

CYCOM® PR 520N RTM

CYCOM® PR 520N RTM is a one-part, 179°C (355°F) curing epoxy resin system offering superior damage tolerance and good strain to failure required for composite primary structure applications.

The value of resin infusion is the ability to design complex geometric parts while leveraging a unitized structure which ultimately leads to a reduction in weight, lower part counts and the elimination of many post-manufacturing processes.

CYCOM® PR 520N RTM is an off-white thick paste at room temperature reducing to a low viscosity when heated for injection. The resin has a low enough viscosity to allow injection at 90°C (194°F) to 100°C (212°F). Following injection, the resin viscosity decreases with increasing tool temperature to below 50 cP (50 mPa·s), thus helping to ensure full fiber wetting.

CYCOM PR® 520N RTM resin is fully cured following a 2-hour dwell at 179°C (355°F) after which it has a continuous hot/wet service temperature of 104°C (220°F).

For reinforcement preforming operations, a fully compatible binder system, CYCOM® 7720 RTM, and a low areal weight film, CYCOM® PR 520-1, have been developed for use with CYCOM® PR 520N RTM. The binder and low areal weight film are available pre-coated onto fabrics of the customer's choice. A separate datasheet for CYCOM® 7720 RTM is available upon request.

Typical applications for CYCOM® PR 520N RTM include containment cases, engine blades, engine blade spacers/platforms, outer guide vanes, hinges, brackets, fittings and generally primary structure applications requiring superior toughness.

Features and Benefits

- One-part epoxy resin system
- 30 day out-life at room temperature [24°C (75°F)]
- 18 month shelf-life at -18°C (0°F)
- Low exotherm, i.e., thick part production capable
- ~500 cP (500 mPa·s) initial injection viscosity
- <50 cP (50 mPa·s) minimum viscosity
- Full cure after 2 hours at 179°C (355°F)
- Continuous hot/wet service performance >104°C (220°F)
- Low moisture absorption, ~0.6%
- High resin toughness
- Fully compatible binder, CYCOM® 7720 RTM, available

CHARACTERISTICS

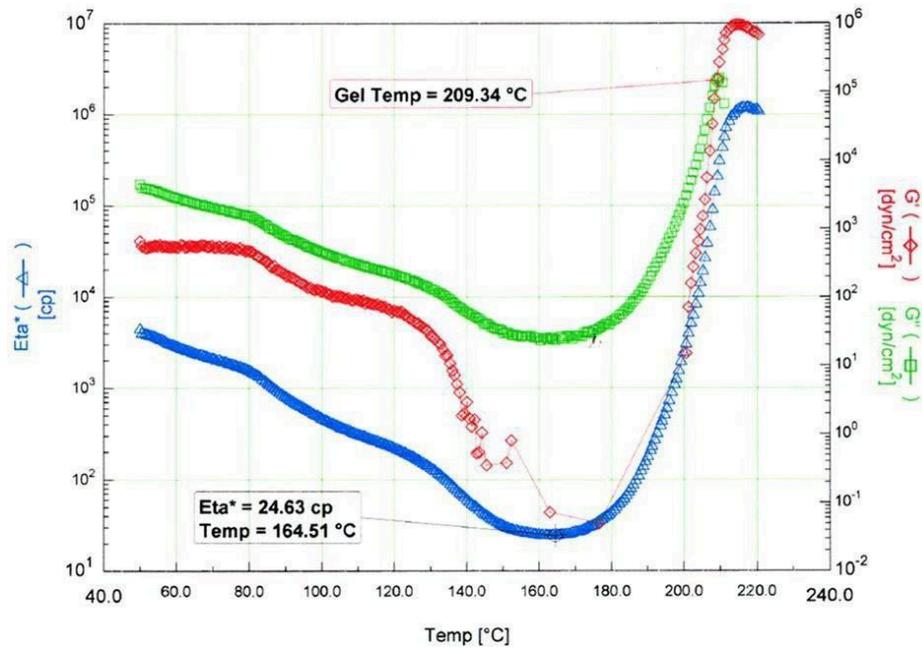
Table 1 | Physical Properties

Property	
Shelf Life	18 months at or below -18°C (0°F) from date of shipment
Shop Life	30 days at or below 24°C (75°F)



Table 2 | Product Availability

Property	CYCOM PR 520N RTM
Color	Off-white
Form	Paste
Size	5 gallons

Resin Viscosity

Figure 1 | CYCOM® PR 520N RTM Dynamic Viscosity at 2°C (3.5°F) per minute

Note: Suitable injection viscosities of <500 cP (<500 mPa·s) are reached at temperatures over 100°C (212°F).



