T-Prime 160

Epoxy Tooling Infusion System

- **Thermally stable up to 160°C (320°F) when fully postcured**
- **Resistant to thermal cycling damage**
- **Viscosity suitable for infusion; 389 cP at 25°C (77°F)**
- **Long pot-life and gel time; capable of infusing large or complex moulds**
- **Ambient curing and low shrinkage for accurate mould manufacture**

Introduction

T-Prime 160 is an epoxy tooling system for manufacturing glass or carbon moulds from liquid infusion processes. T-Prime 160 is compatible with Gurit's range of 160°C gelcoat and repair systems.

T-Prime 160 is an ambient curing system, providing a simple way to produce high accuracy moulds. Designed for infusion and cure at ambient temperatures, it should then be mid-cured at 40°C (104°F) for 4 hours to guarantee the strength needed for demoulding. It can then be postcured off the plug to give a material that is thermally stable to 160°C (320°F). Exceeding this temperature will cause a rapid loss in stiffness and a safety margin is required for the maximum tool operating temperature to prevent distortion or tool damage.

Mix Ratio

T-Prime 160 should be mixed at the following mix ratio:

T-Prime 160 Resin		T-Prime 160 Hardener
100	:	35 (by weight)
100	:	42 (by volume)

Any deviation from the prescribed mix ratio may degrade the thermal capability and physical properties of the material.

System Information

Component Properties

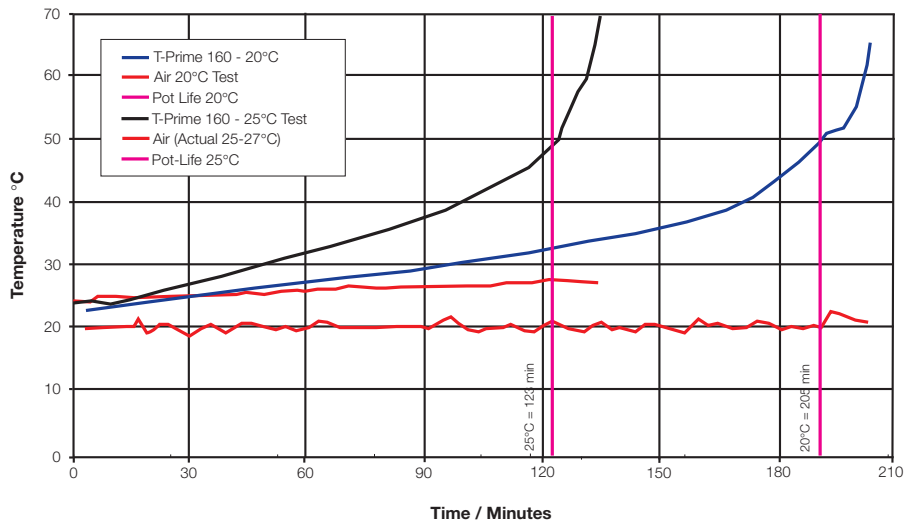
	Resin	Hardener
Viscosity at 20°C	1079 cP (CAP2000L, Cone 4, 750rpm)	30.4 cP (CAP2000L, Cone 1, 1000rpm)
Viscosity at 25°C	724 cP (CAP2000L, Cone 4, 750rpm)	25.8 cP (CAP2000L, Cone 1, 1500rpm)
Viscosity at 30°C	492 cP (CAP2000L, Cone 4, 750rpm)	21.9 cP (CAP2000L, Cone 1, 1500rpm)
Shelf Life (Months)	12	12
Colour (Gardner)	7 (Amber)	0 (Clear)
Density gm/cm^3 (lb/ft^3)	1.09 (68.0)	0.93 (56.8)
Hazard Category	Xi	C

