (75F) Amb 82C (180F) Wet <sup>4/</sup> 121C (250F) Amb 121C (250F) Wet <sup>4</sup>	745 (108) / 53 (7.7) 600 (87) / 54 (7.8) 490 (71) / 53 (7.7) 503 (73) / 52 (7.6) 359 (52) / 51 (7.4)	669 (97) / 44 (6.4) 552 (80) / 44 (6.4) 434 (63) / 43 (6.2) 434 (63) / 44 (6.4) 324 (47) / 42 (6.1)	ASTM D8066
Open Hole Compression Strength MPa (ksi) <sup>3/</sup>	-55C (-67F) Amb 24C (75F) Dry <sup>2/</sup> 24C (75F) Amb 82C (180F) Wet <sup>1/</sup> 82C (180F) Wet <sup>4/</sup> 121C (250F) Dry <sup>2/</sup> 121C (250F) Amb 121C (250F) Wet <sup>1/</sup> 121C (250F) Wet <sup>4/</sup>	365 (53) 345 (50) 324 (47) 296 (43) 269 (39) --- 283(41) 248 (36) 228 (33)	359 (52) 324 (47) 310 (45) 248 (36) 248 (36) 262 (38) 234 (34) 207 (30) 200 (29)	ASTM D6484
Fracture Toughness Glc - VIS J/m <sup>2</sup> (in-lbf/in <sup>2</sup> )	24C (75F) Amb 82C (180F) Wet <sup>1/</sup>	405 (2.31) 212 (1.21)	571 (3.26) ---	ASTM D5528
Fracture Toughness Glc - PROP J/m <sup>2</sup> (in-lbf/in <sup>2</sup> )	24C (75F) Amb 82C (180F) Wet <sup>1/</sup>	298 (1.70) 330 (1.89)	763 (4.36) ---	ASTM D5528
Fracture Toughness Glc - NL J/m <sup>2</sup> (in-lbf/in <sup>2</sup> )	24C (75F) Amb 82C (180F) Wet <sup>1/</sup>	368 (2.10) 341 (1.95)	473 (2.70) ---	ASTM D5528

Property	Test Condition	IM Tape (145gsm)	T650 PW Fabric	Test Method
Compression After Impact 30.5J (270 in lb) Strength MPa (ksi)	-55C (-67F) Amb 24C (75F) Dry 24C (75F) Amb 82C (180F) Wet <sup>4/</sup> 121C (250F) Amb 121C (250F) Wet <sup>4/</sup>	386 (56) 345 (50) 331 (48) 276 (40) 248 (36) 193 (28)	--- 338 (49) 324 (47) --- --- ---	ASTM D7137
Tg °C (°F) via DMA	Dry Amb Wet	188 (370) 185 (365) 144 (291)	184 (363) 177 (350) 143 (289)	ASTM D7028 Dual Cantilever
Tg °C (°F) via TMA	Dry Amb Wet	200 (392) 194 (381) 172 (342)	189 (372) 191 (376) 193 (379)	ASTM E0831
CTE (µm/(m·°C)) <sup>6/</sup>	X Axis Y Axis Z Axis	-0.85 34 56	3.2 3.0 65	ASTM E0831

1/ Wet conditioning = water immersion at 160°F for 14 days

2/ Dry = 175°F (80°C) for 48 hours

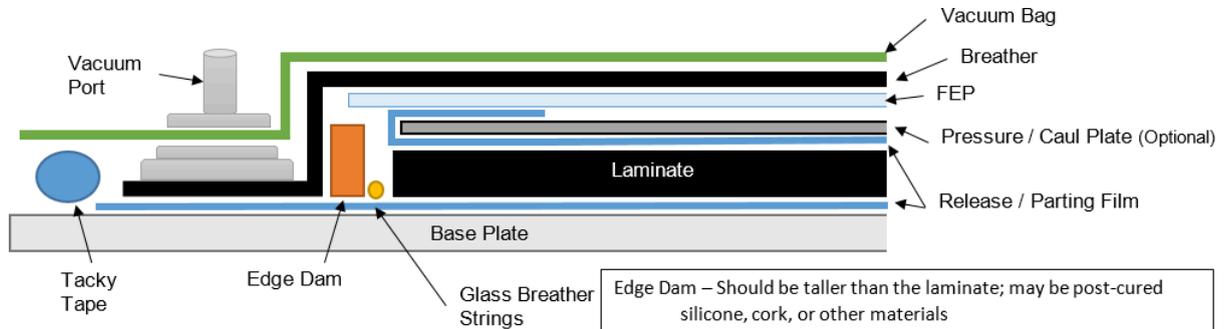
3/ Normalized using cure ply thickness (CPT) PW= 0.0079in, Uni = 0.0056in

