PB 270i / DM 1x

Fire retardant epoxy foam

The two-component foaming epoxy system **PB 270i / DM 1x** enables the production of flame-retardant epoxy foams with a density of 270 kg/m³. Robust and easy to use, this system ensures excellent density homogeneity. The difference in reactivity between the two available hardeners allows the curing speed to be adjusted according to the casting thickness. When exposed to very high temperatures or fire, the intumescent system reacts by forming a protective char barrier that limits flame spread and shields the underlying material.

		PB 270i	
		DM 12	**DM 13**
Reactivity		Slow	Fast
Mixing ratio	By weight	100 / 30	100 / 29
Expanded density (kg/m³)	20 °C	270 ± 20	
Expansion ratio		4.6 ± 0.4	
T_g2 (°C)		85	

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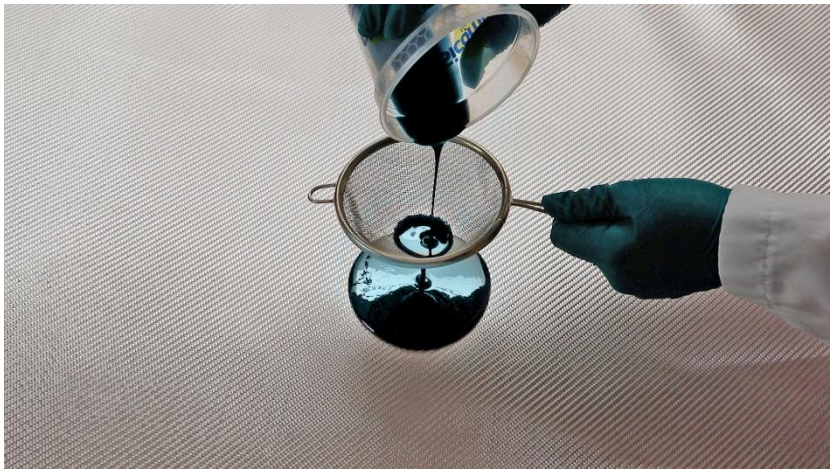
Recommendations for use

Homogenize the resin using a propeller agitator before use. Be sure to scrape the sides and bottom of the bucket.

When mixing the two components, air is incorporated. These bubbles can be largely removed by passing the mixture through a stainless steel sieve with a mesh size of 1 to 2 mm.

The foam expansion is much faster than its polymerization. Mixing and spraying or casting operations must therefore be carried out quickly.



Industrial equipment

For optimal results, the use of a low-pressure mixing and dosing system equipped with a static mixer is recommended.

Demolding

If a demolding step is necessary, it is recommended to apply a post curing cycle (once the resin is totally hard) for at least 4 hours at 40 °C. This step ensures the dimensional stability of the part.

Security

Immediately after mixing resin and hardener, a foaming reaction occurs and dihydrogen (H_2) is released.

1 kg of mix may release up to several liters of H_2 at 22 °C.

H_2 has no toxicological effect and no known ecological impact. Nevertheless, as it is a very flammable gas, ensure adequate ventilation to prevent localized accumulation. Work far from all sources of sparks and open flames.

Ensure that packages are properly closed to prevent contamination or reaction of resin with acids, bases or strong oxidizers that may cause the undesired release of H_2.

Caution when opening resin: slight internal overpressure may be present. In some cases, bubbles may appear on the surface of the resin. This phenomenon has no impact on the performance or appearance of the final product.

Resin

		PB 270i
Aspect and color		White viscous liquid
Viscosity (mPa.s)	20 °C	22 000
	25 °C	12 000
	30 °C	7 500
Density (kg/L)	20 °C	1.35
Shelf life	23 °C	12 months

Hardeners

		DM 12	DM 13
Reactivity		Slow	Fast
Aspect and color		Colorless liquid	Orange liquid
Gardner color		< 2	< 12
Viscosity (mPa.s)	20 °C	475	645
	25 °C	310	425
	30 °C	210	295
Density (kg/L)	20 °C	0.99	1.01
Biobased carbon content (%)		0	27*
Shelf life	23 °C	24 months	12 months

