Advanced Materials

Structural Composites

MATRIX SYSTEMS FOR INDUSTRIAL COMPOSITES **DATA SHEET**

Warm-curing epoxy systems based on Resin XB 3585* / Hardener XB 3403* / Hardener XB 3404* / Hardener XB 3405*

Resin XB 3585 (epoxy resin)
Hardeners XB 3403, XB 3404 and XB 3405 are based on aliphatic polyamines

Applications

Industrial composites, repair of composites

Properties

Laminating systems without reactive diluent. The reactivity of the systems may easily be adjusted to demands through the combination of the three hardeners of different reactivity. The long possible pot life facilitates the production of very large industrial parts.

Processing

- Wet lay-up
- Filament Winding
- Resin Transfer Moulding (RTM)
- Pressure Moulding

Key data

Resin XB 3585		
Aspect (visual)	clear liquid	
Colour (Gardner, ISO 4630)	≤ 3	
Viscosity at 25 °C (ISO 12058-1B)	6500 - 9000	[mPa s]
Density at 25 °C (ISO 1675)	1.15 - 1.20	[g/cm^3]
Flash point (ISO 2719)	> 200	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]
Hardener XB 3403		
Aspect (visual)	transparent liquid	
Viscosity at 25 °C (ISO 12058-1B)	5 - 20	[mPa s]
Density at 25 °C (ISO 1675)	0.95 - 1.0	[g/cm^3]
Flash point (ISO 2719)	124	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]
Hardener XB 3404		
Aspect (visual)	clear, blue liquid	
Viscosity at 25 °C (ISO 12058-1B)	20 - 40	[mPa s]
Density at 25 °C (ISO 1675)	0.95 - 1.0	[g/cm^3]
Flash point (ISO 2719)	121	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]

* *In addition to the brand name product denomination may show different appendices, which allows us to differentiate between our production sites: e.g. BD = Germany, US = United States, IN = India,CI = China, etc. These appendices are in use on packaging, transport and invoicing documents. Generally the same specifications apply for all versions. Please address any additional need for clarification to the appropriate Huntsman contact.*

Key data

Hardener XB 3405		
Aspect (visual)	clear, red liquid	
Viscosity at 25 °C (ISO 12058-1B)	70 - 90	[mPa s]
Density at 25 °C (ISO 1675)	0.95 - 1.0	[g/cm^3]
Flash point (ISO 2719)	109	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]

Storage

Provided that Epoxy Resin XB 3585 and Hardeners XB 3403, XB 3404 and XB 3405 are stored in a dry place in their original, properly closed containers at the above mentioned storage temperatures they will have the shelf lives indicated on the labels. Partly emptied containers should be closed immediately after use.

Epoxy Resin XB 3585 which has crystallized and looks cloudy can be restored to its original state by heating to 60 - 80 °C.

Processing data

Mix ratio

Components	*Parts by weight*	*Parts by volume*
Epoxy Resin XB 3585	100	100
Hardener XB 3403	35	42
Epoxy Resin XB 3585	100	100
Hardener XB 3404	35	42
Epoxy Resin XB 3585	100	100
Hardener XB 3405	35	42

We recommend that the components are weighed with an accurate balance to prevent mixing inaccuracies which can affect the properties of the matrix system. The components should be mixed thoroughly to ensure homogeneity. It is important that the side and the bottom of the vessel are incorporated into the mixing process.

When processing large quantities of mixture the pot life will decrease due to exothermic reaction. It is advisable to divide large mixes into several smaller containers.

