PB 270 i, PB 370 i & PB 570 i

Fireproof autoextinguishing foaming epoxy systems

PB products are 2 component epoxy foaming formulations
These systems give about 270, 370 and 570 kg / m^3 foams after free ambient temperature expansion.
The hardener changes only the hardening time and thus the possible final cast thickness.
Mixes have a two time evolution

1 Casting quick expansion
2 Slow hardening

Performances

Low density foams
No handling of hollow microspheres.
Two component systems.
Good adhesion onto all type of materials.
PB can be cast onto prepregs and wet epoxy resins curing.
Homogeneous density.
Very low water absorption.
With high temperature or fire, the system expands, produce solid char barrier that protects inner materials.

Applications

Fire resistant epoxy foam production
Casting “in situ” of epoxy core materials.
Floating volume.
Increasing density of foams and honey comb.
Thermal insulation.
Machinable blocks for models.

Epoxy resins PB x70 i

		PB 270 i	PB 370 i	PB 570 i
Aspect		Thixotropic liquid	Thixotropic liquid	Thixotropic liquid
Colour		White	White	White
Viscosity (mPa.s)				
Rheometer	20 °C	22 000 ± 4 000	25 000 ± 5 000	45 000 ± 9 000
CP 50 mm	25 °C	12 000 ± 2 500	15 000 ± 3 000	25 000 ± 5 000
Shear rate 10 s^{-1}	30 °C	7 500 ± 1 500	10 000 ± 2 000	16 000 ± 3 000
	40 °C	3 500 ± 700	6 000 ± 1 000	6000 ± 1 500
Density Picnomètre ISO 2811-1	20 °C	1.23 ± 0.01	1.24 ± 0.01	1.25 ± 0.01

Hardeners DM 0x

		DM 03	DM 02
Colour		Clear yellow	Clear to yellow
Reactivity type		Standard	Slow
Viscosity (mPa.s			
Rheometer	15 °C	320 ± 60	190 ± 40
CP 50 mm	20 °C	210 ± 40	130 ± 25
Shear rate 10 s^{-1}	25 °C	150 ± 30	100 ± 20
	30 °C	100 ± 20	70 ± 15
	40 °C	60 ± 10	40 ± 10
Density	20 °C	1.00 ± 0.01	0.98 ± 0.01
Picnomètre ISO 2811-1			

PB x70 i / DM 0x mix

	PB 270 i	PB 370 i	PB 570 i
DM 03	100 g / 22 g	100 g / 23 g	100 g / 23 g
DM 02	100 g / 28 g	100 g / 26 g	100 g / 27 g

Fire resistance

PB 270 i / **DM 03 & DM02 :** meet the requirements of the CS 25/FAR 25 § 25-853 (a) App. F Part.I (a1) (ii) for flammability 12 seconds. CEAT-Toulouse (Fr)
PV # MT-0 8 / 8150155 /P2/A dated 12.12.2008
PV 14-DGATA-MTF/P1400003001004-F-A dated 26.08.2014

Exothermic parameters

Thermal conductivity of substrate.
Open or closed moulding.
Temperature of components and ambient temperature.
Geometry, thickness, volume and mass of the casting.
For casting onto a laminate that is curing, the heat produces by the resin can influence the reactivity of the foaming system, on a thick laminate.

Processing advice

Stir up the **PB x70 i** resin before weighing thanks to an hellicoid stirrer. Take special care to edges and bottom.
Weigh as precisely as possible with a device suited to the quantity used.
The expansion reaction is much faster than the hardening: mixing and application time should be the shortest possible, especially with the low densities. Working time is about 4 minutes max.

When mixing **PB x70 i** and hardener air is included. A expanded foam without big bubbles can be obtained by filtering the liquid mix through a 1 to 2 mm sieve.

Expansion ratio

	Free expansion final density 20 °C	Volume expansion ratio 20 °C
PB 270 i	270 ± 20 kg / m^3	x 3.7
PB 370 i	370 ± 30 kg / m^3	x 2.7
PB 570 i	570 ± 40 kg / m^3	X 1.75

For instance, if the volume to cast is 10 L, you need:

- 10 / 3.7 = 2.7 kg **PB 270 i / DM 0x** mix
- 10 / 2.7 = 3.7 kg **PB 370 i / DM 0x** mix
- 10 / 1.75 = 5.7 kg **PB 570 i / DM 0x** mix

5 to 10 % more mix should be prepared for the loss.
With large volume exothermal peak problem should be considered.

Post cure

Wait the foam to be hard before starting to post cure it.
If possible leave in the mould.
A minimum post cure of 6 hrs at 40°C is required to get a dimensional stability.
To achieve full cured foam the parts should be post cured as followed.
With **DM 03** : + 6 hours at 40 °C + 4 hours at 60 °C + 4 hours at 80 °C
With **DM 02** : + 12 hours at 40 °C + 6 hours at 60 °C + 4 hours at 80 °C
In case of thin parts, this cycle can be optimised.

