

Warm-curing epoxy systems based on Araldite® LY 3505* / Hardeners XB 3403* / XB 3404* / XB 3405*

Araldite LY 3505 is an 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. The systems are qualified by Germanischer Lloyd.		
Processing	<ul style="list-style-type: none"> • Wet lay-up • Filament Winding • Resin Transfer Moulding (RTM) • Pressure Moulding 		
Key data	Araldite LY 3505		
	Aspect (visual)	clear liquid	
	Colour (Gardner, ISO 4630)	≤ 3	
	Viscosity at 25 °C (ISO 12058-1)	6500 - 8000	[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 12058-1)	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 12058-1)	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]
Key data	Hardener XB 3405		
	Aspect (visual)	clear, red liquid	
	Viscosity at 25 °C (ISO 12058-1)	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]

* 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, 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.

Processing data

Mix ratio	Components	Parts by weight	Parts by volume
	Araldite LY 3505	100	100
	Hardener XB 3403	35	42
	Araldite LY 3505	100	100
	Hardener XB 3404	35	42
	Araldite LY 3505	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		[°C]	[mPa s]
(Hoeppler, ISO 12058-1)	LY 3505/XB 3403	at 25	300 - 400
	LY 3505/XB 3404	at 25	550 - 800
	LY 3505/XB 3405	at 25	1000 - 1200

Pot life		[°C]	[min]
(Tecam, 100 ml, 65 % RH)	LY 3505/XB 3403	at 23	600 - 720
		at 30	430 - 510
	LY 3505/XB 3404	at 23	80 - 100
	LY 3505/XB 3405	at 23	26 - 36

Gel time		[°C]	[min]
(Hot plate)	LY 3505/XB 3403	at 60	105 - 125
		at 80	36 - 48
		at 100	14 - 18
	LY 3505/XB 3404	at 60	60 - 70
		at 80	11 - 18
		at 100	3 - 7
	LY 3505/XB 3405	at 60	18 - 26
		at 80	5 - 11
		at 100	1 - 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.

Gelation at 23 °C			[h]
(in thin layers: 0.4 - 0.7 mm)	LY 3505/XB 3403	Start	14 - 16
		End	19 - 21
	LY 3505/XB 3404	Start	5 - 7
		End	9 - 11
	LY 3505/XB 3405	Start	2 - 3
		End	4 - 5

Typical cure cycles	15 h at 50 °C or 8 - 10 h at 60 °C or 6 - 8 h at 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.		

Recommendations to get shortest curing time	at 50 °C	with XB 3403 = 10 h	with XB 3404 = 7 h	with XB 3405 = 6 h
	at 60 °C	with XB 3403 = 8 h	with XB 3404 = 6 h	with XB 3405 = 4 h
	at 80 °C	with XB 3403 = 6 h	with XB 3404 = 3 h	with XB 3405 = 1 h