Initial mix viscosity

(Hoeppler, ISO 12058-1B)

	[°C]	*[mPa s]*
XB 3585 / XB 3403	at 25	300 - 500
XB 3585 / XB 3404	at 25	550 - 800
XB 3585 / XB 3405	at 25	1000 - 1400

Pot life

(Tecam, 100 ml, 65 % RH)

	[°C]	*[min]*
XB 3585 / XB 3403	at 23	700 - 950
XB 3585 / XB 3404	at 23	100 - 130
XB 3585 / XB 3405	at 23	30 - 50

Gel time

(Hot plate)

	[°C]	*[min]*
XB 3585 / XB 3403	at 60	100 - 130
	at 80	40 - 55
	at 100	10 - 20
XB 3585 / XB 3404	at 60	30 - 50
	at 80	10 - 20
	at 100	3 - 7
XB 3585 / XB 3405	at 60	17 - 28
	at 80	4 - 11
	at 100	0.5 - 6

The values shown are for small amounts of pure resin/hardener mix. In composite structures the gel time can differ significantly from the given values depending on the fibre content and the laminate thickness.

Typical cure cycles

15 h 50 °C
or 8 - 10 h 60 °C
or 6 - 8 h 80 °C

Optimum properties cannot be reached with room temperature cure.

The optimum cure cycle has to be determined case by case depending on the processing and the economic requirements.

Properties of the cured, neat formulation

Glass transition temperature		*Cure:*	*XB 3585 XB 3403*	*XB 3585 XB 3404*	*XB 3585 XB 3405*
(IEC 1006, DSC, 10 K/min)		8 days 23 °C	35 - 43	48 - 54	46 - 52
		15 h 50 °C	60 - 68	60 - 68	63 - 69
		1 h 80 °C	65 - 71	67 - 75	77 - 82
		10 h 60 °C	78 - 84	76 - 84	77 - 82
		8 h 80 °C	79 - 85	76 - 84	77 - 82
		4 h 100 °C			
Tensile test (ISO 527)		*Cure: 15 h 50 °C*	*XB 3585 XB 3403*	*XB 3585 XB 3404*	*XB 3585 XB 3405*
	Tensile strength	[MPa]	74 - 80	72 - 80	50 - 60
	Elongation at tensile strength	[%]	3.2 - 4.2	2.8 - 3.4	1.5 - 2.0
	Ultimate strength	[MPa]	70 - 76	69 - 76	50 - 60
	Ultimate elongation	[%]	4.0 - 5.2	3.0 - 4.0	1.5 - 2.0
	Tensile modulus	[MPa]	3300 - 3500	3300 - 3600	3400 - 3800
		Cure: 8 h 80 °C	*XB 3585 XB 3403*	*XB 3585 XB 3404*	*XB 3585 XB 3405*
	Tensile strength	[MPa]	68 - 75	74 - 80	77 - 83
	Elongation at tensile strength	[%]	3.9 - 4.5	4.0 - 4.8	4.1 - 4.9
	Ultimate strength	[MPa]	50 - 62	69 - 75	74 - 81
	Ultimate elongation	[%]	7 - 9	5.5 - 7.5	5.5 - 7.0
	Tensile modulus	[MPa]	3000 - 3200	3200 - 3500	3100 - 3600
Flexural test (ISO 178)		*Cure: 15 h 50 °C*	*XB 3585 XB 3403*	*XB 3585 XB 3404*	*XB 3585 XB 3405*
	Flexural strength	[MPa]	123 - 133	135 - 142	140 - 155
	Elongation at flexural strength	[%]	4.5 - 5.2	5.0 - 5.8	4.8 - 5.8
	Ultimate strength	[MPa]	75 - 81	105 - 120	130 - 140
	Ultimate elongation	[%]	8.5 - 9.5	7.2 - 8.2	5.6 - 6.8
	Flexural modulus	[MPa]	3400 - 3550	3400 - 3550	3600 - 3750
		Cure: 8 h 80 °C	*XB 3585 XB 3403*	*XB 3585 XB 3404*	*XB 3585 XB 3405*
	Flexural strength	[MPa]	118 - 132	128 - 135	140 - 155
	Elongation at flexural strength	[%]	5.4 - 6.2	5.5 - 6.2	6.0 - 7.0
	Ultimate strength	[MPa]	82 - 92	110 - 120	125 - 135
	Ultimate elongation	[%]	10.5 - 12.5	8.0 - 9.5	9.0 - 10.5
	Flexural modulus	[MPa]	3000 - 3200	3200 - 3350	3350 - 3500
Fracture properties Bend notch test (PM 258-0/90)		*Cure: 8 h 80 °C*	*XB 3585 XB 3403*	*XB 3585 XB 3404*	*XB 3585 XB 3405*
	Fracture toughness K_{1C}	[MPa√m]	0.9 - 1.0	0.82 - 0.92	0.82 - 0.92
	Fracture energy G_{1C}	[J/m^2]	240 - 260	180 - 200	165 - 185
Water absorption (ISO 62)	*Immersion:* 10 days H_2O 23 °C	[%]	*Cure: 15 h 50 °C*		*Cure: 8 h 80 °C*
	XB 3585 / XB 3403	[%]	0.50 - 0.54		0.49 - 0.53
	XB 3585 / XB 3404	[%]	0.44 - 0.48		0.43 - 0.47
	XB 3585 / XB 3405		0.55 - 0.59		0.48 - 0.52

