

Advanced Materials

Araldite® LY 5052 / Aradur® 5052*

COLD CURING EPOXY SYSTEMS

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	<ul style="list-style-type: none"> • Low viscosity, easy impregnation of reinforcement materials. • Long pot life (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. <p>Adequate skin protection is indispensable.</p>		
PROCESSING	<ul style="list-style-type: none"> • Wet lay-up • Resin Transfer Moulding (RTM) • Pressure Moulding • Filament Winding 		
KEY DATA	Araldite® LY 5052		
	Aspect (visual)	clear liquid	
	Color (Gardner, ISO 4630)	≤ 2	
	Viscosity at 25 °C (ISO 12058-1)	1000 - 1500	[cps.]
	Density at 25 °C (ISO 1675)	1.17	[g/cm ³]
	Flash point (ISO 2719)	≥ 140	[°C]
	Aradur® 5052		
	Aspect (visual)	clear liquid	
	Color (Gardner, ISO 4630)	≤ 4	
	Viscosity at 25 °C (ISO 12058-1)	40 - 60	[cps.]
	Density at 25 °C (ISO 1675)	0.94	[g/cm ³]
	Flash point (ISO 2719)	≥ 110	[°C]

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 pot lives. Preferably mix smaller quantities or divide large mixes into smaller containers.

INITIAL MIX VISCOSITY (ISO 12058-1)	[°F]	[cps.]
	at 64	1150 - 1350
	at 77	500 - 700
	at 104	200 - 250

VISCOSITY BUILD-UP (ISO 12058-1)	[°F]	[cps.]	[min]
	at 77	to 1500	50 - 60
	at 77	to 3000	90 - 110
	at 104	to 1500	40 - 45
	at 104	to 3000	50 - 60
	at 140	to 1500	15 - 18
	at 140	to 3000	18 - 22

POT LIFE (TECAM, 100 ML, 65 % RH) LONG POTLIFE MEANS AMPLE TIME TO PRODUCE EVEN BIG OBJECTS.	[°F]	[min]
	at 64	280 - 320
	at 77	110 - 160
	at 104	45 - 55

GEL TIME (HOT PLATE)	[°F]	[min]
	at 77	420 - 500
	at 104	150 - 170
	at 104	40 - 55
	at 176	14 - 17
	at 212	4 - 6
	at 248	2 - 3

The values shown are for small amounts of pure resin/hardener mix. In practice, fiber 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 fiber content and the laminate thickness.

GELATION AT 23 °C (IN THIN LAYERS: 0.4 - 0.7 MM)	Start	[h]
	End	5 - 6.5
		7 - 8

TYPICAL CURE CYCLES	1 day 23 °C + 15 h 50 °C or 1 day 23 °C + 4 h 100 °C
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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)	<i>Cure:</i>	T_G onset [°F]	T_G [°F]
	2 days 78 °F	122 - 126	126 - 131
	8 days 78 °F	140 - 147	144 - 151
	4 month 73 °F	147 - 154	153 - 160
	1 day 73 °F + 10 h 104 °F	154 - 162	158 - 169
	1 day 73 °F + 20 h 104 °F	162 - 169	166 - 176
	1 day 73 °F + 10 h 122°F	172 - 180	176 - 185
	1 day 73 °F + 15 h 122°F	178 - 185	180 - 190
	1 day 73 °F + 10 h 140°F	198 - 205	201 - 219
	1 day 73 °F + 15 h 140°F	201 - 208	205 - 223
	1 day 73 °F + 2 h 176°F	223 - 230	226 - 237
	1 day 73 °F + 8 h 176°F	234 - 241	237 - 252
	1 day 73 °F + 1 h 194°F	219 - 226	226 - 244
	1 day 73 °F + 4 h 194°F	234 - 241	241 - 259
	1 day 73 °F + 1 h 212°F	241 - 248	244 - 266
	1 day 73 °F + 4 h 212°F	244 - 255	248 - 273

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 73 °F + 4 h 266°F	223 - 234	248 - 270
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The maximum attainable glass – transition temperature for this system is in the range of 266°F

TENSILE TEST (ISO 527)	<i>Cure:</i>	7 days RT	15 h 122°F	8 h 176°F
Tensile strength	[Ksi]	7.1 – 10.3	11.9 - 12.5	12.2 – 12.5
Elongation at tensile strength	[%]	1.5 - 2.5	3.1 - 3.7	5.7 - 5.9
Ultimate strength	[Ksi]	7.1 – 10.3	11.6 – 12.0	11.6 – 12.2
Ultimate elongation	[%]	1.5 - 2.5	3.5 - 5.5	7.0 - 8.5
Tensile modulus	[Ksi]	486 – 515	500 – 529	435 - 464