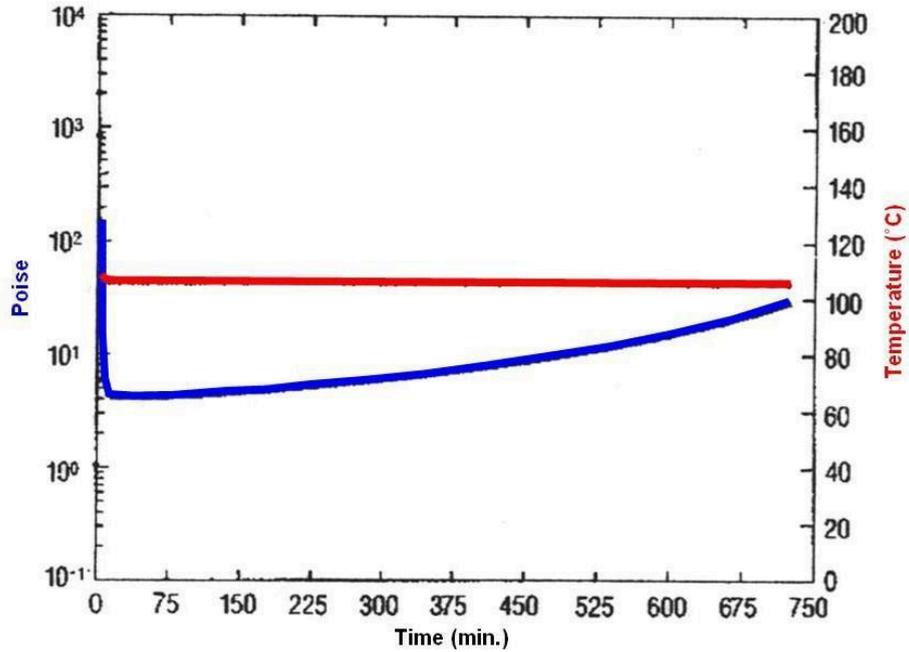


Figure 2 | CYCOM® PR 520N RTM Isothermal Viscosity at 106°C (223°F)

Note: At this temperature the viscosity remains in the region of 500 cP (500 mPa·s) for approximately 5 hours.

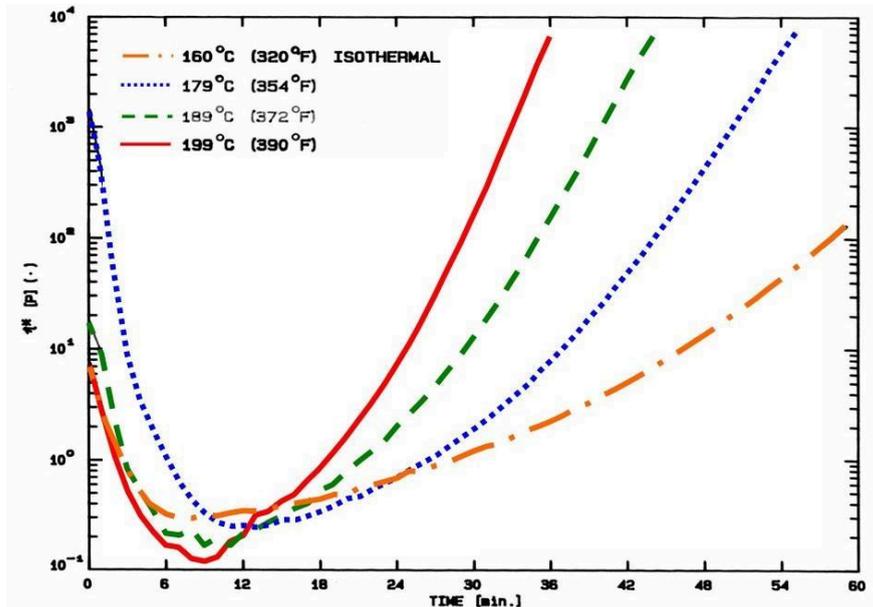


Figure 3 | CYCOM® PR 520N RTM Isothermal Viscosities

Note: At 160°C (320°F) the viscosity remains below 500 cP (500 mPa·s) for approximately 40 minutes.



