# PB 170, PB 250, PB 400, PB 600

## Cellular epoxy foam production system

PB products are 2 component epoxy foaming formulations developed for “in situ” low density epoxy foam production. Foam final density is depends only on the choice of the resin. These systems are white but can be coloured by adding any epoxy compatible pigments.
**PB 170**, **PB 250**, **PB 400** and **PB 600** respectively provide approximately 170, 250, 400 and 600 kg/m$^3$ foams. The hardener has only an influence on the curing time and thus the potential thickness of the one shot cast part.
The mixes evolves in two separate steps:

1 Fast expansion of the casting.
2 Slow hardening of the mass.

## Performances

“in situ” low density foam manufacturing.
No hollow microspheres handling.
Good adhesion onto all type of materials.
PB can be cast onto prepregs and wet epoxy resins curing.
Homogeneous density.
Very low water absorption.

## Applications

Production of epoxy foam.
Casting “in situ” of epoxy core materials.
Floating volume.
Increase the density of foams and honey comb.
Thermal insulation.
Machinable bloks for models.

## Foaming epoxy resins PB xxx

| | | PB 170 | PB 250 | PB 400 | PB 600 |
|---|---|---|---|---|---|
| Aspect | | Thixotropic liquid | Thixotropic liquid | Thixotropic liquid | Thixotropic liquid |
| | | | | | |
| Colour | | White | White | White | Cream |
| Viscosity | | | | | |
| *Rheometer PP 50 mm* | 20 °C | 15 000 ± 3 000 | 22 000 ± 4 000 | 22 000 ± 4 000 | 32 000 ± 6 000 |
| *Shear rate 10 s$^{-1}$* | 25 °C | 8 000 ± 1 500 | 12 000 ± 2 000 | 12 000 ± 2 000 | 16 000 ± 3 000 |
| | 30 °C | 4 500 ± 1 000 | 7 500 ± 1 500 | 7 000 ± 1 400 | 10 000 ± 2 000 |
| | 40 °C | 1 800 ± 350 | 3 800 ± 800 | 3 000 ± 600 | 4 000 ± 800 |
| | | | | | |
| Density<br>*Picnometer ISO 2811-1* | | 1.12 ± 0.01 | 1.10 ± 0.01 | 1.14 ± 0.01 | 1.17 ± 0.01 |

## Hardeners DM 0x

| | | DM 03 | DM 02 |
|---|---|---|---|
| Aspect / colour | | Light yellow liquid | Clear to light yellow liquid |
| Reacivity | | "Standard" | "Slow" |
| Viscosity | | | |
| *Rheometer PP 50 mm* | 15 °C | 320 ± 60 | 190 ± 40 |
| *Shear rate 10 s$^{-1}$* | 20 °C | 210 ± 40 | 130 ± 25 |
| | 25 °C | 150 ± 30 | 100 ± 20 |
| | 30 °C | 100 ± 20 | 70 ± 15 |
| | 40 °C | 60 ± 10 | 40 ± 10 |
| Density<br>*Picnometer ISO 2811-1* | 20 °C | 1.00 ± 0.01 | 0.98 ± 0.01 |

## Mixing ratios

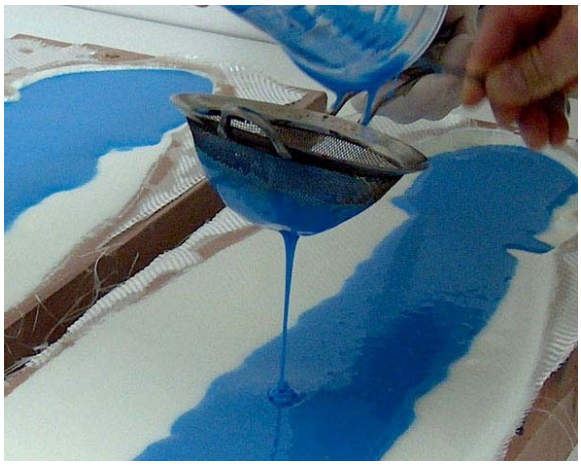
| | PB 170 | PB 250 | PB 400 | PB 600 |
|---|---|---|---|---|
| DM 03 (standard) | 100 g / 31 g | 100g / 31g | 100g / 32g | 100g / 30g |
| DM 02 (slow) | 100 g / 36 g | 100g / 36 g | 100g / 37g | 100g / 35 g |

## 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.

## Recommendations for use

In order to homogenise the PB resins, mix thoroughly with a helicoidal agitator before quantity determination (take a special care to the side and base of the container ).
The quantity determination have to be done by weight, with a precise scale adapted to the quantity used
The expansion is much faster than the polymerisation: mixing and casting operations must be done as quick as possible, especially with the low density foaming systems. The maximum working time of mixes is 4 minutes.



