

Advanced Materials

Araldite® LY 1564* / Hardeners XB 3403* / XB 3404-1* / Aradur® 3405*

COLD TO WARM CURING EPOXY SYSTEMS

Araldite® LY 1564 is a modified epoxy resin

Hardeners XB 3403, XB 3404-1 and Aradur® 3405 are based on aliphatic polyamines

APPLICATIONS	Industrial composites: <ul style="list-style-type: none"> • Windmill blades • Marine craft 		
PROPERTIES	Laminating system with low viscosity and high flexibility. The reactivity may easily be adjusted to demands through the combination of the three hardeners of different reactivity. The long pot life of XB 3403 facilitates the production of very large industrial parts.		
PROCESSING	<ul style="list-style-type: none"> • Vacuum infusion • Resin Transfer Moulding (RTM, SCRIMP) • Wet lay-up • Filament Winding 		
PRODUCT DATA	Araldite® LY 1564		
	Aspect (visual)	clear liquid	
	Viscosity at 25 °C (ISO 12058-1)	1200 – 1400**	[mPa s]
	Density at 25 °C (ISO 1675)	1.10 - 1.20	[g/cm ³]
	Epoxide index (ISO 3001)	5.80 – 6.05**	[Eq/kg]
	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]
	Hardener XB 3404-1		
	Aspect (visual)	Clear slight yellow 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]
Aradur® 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]	

** Specified data are on a regular basis analysed. Data which is described in this document as 'typical' is not analysed on a regular basis and is given for information purposes only. Data values are not guaranteed or warranted unless if specifically mentioned.

STORAGE	Provided that Araldite® LY 1564, XB 3403, XB 3404-1 or Aradur® 3405 are stored in a dry place in their original, properly closed containers at the storage temperatures mentioned in the MSDS they will have the shelf lives indicated on the labels. Partly emptied containers should be closed immediately after use.
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* 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.

TYPICAL SYSTEM DATA**PROCESSING DATA**

MIX RATIO	<i>Components</i>	<i>Parts by weight</i>	<i>Parts by volume</i>
	Araldite® LY 1564	100	100
	Hardener XB 3403	36	42
	Araldite® LY 1564	100	100
	Hardener XB 3404-1	36	42
	Araldite® LY 1564	100	100
	Aradur® 3405	36	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 (HOEPLER, ISO 12058-1)		<i>[°C]</i>	<i>[mPa s]</i>
	LY 1564/XB 3403	at 25	150 - 230
	LY 1564/XB 3404-1	at 25	270 - 370
	LY 1564/Aradur® 3405	at 25	420 - 520

POT LIFE (TECAM, 23°C)		<i>[g]</i>	<i>[min]</i>
	LY 1564/XB 3403	100	870 - 1050
		1000	380 - 460
	LY 1564/XB 3404-1	100	150 - 180
		1000	72 - 88
	LY 1564/ Aradur® 3405	100	47 - 57
		1000	-

GEL TIME (HOT PLATE)		<i>[°C]</i>	<i>[min]</i>
	LY 1564/XB 3403	at 60	108 - 132
		at 80	40 - 50
		at 100	18 - 22
	LY 1564/XB 3404-1	at 60	42 - 52
		at 80	14 - 17
		at 100	4 - 7
	LY 1564/ Aradur® 3405	at 60	18 - 23
		at 80	6 - 9
		at 100	1 - 3

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

24 h at 40 °C
or 15 h at 50 °C
or 8 h at 80 °C

In order to obtain the optimum mechanical properties, it is necessary to cure/ post-cure at elevated temperature.

