Advanced Materials

Structural Composites

MATRIX SYSTEMS FOR AEROSPACE COMPOSITES
MATRIX SYSTEMS FOR INDUSTRIAL COMPOSITES

DATA SHEET

Cold-curing epoxy system based on Araldite® LY 5052* / Aradur® 5052*

Araldite LY 5052 is a low-viscosity epoxy resin
Aradur 5052 is a mixture of polyamines

Applications

Aerospace and industrial composites, tooling, aircraft repair.

Properties

- Low viscosity, easy impregnation of reinforcement materials.
- Long potlife (2 hours for 100 ml at ambient), ample processing time allows production of big objects.
- High temperature resistance (glass transition temperature) after ambient cure: 60 °C, after post-cure at 100:120 °C.
- Excellent mechanical and dynamic properties after ambient cure with potential for even higher properties after post-cure at elevated temperatures.
- Also laminates show outstanding mechanical and dynamic properties. This system is qualified by the Luftfahrtbundesamt (German Aircraft Authority) for the production of gliders.

Adequate skin protection is indispensable.

Processing

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

Key data

Araldite LY 5052		
Aspect (visual)	clear liquid	
Colour (Gardner, ISO 4630)	≤ 2	
Viscosity at 25 °C (ISO 12058-1)	1000 - 1500	[mPa s]
Density at 25 °C (ISO 1675)	1.17	[g/cm^3]
Flash point (ISO 2719)	≥ 140	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]
Aradur 5052		
Aspect (visual)	clear liquid	
Colour (Gardner, ISO 4630)	≤ 4	
Viscosity at 25 °C (ISO 12058-1)	40 - 60	[mPa s]
Density at 25 °C (ISO 1675)	0.94	[g/cm^3]
Flash point (ISO 2719)	≥ 110	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]

Storage

Provided that the products described above 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.

* *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.*

Processing data

Mix ratio

Components	*Parts by weight*	*Parts by volume*
Araldite LY 5052	100	100
Aradur 5052	38	47

The components must be weighed accurately and mixed thoroughly to obtain optimal properties. The sides and bottom of mixing vessels must be included in the mixing process. Large mix quantities will show considerable exotherm, leading to short potlives. Preferably mix smaller quantities or divide large mixes into smaller containers.

Initial mix viscosity

(ISO 12058-1)

[°C]	*[mPa s]*
at 18	1150 - 1350
at 25	500 - 700
at 40	200 - 250

Viscosity build-up

(ISO 12058-1)

[°C]	*[mPa s]*	*[min]*
at 25	to 1500	50 - 60
at 25	to 3000	90 - 110
at 40	to 1500	40 - 45
at 40	to 3000	50 - 60
at 60	to 1500	15 - 18
at 60	to 3000	18 - 22

Pot life

(Tecam, 100 ml, 65 % RH)

Long potlife means ample time to produce even big objects.

[°C]	*[min]*
at 18	280 - 320
at 25	110 - 160
at 40	45 - 55

Gel time

(Hot plate)

[°C]	*[min]*
at 25	420 - 500
at 40	150 - 170
at 60	40 - 55
at 80	14 - 17
at 100	4 - 6
at 120	2 - 3

The values shown are for small amounts of pure resin/hardener mix. In practice, fibre content and laminate thickness may modify the gel time to a very significant extent. 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

(in thin layers: 0.4 - 0.7 mm)

	[h]
Start	5 - 6.5
End	7 - 8

Typical cure cycles

1 day 23 °C + 15 h 50 °C
or 1 day 23 °C + 4 h 100 °C

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

(IEC 1006, DSC, 10 K/min)

Cure:	*T_G onset [°C]*	*T_G [°C]*
2 days 25 °C	50 - 52	52 - 55
8 days 25 °C	60 - 64	62 - 66
4 month 23 °C	64 - 68	67 - 71
1 day 23 °C + 10 h 40 °C	68 - 72	70 - 76
1 day 23 °C + 20 h 40 °C	72 - 76	74 - 80
1 day 23 °C + 10 h 50 °C	78 - 82	80 - 85
1 day 23 °C + 15 h 50 °C	81 - 85	82 - 88
1 day 23 °C + 10 h 60 °C	92 - 96	94 - 104
1 day 23 °C + 15 h 60 °C	94 - 98	96 - 106
1 day 23 °C + 2 h 80 °C	106 - 110	108 - 114
1 day 23 °C + 8 h 80 °C	112 - 116	114 - 122
1 day 23 °C + 1 h 90 °C	104 - 108	108 - 118
1 day 23 °C + 4 h 90 °C	112 - 116	116 - 126
1 day 23 °C + 1 h 100 °C	116 - 120	118 - 130
1 day 23 °C + 4 h 100 °C	118 - 124	120 - 134
Even if post-cured at elevated temperature after a prolonged cure at ambient, a good increase of the glass transition temperature is obtained as follows :		
4 months 23 °C + 4 h 130 °C	106 - 112	120 - 132