While mixing PB resin and hardener, air is usually included. Most of these bubbles can be eliminated by simply passing the blend trough a 1 to 2 mm stainless steal net.

## Expansion ratios

| | Finale density after free expansion @ 20°C | Expansion ratio @ 20°C |
|---|---|---|
| PB 170 | 170 ± 20 kg / $m^3$ | x 6.2 |
| PB 250 | 250 ± 25 kg / $m^3$ | x 4 |
| PB 400 | 400 ± 30 kg / $m^3$ | x 2.5 |
| PB 600 | 600 ± 40 kg / $m^3$ | x 1.7 |

For example, if the volume to fill up is 10 litres, you need :

| | | | |
|---|---|---|---|
| - 10 / 6.2 | = | 1.62 kg | PB 170 / DM 0x mix |
| - 10 / 4 | = | 2.5 kg | PB 250 / DM 0x mix |
| - 10 / 2.5 | = | 4 kg | PB 400 / DM 0x mix |
| - 10 / 1.7 | = | 5.9 kg | PB 600 / DM 0x mix |

Prepare 10 % more of mix for the waste.
Be aware of the problem of exothermal peak with large volume (see graph: Measure of the exothermal peak of the casting relative to the thickness @ 20°C, page 3 & 4.

# Curing

For medium to large volume wait until every parts of the casting is hard.
If possible leave in the mould.
A minimum post cure of 6 hrs @ 40°C. is required to get a dimensional stability.
**Post cure cycle:**
-For small volume:
You can put directly the casting in the oven after pouring and following the schedule describe below.
-For large volume:
6 - 24 hours after the mix of the two components at ambient temperature (18 - 23°C), this will limit the exothermal peak and the risk of “burning” the material.
+ 6 hrs. at 40 °C  Achieving a Tg1 of above 50 °C
+ 12 hrs. at 60 °C  Achieving a Tg1 of above 70 °C