PROPERTIES

Table 3 | Neat Resin Characteristics

Property	Test condition	Value	Test Method
Cured Resin Density g/cc (pcf)	24°C (75°F)	1.25 (78.0)	ASTM D 792
Tg by DSC °C (°F)	24°C (75°F)	156 (312)	ASTM D 3418
Tensile Strength MPa (ksi)	24°C (75°F)	95.0 (13.8)	ASTM D 638
Tensile Modulus GPa (Msi)	24°C (75°F)	4.0 (0.58)	ASTM D 638
Tensile Strain at Break %	24°C (75°F)	3.0	ASTM D 638
Poisson's Ratio	24°C (75°F)	0.398	ASTM D 638
Shear Strength MPa (ksi)	24°C (75°F)	61.4 (8.9)	ASTM D 5379
Shear Modulus GPa (Msi) ¹	24°C (75°F)	0.8 (0.12)	ASTM D 5379
Flexural Strength MPa (ksi)	24°C (75°F)	153.1 (22.2)	ASTM D 790
Flexural Modulus GPa (Msi)	24°C (75°F)	3.5 (0.50)	ASTM D 790
SENB KIC MPa·m ^{1/2} (ksi·in ^{1/2})	24°C (75°F)	1.8 (1.6)	ASTM D 5045
SENB GIC J/m ² (in·lb/in ²)	24°C (75°F)	1060 (6.1)	ASTM D 5045
CTE by TMA m/m·°C (in/in·°F)	24°C (75°F)	52.9 (29.4) x 10 ⁻⁶	ASTM E 831

¹ Minimum modulus below TG



Table 4 | CYCOM® PR 520N RTM Typical Laminate Properties (3k-T650-35 8HS)

Property	Test condition ¹	3k-T650-35 8HS	Test Method
Warp Tensile Strength MPa (ksi) ³	24°C (75°F)	945 (137)	ASTM D 3039
Warp Tensile Modulus GPa (Msi) ³	24°C (75°F)	75.8 (11.0)	ASTM D 3039
Warp Compression Strength MPa (ksi) ³	24°C (75°F)	814 (118)	ASTM D 6641
Warp Compression Modulus GPa (Msi) ³	24°C (75°F)	63.4 (9.2)	ASTM D 6641
In-plane Shear Strength MPa (ksi)	24°C (75°F) 107°C (225°F)/ wet	112 (16.3) 49 (7.12) ²	ASTM D 3518
In-plane Shear Modulus GPa (Msi)	24°C (75°F) 107°C (225°F)/ wet	5.7 (0.83) 3.6 (0.52) ²	ASTM D 3518
OH Tension Strength MPa (ksi) ³	24°C (75°F)	389 (56.4)	ASTM D 5766
OH Compression Strength MPa (ksi) ³	24°C (75°F) 85°C (185°F)/ wet 107°C (225°F)/ wet	319 (46.3) 238 (34.5) ² 203 (29.4) ²	ASTM D 6484
Bearing Strength MPa (ksi) ³	24°C (75°F)	910 (132)	ASTM D 5961
Compression Strength After Impact MPa (ksi) ³			ASTM D 7136/ ASTM D 7137
4.5 J/mm (1010 in-lb/in)	24°C (75°F)	432 (62.7)	
7.0 J/mm (1580 in-lb/in)	24°C (75°F)	396 (57.4)	
8.3 J/mm (1870 in-lb/in)	24°C (75°F)	374 (54.2)	
11.8 J/mm (2650 in-lb/in)	24°C (75°F)	329 (47.7)	

¹ All non- wet conditioned: Dried in vacuum oven for 48 hours at 105°C (221°F) prior to testing

² Wet conditioning: 71°C (160°F) at 95% relative humidity to >90% equilibrium (where equilibrium ~0.47%)

³ Data normalized to 60% V_f

PROCESSING

The CYCOM® PR 520N RTM resin infusion material system is characterized by a processing window that must be respected in order to successfully manufacture a composite component.

For these guidelines the process is divided into three steps, corresponding to infusion preparation, infusion & resin homogenization, and lock-off & cure.

Infusion Preparation

- To sufficiently degas this system it is recommended that a resin temperature of 105°C (221°F) is used. This gives a viscosity of approximately 500 cps (500 mPa·s) and pot-life of 5 hours. Degassing should be administered for a minimum of 15 minutes at 945 mbar absolute (28 in of Hg).



- The resin holding reservoir and all transfer pipework should be kept at 105°C (221°F) for the duration of the injection in order to obtain an optimum viscosity/pot-life relationship [i.e., ~500 cps (~500 mPa·s) for ~5 hours].
- Apply full vacuum, 815 mbar (24 in Hg) minimum, to the tool containing the preformed reinforcement, ensuring minimal vacuum loss. [Loss should not exceed 13.5 mbar (0.40 in Hg) in 5 minutes].
- Preheat the tool to a minimum of 166°C ± 5°C (330°F ± 9°F) before injection begins.
- If vent purging is required, heat exit lines to 105°C (221°F).

