

**Advanced Materials****Araldite® LY 1556 / Aradur® 917 / Accelerator DY 070****HOT CURING EPOXY MATRIX SYSTEM**

Araldite® LY 1556 is an epoxy resin

Aradur® 917 is an anhydride hardener

Accelerator DY 070 is an imidazole accelerator

<b>APPLICATIONS</b>	High performance composite parts		
<b>PROPERTIES</b>	Anhydride-cured, low-viscosity standard matrix system with extremely long pot life. The reactivity of the system is adjustable by variation of the accelerator content. The system is easy to process, has good fiber impregnation properties and exhibits excellent mechanical, dynamic and thermal properties. It has an excellent chemical resistance especially to acids at temperatures up to 176 °F. This epoxy system fulfills MIL specifications R 9300.		
<b>PROCESSING</b>	Filament Winding Pultrusion Pressure Moulding		
<b>KEY DATA</b>	<b>Araldite® LY 1556</b>		
	Aspect (visual)	clear, pale yellow liquid	
	Color (Gardner, ISO 4630)	≤ 2	
	Epoxy content (ISO 3000)	5.30 - 5.45	[eq/kg]
	Viscosity at 25 °C (ISO 12058-1)	10000 - 12000	[cps]
	Density at 25 °C (ISO 1675)	1.15 - 1.20	[g/cm <sup>3</sup> ]
	Flash point (ISO 2719)	> 200	[°C]
	<b>Aradur® 917</b>		
	Aspect (visual)	clear liquid	
	Colour (Gardner, ISO 4630)	≤ 2	
	Viscosity at 25 °C (ISO 12058-1)	50 - 100	[mPa s]
	Density at 25 °C (ISO 1675)	1.20 - 1.25	[g/cm <sup>3</sup> ]
	Flash point (ISO 2719)	195	[°C]
	<b>Accelerator DY 070</b>		
	Aspect (visual)	clear liquid	
	Color (Gardner, ISO 4630)	≤ 9	
	Viscosity at 25 °C (ISO 12058-1)	≤ 50	[mPa s]
	Density at 25 °C (ISO 1675)	0.95 - 1.05	[g/cm <sup>3</sup> ]
	Flash point (ISO 2719)	92	[°C]

## PROCESSING DATA

MIX RATIO	Components	Parts by weight	Parts by volume
	Araldite® LY 1556	100	100
	Aradur® 917	90	86
	Accelerator DY 070	0.5 - 2	0.6 - 2.4

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.

## PROCESSING RECOMMENDATIONS

To simplify the mixing process the resin can be preheated to about 30 °C to 50 °C before adding the cold hardener. Hardener and accelerator can be premixed, thus allowing the use of two component mixing/metering equipment. The mix of hardener and accelerator has a shelf life of several days.

The processing of the system at elevated temperatures of 30 °C to 40 °C shows the best results. The gelation temperature should not be higher than absolutely necessary. A high gelation temperature induces high shrinkage and generates internal stresses.

INITIAL MIX VISCOSITY (HOEPLER, ISO 12058-1B)	[°F]	[cps]
	at 78	600 - 900
	at 104	200 - 300
	at 140	< 75

VISCOSITY BUILD-UP (HOEPLER, ISO 12058-1B)	Components [pbw]	System 1	System 2	System 3
	Araldite® LY 1556	100	100	100
	Aradur® 917	90	90	90
	Accelerator DY 070	0.5	1	2

	[°F]	[cps]	[h]	[h]	[h]	[min]	[min]	[min]	[min]
	at 78	to 1500	10 - 12	3.5 - 4.5	1.5 - 2				
		to 3000	33 - 37	16 - 18	6 - 7				
	at 104	to 1500	19 - 21	7 - 8	3 - 4				
		to 3000	23 - 26	9 - 10	4 - 5				
	at 176	to 1500	95 - 105	52 - 57	32 - 35				
		to 3000	105 - 115	60 - 65	35 - 38				
	at 194	to 1500			14 - 16				
		to 3000			15 - 17				