FLEXURAL TEST (ISO 178)	<i>Cure:</i>	15 h 122°F	8 h 176°F
Flexural strength	[Ksi]	18.9 – 20.3	16.8 – 17.7
Elongation at flexural strength	[%]	5.8 - 6.3	6.5 - 7.2
Ultimate strength	[Ksi]	13.1 – 16.7	12.6 – 16.4
Ultimate elongation	[%]	8.0 - 9.5	8.5 - 13.4
Flexural modulus	[Ksi]	435 - 479	392 - 435

FRACTURE PROPERTIES BEND NOTCH TEST (PM 258-0/90)	<i>Cure:</i>	8 h 176°F
Fracture toughness K_{1C}	[vin*lb/in ²]	846 -912
Fracture energy G_{1C}	[ln*lb/in ²]	1.09 – 1.21

WATER ABSORPTION (ISO 62)	<i>Immersion:</i>	<i>Cure:</i>	7 days RT	8 h 176°F
	4 days H ₂ O 23 °C	[%]	0.45 - 0.50	0.40 - 0.45
	10 days H ₂ O 23 °C	[%]	0.70 - 0.80	0.65 - 0.70
	30 min H ₂ O 100 °C	[%]	0.55 - 0.60	0.45 - 0.50
	60 min H ₂ O 100 °C	[%]	0.70 - 0.80	0.60 - 0.70

COEFFICIENT OF	<i>Mean value:</i>	<i>Cure:</i>	7 d RT	15 h 122°F	8 h 176°F
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LINEAR THERMAL EXPANSION (DIN 53 752)	α from 20 - 50 °C	$10^{-6}/^{\circ}\text{F}/[\text{K}]$	54 [97]	-	-
	α from 20 - 90 °C	$10^{-6}/^{\circ}\text{F}/[\text{K}]$	-	39 [71]	-
	α from 20 - 120 °C	$10^{-6}/^{\circ}\text{F}/[\text{K}]$	-	-	39 [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 Fiber volume content: 45 - 46 % Cure: 10 h 176°F				
					<i>Unconditioned</i>
	Flexural strength	[Ksi]			63.8 – 71.1
	Elongation at flexural strength	[%]			2.7 - 3.0
	Ultimate strength	[Ksi]			60.9 – 66.7
	Ultimate elongation	[%]			2.9 - 3.2
	Flexural modulus	[Ksi]			2900 - 3190
					<i>After 30 days in H₂O 73°F</i>
	Flexural strength	[Ksi]			55.1 – 58.0
	Elongation at flexural strength	[%]			2.7 - 3.0
	Ultimate strength	[Ksi]			49.3 – 53.7
	Ultimate elongation	[%]			1.9 - 3.4
	Flexural modulus	[Ksi]			2755 - 3045

TENSILE TEST (ISO 527)	Samples: 16 layers (4 mm) E-glass fabric 1:1, 280-300 g/m ² Fiber volume content : 45 - 46 % Cure: 10 h 176°F				
	Tensile strength	[Ksi]			52.2 – 56.6
	Ultimate elongation	[%]			1.6 - 1.9
	Tensile modulus	[Ksi]			4800 - 5670

INTERLAMINAR SHEAR STRENGTH (ASTM D 2344)	Short beam: E-glass unidirectional specimen, thickness t = 3.2 mm Fiber volume content: 60 %				
		<i>Cure:</i>	<i>7 days RT</i>	<i>8 h 80 °C</i>	
	Unconditioned	[psi]	8265 - 8845	8700 - 9425	
	After 1 h in H ₂ O 100 °C	[psi]	7975 - 8700	8410 - 8990	

STORAGE Araldite® LY 5052 should be stored in a dry place, in the sealed original container, away from heat and humidity, at temperatures between +2°C and +40°C (+35.6°F and +104°F). Under these storage conditions, the shelf life is 5 years. The product should not be exposed to direct sunlight.

Aradur® 5052 should be stored in a dry place, in the sealed original container, away from heat and humidity, at temperatures between +2°C and +40°C (+35.6°F and +104°F). Under these storage conditions, the shelf life is 3 years. The product should not be exposed to direct sunlight.

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First Aid!

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Main Office:

Huntsman Advanced Materials
10003 Woodloch Forest Dr.
The Woodlands, TX 77380
888-564-9318

www.huntsman.com/advanced_materials
advanced_aterials@huntsman.com