4/ Wet uptake = 1% gain after drying coupons 160F / 90% RH

5/ Wet uptake = EQ after 120 days at 160F / 90% RH

6/ Value taken over following temperature range: Tape: 25 -125C, Fabric: -60 - 120C



**PROCESSING INFORMATION**
**Bagging**


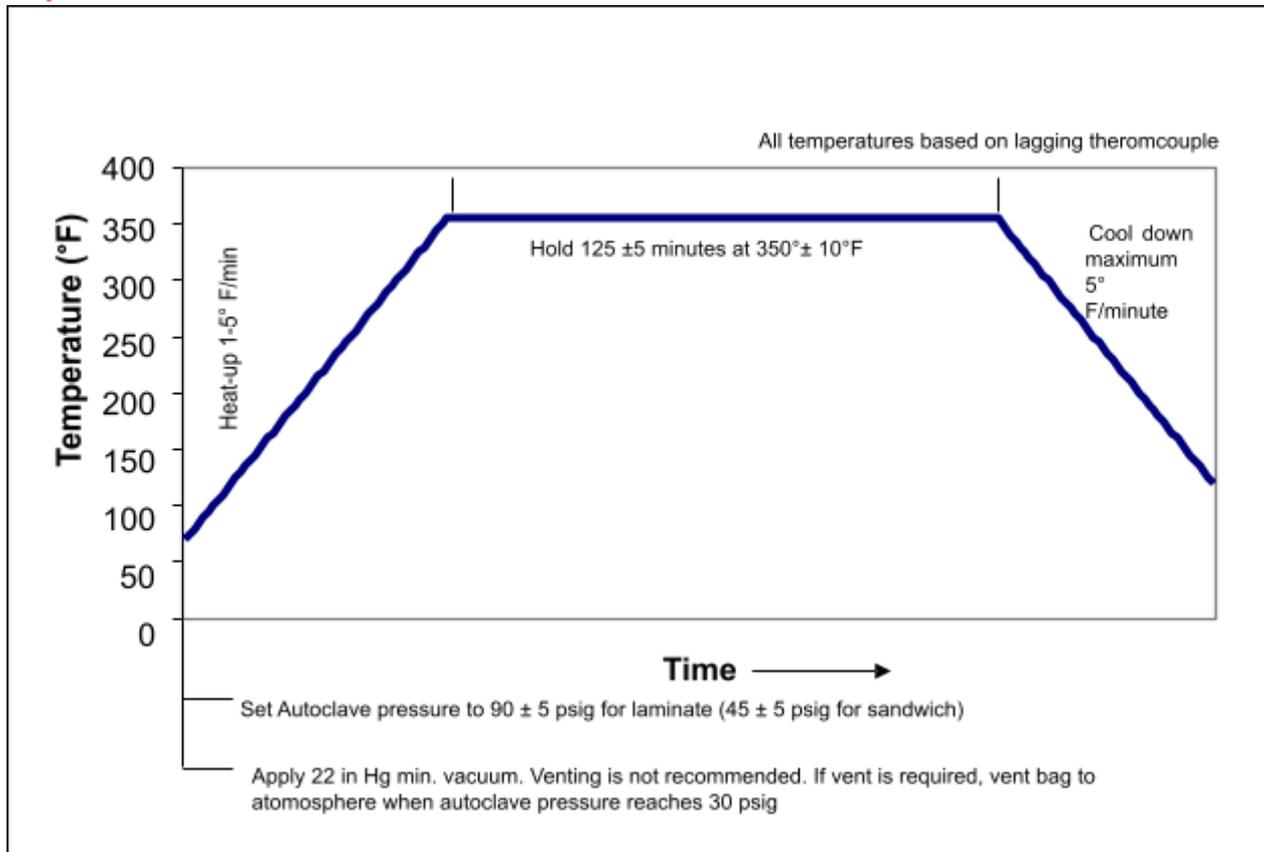
Edge Dam – Should be taller than the laminate; may be post-cured silicone, cork, or other materials

Glass Breather Strings – 2 to 4 strings around laminate edges; contact with the breather necessary