Working Properties

Mixed Density @ 20°C	1.04 gm/cm^3 (64.9 lb/ft^3)			
Initial Mixed Viscosity at 20°C (68°F)	568 cP (CAP2000L, Cone 5, 700rpm)			
Initial Mixed Viscosity at 25°C (77°F)	389 cP (CAP2000L, Cone 5, 700rpm)			
Initial Mixed Viscosity at 30°C (86°F)	277 cP (CAP2000L, Cone 5, 700rpm)			
Gel Time (150g in Water at 25°C - 77°F)	6:20 (hours:minutes)			
Pot Life (500g in Air at 20°C, 68°F)*	3:11 (hours:minutes)			
Pot Life (500g in Air at 25°C, 77°F)	2:03 (hours:minutes)			
Resin Gel times vs Temperature	**20°C (68°F)**	**25°C (77°F)**	**30°C (86°F)**	**40°C (104°F)**
Latest flow under vacuum (5,000P Theoretical thin film) (hr:min)	6:20	5:10	4:18	2:42
Earliest Vacuum off time (100,000P Theoretical thin film) (hr:min)	8:30	6:50	5:30	3:30
Demould Time	Recommended 4 hours at 40°C (104°F) after system has gelled to reduced risk of laminate damage			
Overcoating window on T-Gel 160 Slow. 20°C (68°F), 50-70% RH	tbc			

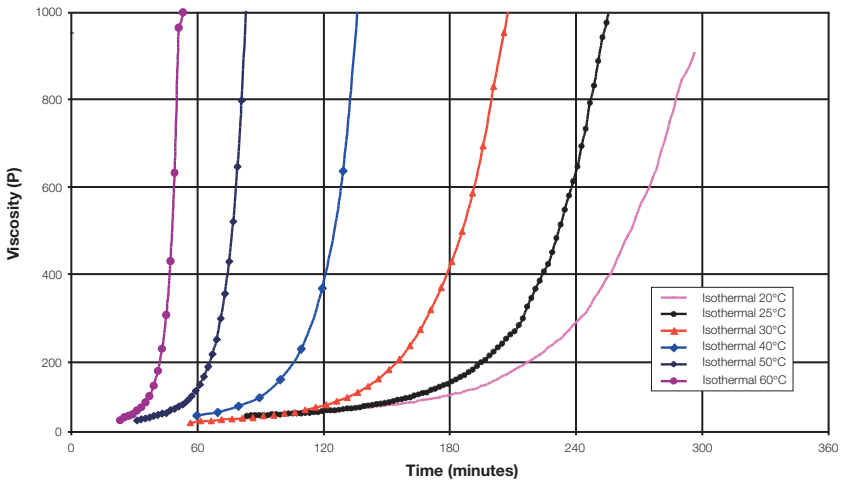
* Pot life in larger volumes can be reduced. Pot life depends mainly on the depth of resin and can be extended for shallower filled containers. Material approaching its pot life is typically 40-50°C (104 – 122°F) in the centre of the pot and it will then thicken as it cools in the laminate and feed pipes. This material will have already seen higher temperature will reach a higher viscosity more quickly than the thin film data at a given workshop temperature.

T-Prime 160 500g Pot Life (SP Pot = 57mm)



Large volumes of T-Prime 160 left in a pot can exotherm strongly and remaining mixed resin will need to be dispensed into a shallower vessel towards the end of the pot-life. Ideally the remaining resin should be less than 30mm deep or the pot placed into water to cool. Both the 20°C and the 25°C sample in this test (57mm deep) produced smoke at the end of the pot-life from the large exotherm temperature.