Infusion and Resin Homogenization

- For successful processing it is critical that the resin reaches a minimum of 166°C ± 5°C (330°F ± 9°F) prior to entering the preform. This ensures no preform filtration of one of the formulation ingredients during infusion. At this temperature the resin viscosity will remain below 500 cps (500 mPa·s) for approximately 40 minutes and the formulation ingredient will be fully dissolved.
- Incorporation troughs or channels between inlet and preform (Refer to Figure 4b, where a suggested tool feature is illustrated to allow curative melt) or a heat exchanger prior to the inlet have been found to efficiently heat the resin for injection. It should be noted that relying solely on heated hosing is a very inefficient manner to heat the resin.
- With vacuum maintained within the mold, initiate injection using a steady flow rate to allow resin sufficient time to reach temperature.
- Continue injection with the assistance of positive pressure, where required, until resin is witnessed at the exit vents.

Lock-Off & Cure Cycle

- Lock vents and continue injection to a positive pressure of 2.5 bar – 14.0 bar (36 psi – 203 psi). Once mold is full (as indicated by pressure being reached) purge each vent to remove entrapped air. Repeat until resin at vents is bubble free.

Cure Cycle

Heat to 179°C ± 5°C (355°F ± 9°F) at 1°C - 3°C (2°F - 5°F)/minute.

Hold at 179°C ± 5°C (355°F ± 9°F) for 120 minutes.

Maintain 2.5 bar – 14.0 bar (36 psi – 203 psi) positive pressure for at least 30 minutes of dwell.



Lay-Up/ Tooling Recommendations

As previously mentioned and illustrated in Figure 4, the use of heat exchanging troughs and channels within the mold has been found to efficiently heat CYCOM® PR 520N RTM for injection. The benefit of these features is that the resin has sufficient time to heat up prior to entering the preform. It is recommended that these Heat Exchange Areas run the entire injection length. Some example dimensions of this feature are a 0.5 mm (0.020 inch) gap and 50 mm (2 inch) width so that the resin is reduced to a thin liquid film into which heat is quickly transferred.

For larger or thicker parts, some parameters may require adjustment to avoid the risk of exotherm. Injection pressure for larger parts/alternative tooling may require adjustment to ensure filling of the tool cavity within an acceptable time and to ensure full consolidation of the component. Different injection equipment may require alternative conditions for degassing.

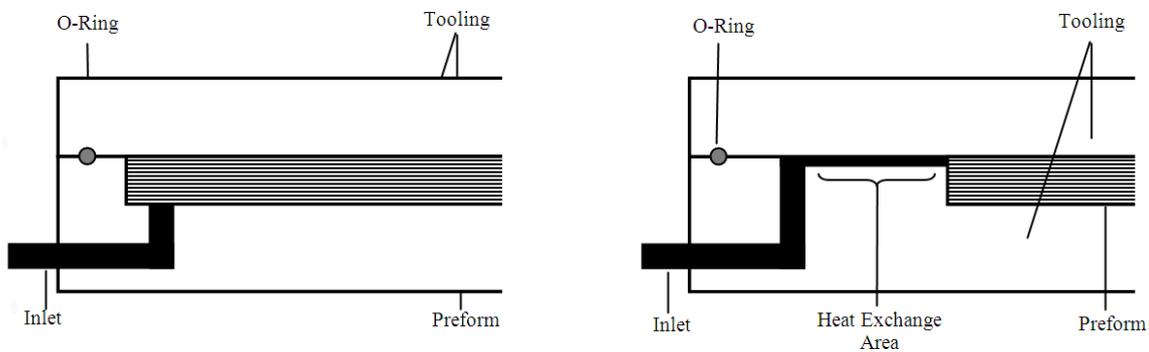


Figure 4 | CYCOM® PR 520N Tooling Recommendation



Recommended Consumables

Table 5 below provides a list of Syensqo's consumable processing materials recommended for use with CYCOM® PR 520N RTM.

Table 5 | Syensqo's Processing Materials

Sealant Tape	SM5126, SM 5127, SM 5142BY
Release Film	A5000, A6200
Release Fabric	200 TFP, 200 TFNP
Breather/Bleeder Fabric	RC3000-10, A3000-4
Peel Ply	60001, 60002, 51789
Bagging Film	HS 8171, SV3000
Adhesive Tape	Flashtape 1, Flashtape 2

Recommended processing materials listed above can be purchased through Syensqo. Technical Data Sheets (TDS) and additional information are available at www.syensqo.com

HEALTH & SAFETY

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