# Colour

**PB 170**, **PB 250**, **PB 400**, **PB 600** are white, coloration possible according to customer's specifications

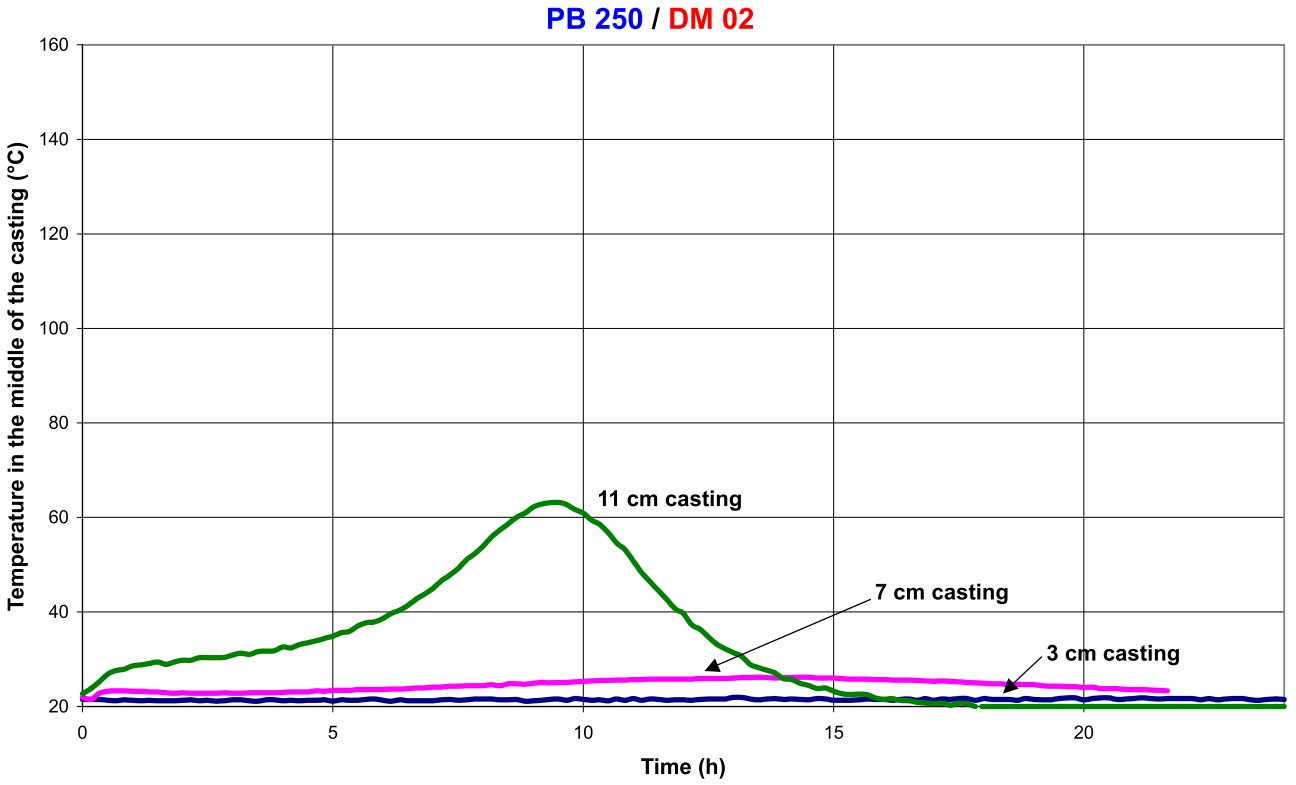
# Other blends

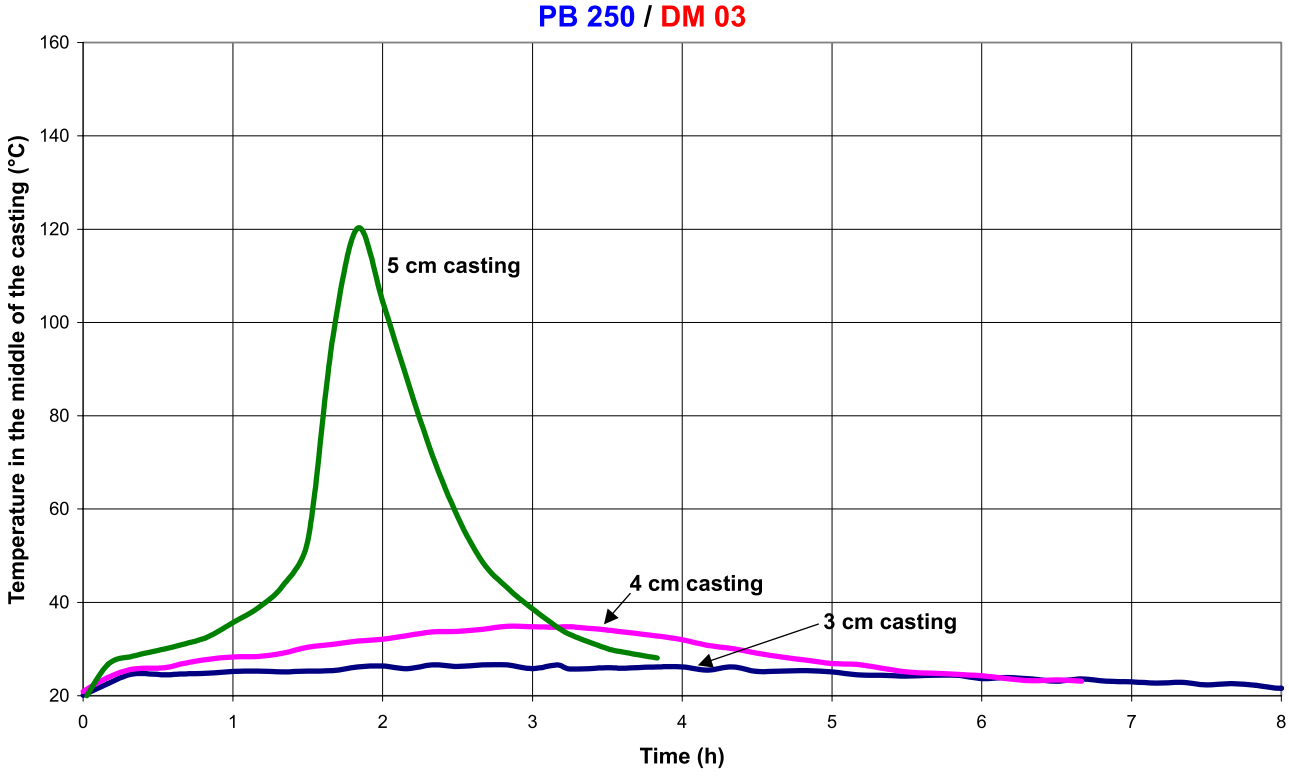
| PB | SD | Weight ratios | Tg 1 max ( °C ) |
|---|---|---|---|
| PB 170 | SD 2505 | 100 / 30 | 97 |
| | SD 8203 | 100 / 30 | 115 |
| | SD 7820 | 100 / 30 | 129 |
| | DM 06 | 100 / 40 (2 / 1 volume) | 90 |
| PB 250 | SD 8205 | 100 / 27 | 96 |
| | SD 7820 | 100 / 30 | 125 |
| | SD 2630 | 100 / 27 | 137 |
| | DM 06 | 100 / 40 (2 / 1 volume) | 90 |
| PB 400 | SD 7820 | 100 / 28 | 133 |
| | SD 2630 | 100 / 27 | 135 |
| | DM 06 | 100 / 40 (2 / 1 volume) | 90 |
| PB 600 | SD 7820 | 100 / 27 | 137 |
| | SD 2630 | 100 / 26 | 142 |
| | DM 06 | 100 / 40 (2 / 1 volume) | 90 |