T-Prime 160 Isothermals CAP2000L Cone 6, 50rpm



Application Notes

- A good level of understanding of the infusion process is required to achieve a high quality mould. Contact Gurit for further advice or refer to Gurit process notes for further information.
- Any deviation from the prescribed mix ratio may degrade the thermal capability and physical properties of the material.
- Recommended workshop temperature is between 18°C and 25°C (64°F and 77°F)
- If "drill" style mixing is used, this must be on the lowest setting to reduce the air introduced. Particular attention is needed to mix the sides and bottom of the container
- Allowing the mixed resin to stand for 5-10 minutes before use in order to allow air to dissipate to improve the final laminate quality.
- For large components pre-weigh and dispense into labelled or coloured pots rather than pre-mix all the material to extend pot life for large infusions. This also avoids potential exotherm problems with large quantities of unused mixed system.
- If large quantities are left in feed buckets and vacuum pots at the end of the infusion it is recommended to transfer some of the bulk material into a shallow vessel, with a large surface area, to dissipate heat. It is recommended to always keep the bottom of feed pipes covered in resin to avoid the risk of air inclusion even after the feed pipes are closed / clamped.
- Depending on the infusion design it can take a large amount of time to infuse the final 10% of a part as the flow rate slows with distance from the final feed pipe. This is a critical time to monitor the resin pot life and change to new resin if required. Material close to the pot life can build in viscosity and block the feed pipes. If the infusion is running slowly it is recommended to allow the resin levels to lower in the feed pot and aim to supply new resin every 2.5 hours at 20°C and 1 to 1.5 hours at 25°C if there looks like there will be a problem with filling the final laminate.
- If emptying a receiving bucket inside a vacuum pot remember to allow time for the vacuum to fully build back up inside the pot before opening the control valves to the part otherwise any air inside the vacuum pot may be pulled back into the part.
- If using T-Gel 160 allow at least 24 hours at 20°C (68°F) before applying vacuum to begin the infusion to ensure sufficient stiffness of T-Gel 160. Infusing too soon can lift the gelcoat and cause sink marks.
- T-Prime is not recommended for use as a laminating system as the hardener is designed for a closed mould process and as such bi-product can form between layers in a laminating process. The viscosity and drainage properties are also not suitable for a laminating system.

Cured Properties

Ambient cure

The mechanical strength after 24 hours at 20°C (68°F) is still low and a mid cure is needed to de-mould.

If more than one infusion stage is used allow at least **2 days at 20°C (68°F), or cure elevated temperature, before removing peel ply and other infusion consumables.** This is to remove the risk of delamination and subsequent blisters from lifting the part cured laminate. The peel ply is easiest to remove at this stage before the full mechanical strength is reached. Leaving the consumables on for the complete cure can lead to in-built stress, which can lead to some final distortion of the tool. This is more important with T-Prime 160 which has higher shrinkage than T-Prime 130 and T-Prime 110 resin systems.

If peel ply is removed before a full cure the part cured shards of resin created can contain a significant amount of un-reacted epoxy. Un-reacted epoxy dust is a particular skin irritant and the appropriate personal protective equipment (PPE) should be used.

Mid cure

A mid cure of at least **4 hours at 40°C (104°F) is recommended before de-moulding** to maximise gelcoat adhesion and build sufficient resin strength for demould. Ramp rate is not critical at this stage.

Post Cure

To achieve full postcure ramp at **0.2°C /min to 150°C (10 hours, 50 min) and dwell for 2 hours (0.36°F /min to 302°F)**. Faster postcure risks thermal softening of the tool and will increase the risk of distortion and shape change. The postcure can be stopped and re-started to look for and repair surface if required. Contact Gurit for advice when in doubt.

Cured Properties			
Property	**Unit**	**Mid Cure 4 Hours at 40°C (104°F)**	**Mid Cure + Postcure 2 hours at 150°C (302°F)**
Cured Density	gm/cm³ (ib/ft³)	1.15 (71.8)	1.15 (71.8)
Total Linear Shrinkage by density change	%	2.1	2.1
Tg2 – by DSC	°C (°F)	53°C (127°F)	163°C (325°F)

Approximate Materials Coverage

Approx net resin use and thickness for Gurit woven and stitched carbon and glass structural laminates infused at 100% vacuum. Other fabrics such as Tissues and Chop Strand Mat materials use additional resin test panels may be needed to verify usage for these material.