Properties of the cured, reinforced formulation

Flexural test
(ISO 178)

Laminate comprising 12 layers unidirectional
E-glass fabric (425 g/m^2)
Laminate thickness t: 3.0 - 3.3 mm
Fibre volume content: 62 - 65 %

	Cure: 8 h 80 °C	*XB 3585 XB 3403*	*XB 3585 XB 3404*	*XB 3585 XB 3405*
Flexural strength	[MPa]	1000 - 1140	980 - 1120	1000 - 1200
Elongation at flexural strength	[%]	2.2 - 2.4	2.3 - 2.6	2.3 - 2.6
Ultimate strength	[MPa]	1000 - 1140	980 - 1120	1000 - 1200
Ultimate elongation	[%]	2.2 - 2.4	2.3 - 2.6	2.3 - 2.6
Flexural modulus	[MPa]	43000-46000	38000-42000	39000-43000

Interlaminar shear strength
(ASTM D 2344)

Short beam: Laminate comprising 12 layers unidirectional
E-glass fabric (425 g/m^2),
Laminate thickness t = 3.2 mm
Fibre volume content: 62 - 65 %

	Cure: 8 h 80 °C	*XB 3585 XB 3403*	*XB 3585 XB 3404*	*XB 3585 XB 3405*
Shear strength	[MPa]	56 - 60	62 - 67	66 - 72

Handling precautions

Mandatory and recommended industrial hygiene procedures should be followed whenever our products are being handled and processed. For additional information please consult the corresponding product safety data sheets and the brochure "Hygienic precautions for handling plastics products" .

Personal hygiene

Safety precautions at workplace	
protective clothing	yes
gloves	essential
arm protectors	recommended when skin contact likely
goggles/safety glasses	yes
Skin protection	
before starting work	Apply barrier cream to exposed skin
after washing	Apply barrier or nourishing cream
Cleansing of contaminated skin	
	Dab off with absorbent paper, wash with warm water and alkali-free soap, then dry with disposable towels. Do not use solvents
Disposal of spillage	
	Soak up with sawdust or cotton waste and deposit in plastic-lined bin
Ventilation	
of workshop	Renew air 3 to 5 times an hour
of workplaces	Exhaust fans. Operatives should avoid inhaling vapours

First aid

Contamination of the *eyes* by resin, hardener or mix should be treated immediately by flushing with clean, running water for 10 to 15 minutes. A doctor should then be consulted.

Material smeared or splashed on the *skin* should be dabbed off, and the contaminated area then washed and treated with a cleansing cream (see above). A doctor should be consulted in the event of severe irritation or burns. Contaminated clothing should be changed immediately.

Anyone taken ill after *inhaling* vapours should be moved out of doors immediately.

In all cases of doubt call for medical assistance.