POT LIFE (TECAM, 65 % RH, 100 G) 10 KG METAL CONTAINER	[°F]	System 1	System 2	System 3
	at 73	165 - 175 [h]	95 - 105	48 - 54
	at 104	5 - 7 [h]	4 - 5	-

GEL TIME (HOT PLATE)	[°F]		System 1	System 2	System 3
	at 176		[min]	230 - 270	140 - 160
at 212		[min]	65 - 75	35 - 45	18 - 22
at 248		[min]	21 - 25	10 - 12	5 - 7
at 284		[min]	7 - 9	3 - 5	1 - 3
at 320		[min]	2 - 4	1 - 2	-

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		
Gelation either or		2 - 4 h at 176 °F
		1 - 3 h at 194 °F
Post-cure either or or		4 - 8 h at 248 °F
		2 - 8 h at 284 °F
		2 - 8 h at 320 °F

Cure temperatures in excess of about 130 °C cause brown discolouration but do not impair the properties of the product.

## PROPERTIES OF THE CURED, NEAT FORMULATION

Unless otherwise stated, the processing schedule for the samples tested was gelation for 4 hours at 80 °C and post-cured for 8 hours at 140 °C.

GLASS TRANSITION TEMPERATURE (T <sub>G</sub> ) (IEC 1006, 10 K/MIN)	Cure:		T <sub>G</sub> DSC [°F]	T <sub>G</sub> TMA [°F]
		4 h 176 °F + 4 h 248 °F		284 - 291
	4 h 176 °F + 8 h 248 °F		291 - 148	257 - 262
	4 h 176 °F + 4 h 284 °F		293 - 302	266 - 275
	4 h 176 °F + 8 h 284 °F		298 - 307	275 - 293
	4 h 176 °F + 4 h 320 °F		302 - 311	284 - 293
	4 h 176 °F + 8 h 320 °F		302 - 311	284 - 293
TENSILE TEST (ISO 527)	Tensile strength	[Kpsi]		12.0 - 13.5
	Elongation at tensile strength	[%]		4.2 - 5.6
	Ultimate strength	[Kpsi]		11.6 - 13.1
	Ultimate elongation	[%]		5.0 - 7.0
	Tensile modulus	[Kpsi]		450 - 479
FLEXURAL TEST (ISO 178)	Flexural strength	[Kpsi]		18.1 - 19.6
	Deflection at maximum load	[mm]		10 - 18
	10 days in H <sub>2</sub> O 23 °C	[Kpsi]		16.0 - 17.4
	Flexural strength	[mm]		8 - 18
	Deflection at maximum load			
	60 min in H <sub>2</sub> O/100 °C	[Kpsi]		18.1 - 19.6
Flexural strength	[mm]		10 - 18	
FRACTURE PROPERTIES BEND NOTCH TEST (PM 258-0/90)	Fracture toughness K1C	[vin*lb/in <sup>2</sup> ]		615 - 659
	Fracture energy G <sub>1c</sub>	[ ln*lb/in <sup>2</sup> ]		0.50 - 0.55
WATER ABSORPTION (ISO 62)	Immersion:			
	1 day H <sub>2</sub> O 23 °C	[%]		0.10 - 0.15
	10 days H <sub>2</sub> O 23 °C	[%]		0.30 - 0.40
	30 min H <sub>2</sub> O 100 °C	[%]		0.10 - 0.15

	60 min H <sub>2</sub> O 100 °C		0.15 - 0.20
<b>COEFFICIENT OF LINEAR THERMAL EXPANSION</b> (DIN 53 752)	<i>Mean value:</i>		
	$\alpha$ from 68 - 212 °F	[10 <sup>-6</sup> /°F]	31 - 32
	$\alpha$ from 212 - 266 °F	[10 <sup>-6</sup> /°F]	37 - 39
<b>POISSON'S RATIO</b>		[ $\mu$ ]	0.35

## PROPERTIES OF THE CURED, REINFORCED FORMULATION

Unless otherwise stated, the figures given are for pressed laminate samples comprising 16 layers (4 mm) of E-glass fabric 1:1, 280 - 300 g/m<sup>2</sup>, fibre volume content 42 - 47 %.