*Calculated value

Mixtures PB 270i / DM 1x

		PB 270i	
		DM 12	**DM 13**
Mixing ratio	By weight	100 / 30	100 / 29
Initial viscosity (mPa.s)	20 °C	5 000	6 400
	30 °C	2 400	3 400
Gel time (1 mm)	20 °C	20 h 45	9 h 00
	30 °C	11 h 00	4 h 40
Expanded density (kg/m^3)	20 °C	270 ± 20	
Expansion ratio		4.6 ± 0.4	
T_g2 (°C)		85	87

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Post-curing

The mechanical properties on an epoxy system can be optimized through the implementation of a post-curing cycle. The Sicomin laboratory uses predefined cycles to create technical data sheets and facilitate the comparison of different systems. These experimental cycles can be adapted to the specific target application, taking into account the following parameters:

- Selected epoxy system (T_g2)
- Available heating methods
- Dimensions and sampling of the piece
- Nature of the tooling (thermal conductivity of the material)

Many system can provide good mechanical properties after curing at room temperature (>18 °C) for 24 to 48 hours before demolding. However, mechanical properties improve rapidly with a slightly higher temperature, around 40 °C, for several hours.

Epoxy systems with high T_g and slow hardeners imperatively require post-curing at higher temperature. The post-curing can start immediately after the exothermic peak, but it can also begin later, after the assembly of different components and before finishing operations. If the nature of the models and tooling is not suitable for high temperatures, we recommend carrying out the initial steps up to a maximum admissible temperature, then, after cooling and demolding, continuing the cycle with suitable former.

For a conventional epoxy system, we recommend a step-by-step cycle of 20 °C each for a duration of 4 hours.

Example for an epoxy system with a T_g2 of 100 °C:

4 h at 40 °C + 4 h at 60 °C + 4 h at 80 °C + cooling at room temperature before demolding.

There are many epoxy systems with short, high temperature curing cycles that do not fit into this post-curing scheme (pultrusion, hot press, pre-preg). For these systems, the initial curing achieves maximum mechanical performance without post-curing.

We invite you to contact our technical department for any questions on this subject.

Mechanical properties on cast resin (10 mm thickness)

		PB 270i			
		DM 12		DM 13	
Post-curing cycle*		24 h 40 °C	16 h 60 °C	24 h 40 °C	16 h 60 °C
Density	kg/m³	262	272	269	264
Tensile					
Modulus	N/mm²	340	300	300	300
Maximum strength	N/mm²	2.6	2.7	2.7	2.6
Elongation at max. strength	%	0.9	1.0	1.1	1.1
Flexion					
Modulus	N/mm²	260	220	250	230
Maximum strength	N/mm²	4.2	3.8	4.4	4.4
Elongation at max. strength	%	1.8	2.0	2.2	2.3
Shear					
Breaking strength	N/mm²	2.0	2.1	2.0	2.0
Compression					
Yield strength	N/mm²	80	65	65	100
Yield strength	N/mm²	4.0	4.2	4.3	4.5
Offset compression yield	%	9.6	12.0	11.8	9.4
Glass transition					
T_g1	°C	69	79	67	80
T_g2	°C		85		87

*These post-curing cycles are applied after a 24 hour ambient temperature hardening period, allowing to surpass gel point and the exothemic peak.

Mechanical tests are carried out on samples of pure cast resin, without prior degassing, between steel plates.

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Measurements are carried out following norms:

Physical properties

Gardner color	*NF EN ISO 4630*
Viscosity	*NF EN ISO 3219 - Rheometer, geometry cone/plate 50 mm - 2 ° at 10 s^{-1}*
Liquid density	*ISO 2811-1 - Pycnometer*
Powder density	*NF EN ISO 1183-3 – Helium pycnometer*
Foam density	*NF EN ISO 845*
Biobased carbon content	*ASTM D68166-16 – Some values are theoretically calculated*

Reactivity

Gel time	*Time sweep G' = G''- Rheometer, geometry plate/plate 50 mm*
Pot life	*Mean time to reach 50 °C or limit time for use*

Thermal properties

Glass transition	*NF EN ISO 11357-2 - Ramp from -5 to 180 °C at 20 °C/min* *The T_g values are recorded at the midpoint using the tangent method.* *T_g1 : 1^{er} pass* *T_g2 : 2^{nd} pass*

Mechanical properties

Tensile	*ISO 527-2*
Flexion	*ISO178*
Compression	*ISO 604 ou NF EN ISO 844 (foams)*
Charpy impact strength	*NF EN ISO 179-1*
Shear	*ASTM D732-17 (Punch tool)*
Toughness	*ISO 13586:2000*