Properties of the cured, neat formulation

Glass transition temperature (IEC 1006, DSC, 10 K/min)	<i>Cure:</i>	T_g	LY 3505 XB 3403	LY 3505 XB 3404	LY 3505 XB 3405
	8 days 23 °C	[°C]	49 - 53	48 - 52	55 - 60
	1 day 23 °C + 15 h 50 °C	[°C]	63 - 68	64 - 69	68 - 73
	8 h 60 °C	[°C]	66 - 72	66 - 71	71 - 76
	6 h 80 °C	[°C]	75 - 80	75 - 80	86 - 91
	4 h 60 °C + 6 h 80 °C	[°C]	78 - 83	76 - 81	87 - 92
	8 h 100 °C	[°C]	81 - 86	77 - 82	85 - 89
Tensile test (ISO 527)					
	<i>Cure: 4 h 60 °C + 6 h 80 °C</i>		LY 3505 XB 3403	LY 3505 XB 3404	LY 3505 XB 3405
	Tensile strength	[MPa]	70 - 74	82 - 86	85 - 90
	Elongation at tensile strength	[%]	3.8 - 4.2	4.0 - 4.4	4.4 - 4.9
	Ultimate strength	[MPa]	46 - 50	73 - 78	83 - 89
	Ultimate elongation	[%]	10 - 13	5.2 - 5.8	5.0 - 6.2
	Tensile modulus	[MPa]	3180 - 3280	3400 - 3700	3500 - 3900
Flexural test (ISO 178)					
	<i>Cure: 7 days 23 °C</i>		LY 3505 XB 3403	LY 3505 XB 3404	LY 3505 XB 3405
	Flexural strength	[MPa]	85 - 93	100 - 110	90 - 100
	Elongation at flexural strength	[%]	2.4 - 2.8	3.3 - 4.0	2.2 - 2.6
	Ultimate strength	[MPa]	85 - 93	100 - 110	90 - 100
	Ultimate elongation	[%]	2.4 - 2.8	3.3 - 4.0	2.2 - 2.6
	Flexural modulus	[MPa]	3450 - 3600	3400 - 3550	3800 - 4000
	<i>Cure: 24 h 23 °C + 15 h 50 °C</i>		LY 3505 XB 3403	LY 3505 XB 3404	LY 3505 XB 3405
	Flexural strength	[MPa]	120 - 135	135 - 150	140 - 155
	Elongation at flexural strength	[%]	4.4 - 4.8	4.5 - 5.3	5.0 - 6.0
	Ultimate strength	[MPa]	64 - 72	125 - 150	125 - 140
	Ultimate elongation	[%]	11.0 - 13.0	5.5 - 7.5	7.0 - 8.5
	Flexural modulus	[MPa]	3400 - 3550	3550 - 3700	3600 - 3750
	<i>Cure: 4 h 60 °C + 6 h 80 °C</i>		LY 3505 XB 3403	LY 3505 XB 3404	LY 3505 XB 3405
	Flexural strength	[MPa]	110 - 130	125 - 145	135 - 155
	Elongation at flexural strength	[%]	4.8 - 5.5	5.0 6.0	5.2 - 6.2
	Ultimate strength	[MPa]	70 - 85	100 - 135	125 - 145
	Ultimate elongation	[%]	10.5 - 13.0	6.5 - 9.5	7.0 - 9.0
	Flexural modulus	[MPa]	3100 - 3300	3450 - 3600	3450 - 3650
Fracture properties Bend notch test (PM 258-0/90)					
	<i>Cure: 4 h 60 °C + 6 h 80 °C</i>		LY 3505 XB 3403	LY 3505 XB 3404	LY 3505 XB 3405
	Fracture toughness K_{1C}	[MPa \sqrt{m}]	0.95 - 1.05	0.8 - 0.95	0.8 - 0.9
	Fracture energy G_{1C}	[J/m ²]	250 - 280	160 - 200	150 - 190
Water absorption (ISO 62)					
	<i>Immersion:</i>				
	<i>Cure: 4 h 60 °C + 6 h 80 °C</i>		LY 3505 XB 3403	LY 3505 XB 3404	LY 3505 XB 3405
	10 days H ₂ O 23 °C	[%]	0.38 - 0.42	0.25 - 0.30	0.30 - 0.35

Properties of the cured, reinforced formulation

Interlaminar shear strength (ASTM D 2344)	Short beam: Laminate comprising 12 layers unidirectional E-glass fabric (425 g/m ²) Laminate thickness t = 3.0 - 3.2 mm Fibre volume content: 63 - 65 %			
	<i>Cure: 4 h 60 °C + 6 h 80 °C</i>	<i>LY 3505 XB 3403</i>	<i>LY 3505 XB 3404</i>	<i>LY 3505 XB 3405</i>
Shear strength	[MPa]	53 - 57	59 - 62	54 - 58

Storage	Provided that Araldite LY 3505 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.																
Handling precautions	<p>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 sheets and the brochure "Hygienic precautions for handling plastics products" (Publ. No. 24264/e).</p> <p>Personal hygiene</p> <hr/> <p><i>Safety precautions at workplace</i></p> <table border="0"> <tr> <td>protective clothing</td> <td>yes</td> </tr> <tr> <td>gloves</td> <td>essential</td> </tr> <tr> <td>arm protectors</td> <td>recommended when skin contact likely</td> </tr> <tr> <td>goggles/safety glasses</td> <td>yes</td> </tr> </table> <hr/> <p><i>Skin protection</i></p> <table border="0"> <tr> <td>before starting work</td> <td>Apply barrier cream to exposed skin</td> </tr> <tr> <td>after washing</td> <td>Apply barrier or nourishing cream</td> </tr> </table> <hr/> <p><i>Cleansing of contaminated skin</i></p> <p>Dab off with absorbent paper, wash with warm water and alkali-free soap, then dry with disposable towels. Do not use solvents</p> <hr/> <p><i>Disposal of spillage</i></p> <p>Soak up with sawdust or cotton waste and deposit in plastic-lined bin</p> <hr/> <p><i>Ventilation</i></p> <table border="0"> <tr> <td>of workshop</td> <td>Renew air 3 to 5 times an hour</td> </tr> <tr> <td>of workplaces</td> <td>Exhaust fans. Operatives should avoid inhaling vapours</td> </tr> </table>	protective clothing	yes	gloves	essential	arm protectors	recommended when skin contact likely	goggles/safety glasses	yes	before starting work	Apply barrier cream to exposed skin	after washing	Apply barrier or nourishing cream	of workshop	Renew air 3 to 5 times an hour	of workplaces	Exhaust fans. Operatives should avoid inhaling vapours
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First aid	<p>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.</p> <p>Material smeared or splashed on the <i>skin</i> 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.</p> <p>Anyone taken ill after <i>inhaling</i> vapours should be moved out of doors immediately. In all cases of doubt call for medical assistance.</p>																

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