<b>FLEXURAL TEST</b> (ISO 178)	Flexural strength	[Kpsi]	75.4 – 79.8	
	Deflection at maximum load	[mm]	5 - 6	
	Flexural modulus	[Kpsi]	2393 - 2422	
	10 days in H <sub>2</sub> O 73 °F			
	Flexural strength	[Kpsi]	56.6 – 59.5	
	Deflection at maximum load	[mm]	4 - 5	
	60 min in H <sub>2</sub> O/212 °F			
Flexural strength	[Kpsi]	66.7 – 69.6		
Deflection at maximum load	[mm]	5 - 6		
<b>TENSILE TEST</b> (ISO 3268 - 1978)	Tensile strength	[Kpsi]	50.0 – 54.4	
	Ultimate elongation	[%]	1 - 2	
	Tensile modulus	[Kpsi]	3698 - 3770	
<b>INTERLAMINAR SHEAR STRENGTH</b> (ASTM D 2344)	Short beam: E-glass unidirectional specimen Laminate thickness t = 6.4 mm Fibre volume content: 60 %			
	Shear strength:	[Kpsi]	10.9 – 11.2	
<b>WATER ABSORPTION</b> (ISO 62)	<i>Immersion:</i>			
	1 day H <sub>2</sub> O 73 °F	[%]	0.15 - 0.20	
	10 days H <sub>2</sub> O 73 °F	[%]	0.25 - 0.30	
	30 min H <sub>2</sub> O 212 °F	[%]	0.01 - 0.05	
60 min H <sub>2</sub> O 212 °F	[%]	0.03 - 0.07		
<b>TENSILE, COMPRESSIVE AND TORSIONAL TEST</b> (TCT)	E-glass	Roving	E-glass roving, 1200 tex, silane finish	
		Fibre volume content	67 %	
		Gelation temperature	194 °F	
		Post-cure	8 h at 284 °F	
	Carbon HT	Roving	Carbon fibre high tensile, Torayca T 300 B - 6000 - 50 B	
		Fibre volume content	64 %	
		Gelation temperature	194 °F	
		Post-cure	8 h at 284 °F	
	<b>Transverse tensile test</b>		<i>E-Glass</i>	<i>Carbon HT</i>
	Tensile strength	[Kpsi]	7.0 – 8.0	11.2 - 12.3
Tensile strain	[%]	0.25 - 0.33	0.9 - 1.0	
Elastic modulus	[Kpsi]	2610 - 2900	1349 - 1436	
<b>Transverse compressive test</b>				
	[Kpsi]		27.6 – 29.9	

Compressive strength	[%]	23.9 – 25.4	2.7 - 3.4
Compressive strain at break	[Kpsi]	1.2 - 1.4	1407 - 1436
Elastic modulus		2900 - 3190	
<b><i>Torsional test</i></b>			
Shear strength	[Kpsi]	11.2 – 11.9	11.0 – 11.6
Shear angle	[%]	2.7 - 3.1	3.3 - 4.0
Shear modulus	[Kpsi]	885 - 1030	870 - 914

**STORAGE**

Araldite<sup>®</sup> LY 1556 should be stored in a dry place, 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 6 years. The product should not be exposed to direct sunlight.

Araldite<sup>®</sup> LY 1556 which has crystallized and looks cloudy can be restored to its original state by heating to 60 - 80 °C.

Aradur<sup>®</sup> 917 should be stored in a dry place, 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 2 years. The product should not be exposed to direct sunlight. Because Aradur<sup>®</sup> 917 is sensitive to moisture, storage containers should be ventilated with dry air only.

Accelerator DY 070 should be stored in a dry place, 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.

Partly emptied containers should be closed immediately after use.

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**First Aid!**

Refer to MSDS as mentioned above.

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