Thermal conductivity array

Material	Density (kg / m^3)	Thermal conductivity à 20 °C (W / m x °C)
Copper	8800	380
Carbon / carbon composite	1700 – 2000	300
Aluminium (AU 4G)	2800	140
Steel	7800	20 à 100
Carbon fibre HR or HM	1800	200
Glass E fibre	2600	1
Aramid fibre	1450	0.03
Concrete	2000 à 2500	1 à 1.5
Plaster		0.37
Expanded PVC (Forex)	650	0.12
PB 600 epoxy foam	**600**	**0.16**
PB 570 i	**570**	**0.21**
PB 400 epoxy foam	**400**	**0.13**
PB 370 i	**370**	**0.20**
PB 270 i	**270**	**0.16**
PB 250 epoxy foam	**250**	**0.07**
Ethafoam E 220 & E 900	35 & 150	0.05
Herex C70.33 C70.75 C70.200	33, 80 et 200	0.030, 0.033 et 0.048
Airex R82.80 R 82.110	80 et 110	0.037 et 0.040
Airex R63.80 R63.140	90 et 140	0.034 et 0.039
Kapex C51	60	0.036
Unfilled thermoset materials Epoxy, polyester, phenolic	1100 à 1300	0.2
Polyethylene BD / HD	960	0.25 à 0.34
Glass / epoxy laminate		0.3 à 0.8
Wood	400 à 700	0.12 à 0.2
Balsa	100 à 250	0.051 à 0.090
Expanded polystyrene	20	0.035
Extruded polystyrene	28 à 45	0.033 à 0.025
Air		0.021

Mechanical properties on pure cast foam

		PB 270 i / DM 03		PB 270 i / DM 02		PB 370 i / DM 03		PB 370 i / DM 02	
Curing cycle		24 h Ta + 24 h 40 °C	24 h Ta + 12 h 40 °C + 8 h 60 °C	24 h Ta + 24 h 40 °C	24 h Ta + 12 h 40 °C + 8 h 60 °C	24 h Ta + 24 h 40 °C	24 h Ta + 12 h 40 °C + 8 h 60 °C	24 h Ta + 24 h 40 °C	24 h Ta + 12 h 40 °C + 8 h 60 °C
Compression									
Modulus	N/mm^2	165	155	150	140	210	195	260	235
Compressive yield strength	N/mm^2	4	5	4	5	6	6.7	5.3	5.7
Offset compressive yield	%	4.5	4.8	4.3	4.6	6.5	7.8	6.0	8.0
Flexion									
Modulus of elasticity	N/mm^2	300	280	252	230	530	450	460	430
Maximum resistance at break	N/mm^2	3.5	4	3.5	3.5	5.7	6.2	5.5	6 .0
Elongation at maximum load	%	1.6	1.8	1.5	1.6	1.2	1.4	1.2	1.4
Glass transition temperature									
Tg1	°C	68	79	66	81	62	80	63	82
Tg1 max.	°C		81		85		88		88

		PB 570 i / DM 03		PB 570 i / DM 02	
Curing cycle		24 h Ta + 24 h 40 °C	24 h Ta + 12 h 40 °C + 8 h 60 °C	24 h Ta + 24 h 40 °C	24 h Ta + 12 h 40 °C + 8 h 60 °C
Compression					
Modulus	N/mm^2	460	480	465	450
Compressive yield strength	N/mm^2	19	20	17	19
Offset compressive yield	%	5.3	6.4	4.1	5.9
Flexion					
Modulus of elasticity	N/mm^2	980	920	1 030	980
Maximum resistance at break	N/mm^2	13	14	13.5	14
Elongation at maximum load	%	1.3	1.5	1.3	1.5
Glass transition temperature					
Tg1	°C	65	79	62	85
g1 max.	°C		82		86

Essais réalisés sur des éprouvettes de résine pure coulée,
sans dégazage préalable, entre des plaques en acier.
Mesures effectuées suivant les normes AFNOR:
Compression : NF T51-101
Flexion : NF T51-001
Transition vitreuse: ISO 11357-2 : 1999 -5 °C / 180 °C sous azote
Tg1 ou Onset : 1er point à 20 °C / mn
Tg1 maximum ou Onset : deuxième passage

Fire Resistance Certifications

Standards	**EN 45545-2** *(March 2013)*	**EN 45545-2** *(March 2013)*	**CS 25 / FAR 25**
Sector	Railway	Railway	Aeronautic
Laboratory	LNE– France	LNE– France	DGA - France
Test / report:	P151143	P151143	14DGATA-MTF-P1400003001004-F-A MT-08/8150155/F2/A
Samples	**PB270i / DM0x** A casting 10 mm thick	**PB270i / DM0x** A casting 10 mm thick	**PB270i / DM0x** A casting 10 mm thick
Classification	**R22 : HL1, HL2**	**R23 : HL1, HL2**	**Meet the requirements of the CS25/JAR25/FAR25 25.853 (a) app. F part I (ii) 12s**