# Material thermal conductivity

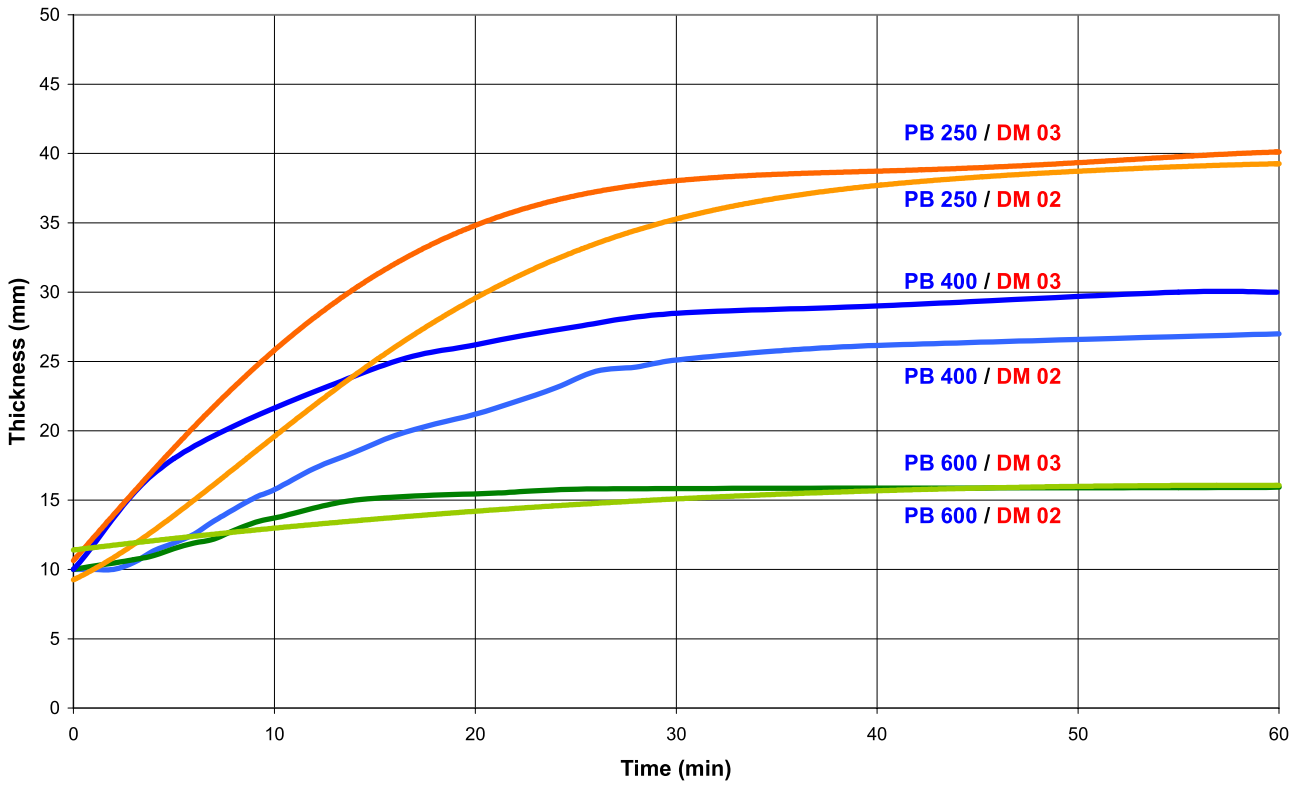
| Materials | **Density (kg / m$^3$)** | **Thermal Conductivity at 20 °C (W / m x °C)** |
|---|---|---|
| Copper | 8800 | 380 |
| Composite Carbon / carbon | 1700 – 2000 | 300 |
| Aluminium (AU 4G) | 2800 | 140 |
| Steel | 7800 | 20 to 100 |
| Carbon fiber: HR or HM | 1800 | 200 |
| E glass fiber | 2600 | 1 |
| Aramid fiber | 1450 | 0.03 |
| Concrete | 2000 to 2500 | 1 to 1.5 |
| Plaster | | 0.37 |
| Expanded PVC (Forex) | 650 | 0.12 |
| **PB 600 epoxy foam** | **600** | **0.157** |
| **PB 400 epoxy foam** | **400** | **0.130** |
| **PB 250 epoxy foam** | **250** | **0.065** |
| Extruded polyethylene foam | 35 to 150 | 0.05 |
| Herex C70.33 C70.75 C70.200 | 33, 80 and 200 | 0.030, 0.033 and 0.048 |
| Airex R82.80 R 82.110 | 80 and 110 | 0.037 and 0.040 |
| Airex R63.80 R63.140 | 90 and 140 | 0.034 and 0.039 |
| Kapex C51 | 60 | 0.036 |
| Non-filled thermoset resins Epoxy, polyester, phenolic | 1100 to 1300 | 0.2 |
| Polyethylene LD / HD | 960 | 0.25 to 0.34 |
| Laminate E glass / epoxy | | 0.3 to 0.8 |
| Wood | 400 to 700 | 0.12 to 0.2 |
| Balsa | 100 to 250 | 0.051 to 0.090 |
| Expanded Polystyrene | 20 | 0.035 |
| Extruded Polystyrene | 28 to 45 | 0.033 to 0.025 |
| Air 0.021 | | |