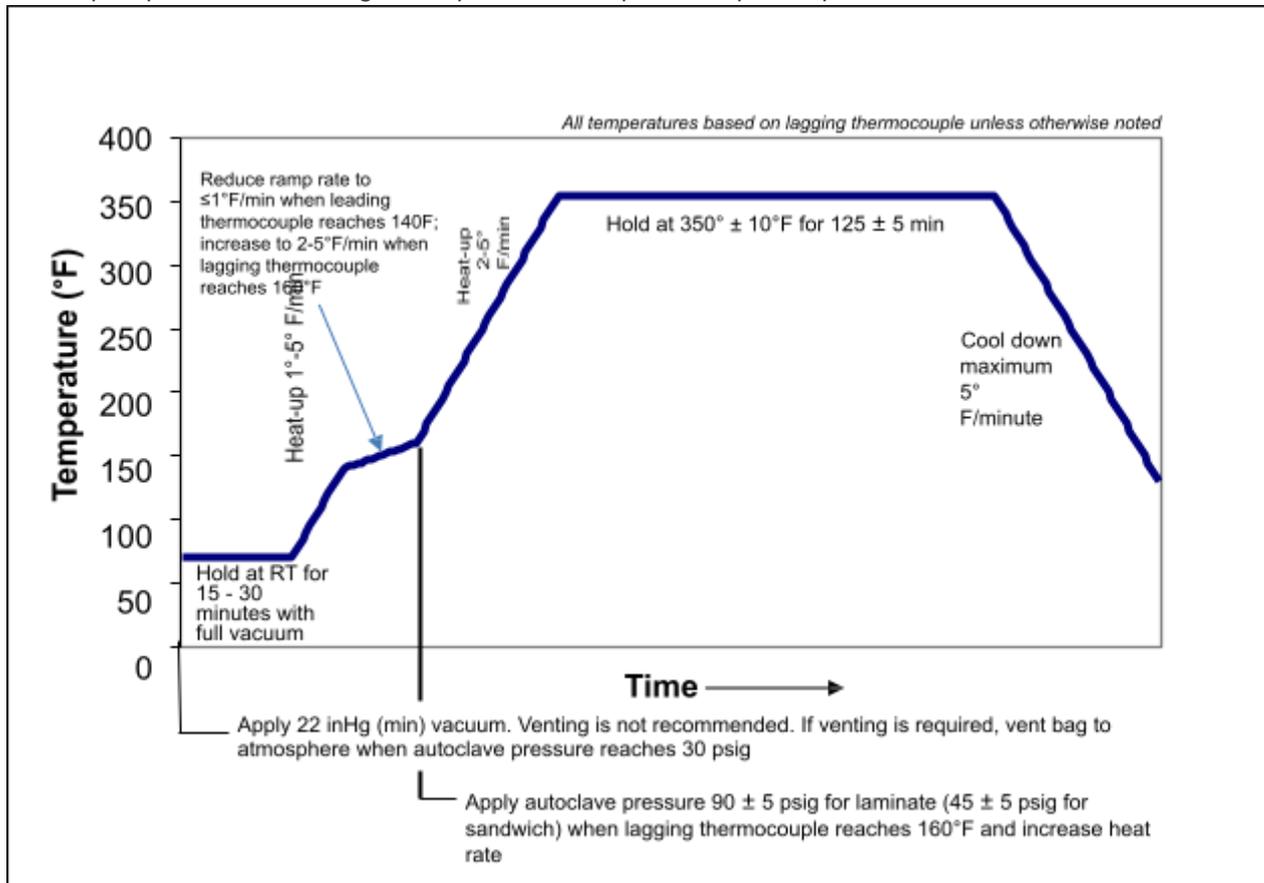
Breather – 1 to 2 layers N10, 181 glass or equivalent

FEP – Solid recommended with pressure plate, Perforated (P6) optional



**Cure Cycles**

For complex parts, the following cure cycle could help resolve porosity issues.



## EXOTHERM

CYCOM® EP2190 prepregs are reactive formulations which can undergo severe exothermic heat up during the initial curing process if incorrect curing procedures are followed.

Great care must be taken to ensure that safe heating rates, dwell temperatures and lay-up/bagging procedures are adhered to, especially when moulding solid laminates in excess of 10mm (0.4in) thickness. The risk of exotherm increases with lay-up thickness and increasing cure temperature. It is strongly recommended that trials, representative of all the relevant circumstances, are carried out by the user to allow a safe cure cycle to be specified. It is also important to recognise that the model or tool material and its thermal mass, combined with the insulating effect of breather/bagging materials can affect the risk of exotherm in particular cases.

## HEALTH & SAFETY

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