Structural Glass Laminates (32% Resin Content) – Resin & Thickness by Fibre gsm			
Fibre gsm	**Resin gsm**	**Total /Kg/m²**	**Thickness /mm**
200	94	0.294	0.155
300	141	0.441	0.233
450	211	0.661	0.349
600	281	0.881	0.465
900	422	1.322	0.698
1200	563	1.763	0.930
Structural Glass Laminates (32% Resin Content) – Fibre & Resin for Set Thickness			
Fibre gsm	**Resin /Kg**	**Total /Kg/m²**	**Thickness /mm**
7,740	3.63	11.37	6.0
12,900	6.05	18.95	10.0

Net Resin Figures - No waste allowance

Structural Carbon Laminates (40% Resin Content) - Resin & Thickness by Fibre gsm			
Fibre gsm	**Resin gsm**	**Total /Kg/m^2**	**Thickness /mm**
200	134	0.334	0.221
300	201	0.501	0.331
450	301	0.751	0.497
600	401	1.001	0.663
900	602	1.502	0.994
1200	802	2.002	1.326
Structural Carbon Laminates (40% Resin Content) – Fibre & Resin for Set Thickness			
Fibre gsm	**Resin /Kg**	**Total /Kg/m^2**	**Thickness /mm**
5,430	3.63	9.06	6
9,050	6.05	15.10	10

Net Resin Figures - No waste allowance

A general 10 to 15% waste value is then recommended for purchase estimation. Additional resin is also required for infusion consumables. Resin waste in feed meshes and pipework depends on the component geometry and infusion design. As approx guide resin allow;

- Small Infusion (Up to 2m^2) Approx 2 Kg/m^2 (Generally have a higher % waste)
- Large Infusion (20m^2 and above) Approx 1 Kg/m^2

For the first components, and when new to infusion, allow extra resin for feed pots.

Health and Safety

The T-Prime 160 system has been designed for use in closed mould processes. Users should ensure that some elevated temperature cure is applied to the component before trying to machine it. In a component made from T-Prime 160, which has seen no heat, there will only be a partial cure. Therefore the sanding dust will be more irritating than dust from a laminate cured at elevated temperature, in which there will be more thorough cross linking. Particular care should also be taken when removing peel plies from part cured material as this can also product a dust like particle, and an elevated cure or personal protective equipment is recommended.

The following points must be considered:

1. Skin contact must be avoided by wearing protective gloves. Gurit recommends the use of disposable nitrile gloves for most applications. The use of barrier creams is notrecommended, but to preserve skin condition a moisturising cream should be used after washing.

2. Overalls or other protective clothing should be worn when mixing, laminating or sanding. Contaminated work clothes should be thoroughly cleaned before re-use.

3. Eye protection should be worn if there is a risk of resin, hardener, solvent or dust entering the eyes. If this occurs flush the eye with water for 15 minutes, holding the eyelid open, and seek medical attention.

4. Ensure adequate ventilation in work areas. Respiratory protection should be worn if there is insufficient ventilation. Solvent vapours should not be inhaled as they can cause dizziness, headaches, loss of consciousness and can have long term health effects.

5. If the skin becomes contaminated, then the area must be immediately cleansed. The use of resin-removing cleansers is recommended. To finish, wash with soap and warm water. The use of solvents on the skin to remove resins etc must be avoided.

Washing should be part of routine practice:

- before eating or drinking
- before smoking
- before using the lavatory
- after finishing work

6. The inhalation of sanding dust should be avoided and if it settles on the skin then it should be washed off. After more extensive sanding operations a shower/bath and hair wash is advised.

Gurit produces a separate full Material Safety Data Sheet for all hazardous products. Please ensure that you have the correct MSDS to hand for the materials you are using before commencing work. A more detailed guide for the safe use of Gurit resin systems is also available from Gurit, and can be found on our website at www.gurit.com

Applicable Risk & Safety Phrases

Resin	Hardener
R 36/38, 43, 52/53	R 21/22, 34, 43, 52/53
S 23, 24, 26, 28, 37/39, 61	S 1/2, 26, 36/37/39, 45, 61

Transport & Storage

The resin and hardener should be kept in securely closed containers during transport and storage. Any accidental spillage should be soaked up with sand, sawdust, cotton waste or any other absorbent material. The area should then be washed clean (see appropriate Safety Data Sheet).

Adequate long term storage conditions will result in a shelf life of 12 months for both the resin and hardener. Storage should be in a warm dry place out of direct sunlight and protected from frost. The temperature should be between 10°C and 25°C. Containers should be firmly closed. Hardeners, in particular, will suffer serious degradation if left exposed to air. The materials should be stirred before use.

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