# Exothermal of cast relative to thickness at 20°C , open mould 480x 480mm PB 250



# Expansion speed of a 10 mm cast at 20 °C




DUROplastic

# Mechanical Properties of cured foam

| Curing cycle | | PB 250 / DM 02 | | | | PB 250 / DM 03 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 48 h Tamb + 6 h 40 °C | 48 h Tamb + 6 h 40 °C + 48 h water | 48h Tamb + 6 h 40 °C +16 h 60 °C | 48 h Tamb + 6 h 40 °C + 16 h 60 °C + 48 h water | 48 h Tamb + 6 h 40 °C | 48 h Tamb + 6 h 40 °C + 48 h water | 48 h Tamb + 6 h 40 °C + 16 h 60 °C | 48 h Tamb + 6 h 40 °C +16 h 60 °C + 48 h water |
| **Compressive strength** | | | | | | | | | |
| Modulus of elasticity | $N/mm^2$ | 205 | 155 | 135 | 140 | 240 | 160 | 180 | 175 |
| Compressive yield strength | $N/mm^2$ | 6 | 6 | 5 | 5 | 6 | 6 | 6 | 7 |
| Offset compressive yield | % | 3.6 | 6.1 | 4.5 | 4.7 | 3.7 | 6.1 | 5.3 | 5.8 |
| **Flexion** | | | | | | | | | |
| Modulus of elasticity | $N/mm^2$ | 275 | | 240 | | 255 | | 235 | |
| Maximum resistance at break | $N/mm^2$ | 5 | | 6 | | 5 | | 5 | |
| Elongation at maximum load | % | 1.9 | | 2.3 | | 1.8 | | 2.0 | |
| **Shear strength** | | | | | | | | | |
| Modulus of elasticity | $N/mm^2$ | | | 100 | | | | 120 | |
| Shear load at break | $N/mm^2$ | | | 3 | | | | 3 | |
| Elongation at break | % | | | 16 | | | | 13 | |
| **Water absorption** | %weight | | + 0.69 | | + 1.0 | | + 0.98 | | + 1.0 |
| **Glass transition** | | | | | | | | | |
| Tg1 | °C | 60 | 95 | 76 | 93 | 59 | 83 | 75 | 95 |
| Tg1 max. | °C | | | 94 | | | | 88 | |

*Tests carried out on samples of pure cast resin, without prior degassing, between steel plates.*
*Measures undertaken according to the following norms :*

| | |
|---|---|
| *Flexion :* | *NF T 51-001* |
| *Compression:* | *NF T 51-101* |
| *Shear strength* | *ASTM 1041D* |
| *Water absorption:* | *Internal. Polymerisation according to cycle, machining, weighing, time spent in distilled water at 70 °C / 48 hours, weighing 1 hour after emerging,* |
| *Glass transition DSC :* | *ISO 11357-2 : 1999 -5°C to 180°C under nitrogen gaz*<br>*Tg1 or Onset : 1st point at 20 °C/mn*<br>*Tg1 maximum or Onset : second passage* |