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

PROPERTIES OF THE CURED, NEAT FORMULATION

GLASS TRANSITION TEMPERATURE		<i>Cure:</i>	T_G	LY 1564 XB 3403	LY 1564 XB 3404-1	LY 1564 Aradur 3405
(ISO 11357-2, DSC, 10 K/MIN)		8 days 23 °C	[°C]	49 - 53	50 - 54	54 - 58
		20 h 40 °C	[°C]	47 - 51	52 - 56	65 - 70
		15 h 50 °C	[°C]	51 - 55	55 - 59	68 - 73
		10 h 60 °C	[°C]	55 - 59	59 - 63	68 - 72
		8 h 80 °C	[°C]	68 - 73	68 - 72	67 - 73
		4 h 100 °C	[°C]	68 - 73	70 - 75	67 - 72
TENSILE TEST		<i>Cure: 15 h 50 °C</i>		LY 1564 XB 3403	LY 1564 XB 3404-1	LY 1564 Aradur 3405
(ISO 527)		Tensile strength	[MPa]	65 - 70	70 - 75	82 - 87
		Ultimate elongation	[%]	6.6 - 7.3	6.9 - 7.5	7.3 - 7.9
		Tensile modulus	[MPa]	3060 - 3240	3180 - 3300	3290 - 3420
		<i>Cure: 8 h 80 °C</i>		LY 1564 XB 3403	LY 1564 XB 3404-1	LY 1564 Aradur 3405
		Tensile strength	[MPa]	63 - 67	71 - 75	72 - 76
		Ultimate elongation	[%]	7.3 - 7.8	10.1 - 10.8	7.0 - 7.6
		Tensile modulus	[MPa]	2850 - 3050	3060 - 3200	3080 - 3210
FLEXURAL TEST		<i>Cure: 15 h 50 °C</i>		LY 1564 XB 3403	LY 1564 XB 3404-1	LY 1564 Aradur 3405
(ISO 178)		Flexural strength	[MPa]	108 - 118	112 - 126	128 - 142
		Ultimate elongation	[%]	10.2 - 11.3	7.0 - 8.0	9.2 - 10.2
		Flexural modulus	[MPa]	2980 - 3150	3000 - 3200	3150 - 3300
		<i>Cure: 8 h 80 °C</i>		LY 1564 XB 3403	LY 1564 XB 3404-1	LY 1564 Aradur 3405
		Flexural strength	[MPa]	104 - 115	115 - 125	116 - 130
		Ultimate elongation	[%]	10.7 - 11.6	10.2 - 11.2	9.2 - 10.1
		Flexural modulus	[MPa]	2760 - 3000	2940 - 3100	3000 - 3180
FRACTURE PROPERTIES		<i>Cure: : 8 h 80 °C</i>		LY 1564 XB 3403	LY 1564 XB 3404-1	LY 1564 Aradur 3405
BEND NOTCH TEST (ISO 13586)		Fracture toughness K_{1C}	MPa√m]	1.0 - 1.1	1.0 - 1.1	1.1 - 1.3
		Fracture energy G_{1C}	[J/m ²]	360 - 380	400 - 420	460 - 480
WATER ABSORPTION		<i>Immersion:</i>		<i>Cure: 8 h 80 °C</i>		LY 1564 Aradur 3405
(ISO 62)		1 day water 23 °C	[%]	0.1 - 0.2	0.1 - 0.2	0.1 - 0.2
		10 days water 23 °C	[%]	0.4 - 0.6	0.5 - 0.7	0.6 - 0.8

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: 8 h 80 °C</i>	<i>LY 1564 XB 3403</i>	<i>LY 1564 XB 3404-1</i>	<i>LY 1564 Aradur 3405</i>
Shear strength		[MPa]	53 - 57	56 - 60	56 - 60
FLEXURAL TEST (ISO 178)		<i>Cure: 8 h 80 °C</i>	<i>LY 1564 XB 3403</i>	<i>LY 1564 XB 3404-1</i>	<i>LY 1564 Aradur 3405</i>
Flexural strength		[MPa]	900 - 1100	950 - 1150	950 - 1150
Ultimate elongation		[%]	2 - 3	2 - 3	2 - 3
Flexural modulus		[MPa]	40000 - 43000	41000 - 44000	41000 - 44000

**HANDLING
PRECAUTIONS**

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.

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