The maximum attainable glass – transition temperature for this system is in the range of 130 °C

Tensile test (ISO 527)

	Cure:	*7 days RT*	*15 h 50 °C*	*8 h 80 °C*
Tensile strength	[MPa]	49 - 71	82 - 86	84 - 86
Elongation at tensile strength	[%]	1.5 - 2.5	3.1 - 3.7	5.7 - 5.9
Ultimate strength	[MPa]	49 - 71	80 - 83	80 - 84
Ultimate elongation	[%]	1.5 - 2.5	3.5 - 5.5	7.0 - 8.5
Tensile modulus	[MPa]	3350 - 3550	3450 - 3650	3000 - 3200

Flexural test (ISO 178)

	Cure:	*15 h 50 °C*	*8 h 80 °C*
Flexural strength	[MPa]	130 - 140	116 - 122
Elongation at flexural strength	[%]	5.8 - 6.3	6.5 - 7.2
Ultimate strength	[MPa]	90 - 115	87 - 113
Ultimate elongation	[%]	8.0 - 9.5	8.5 - 13.4
Flexural modulus	[MPa]	3000 - 3300	2700 - 3000

Fracture properties Bend notch test (PM 258-0/90)

	Cure:	*8 h 80 °C*
Fracture toughness K_{1C}	MPa√m]	0.77-0.83
Fracture energy G_{1C}	[J/m^2]	192 - 212

Water absorption (ISO 62)

Immersion:	*Cure:*	*7 days RT*	*8 h 80 °C*
4 days H_2O 23 °C	[%]	0.45 - 0.50	0.40 - 0.45
10 days H_2O 23 °C	[%]	0.70 - 0.80	0.65 - 0.70
30 min H_2O 100 °C	[%]	0.55 - 0.60	0.45 - 0.50
60 min H_2O 100 °C	[%]	0.70 - 0.80	0.60 - 0.70

Coefficient of linear thermal expansion (DIN 53 752)

Mean value:	*Cure:*	*7 d RT*	*15 h 50 °C*	*8 h 80 °C*
α from 20 - 50 °C	[10^{-6}/K]	97	-	-
α from 20 - 90 °C	[10^{-6}/K]	-	71	-
α from 20 - 120 °C	[10^{-6}/K]	-	-	71

Poisons's Ratio [ ] 0.35

Properties of the cured, reinforced formulation

Flexural test

(ISO 178)

Samples:

16 layers (4 mm) E-glass fabric 1:1, 280-300 g/m^2
Fibre volume content: 45 - 46 %
Cure: 10 h 80 °C

		Unconditioned
Flexural strength	[MPa]	440 - 490
Elongation at flexural strength	[%]	2.7 - 3.0
Ultimate strength	[MPa]	420 - 460
Ultimate elongation	[%]	2.9 - 3.2
Flexural modulus	[MPa]	20000 - 22000
		After 30 days in H_2O 23 °C
Flexural strength	[MPa]	380 - 400
Elongation at flexural strength	[%]	2.7 - 3.0
Ultimate strength	[MPa]	340 - 370
Ultimate elongation	[%]	1.9 - 3.4
Flexural modulus	[MPa]	19000 - 21000

Tensile test

(ISO 527)

Samples:

16 layers (4 mm) E-glass fabric 1:1, 280-300 g/m^2
Fibre volume content : 45 - 46 %
Cure: 10 h 80 °C

Tensile strength	[MPa]	360 - 390
Ultimate elongation	[%]	1.6 - 1.9
Tensile modulus	[MPa]	33100 - 39100

Interlaminar shear strength

(ASTM D 2344)

Short beam: E-glass unidirectional specimen, thickness t = 3.2 mm
Fibre volume content: 60 %

	Cure:	*7 days RT*	*8 h 80 °C*
Unconditioned	[MPa]	57 - 61	60 - 65
After 1 h in H_2O 100 °C	[MPa]	55 - 60	58 - 62

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.

Note

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