HUNTSMAN

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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

APPLICATIONS	High performance composite parts		
PROPERTIES	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.		
PROCESSING	Filament Winding		
	Pultrusion		
	Pressure Moulding		
KEY DATA	**Araldite® LY 1556**		
	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^3]
	Flash point (ISO 2719)	> 200	[°C]
	Aradur® 917		
	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^3]
	Flash point (ISO 2719)	195	[°C]
	Accelerator DY 070		
	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^3]
	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 (HOEPPLER, ISO 12058-1B)

[°F]	*[cps]*
at 78	600 - 900
at 104	200 - 300
at 140	< 75

VISCOSITY BUILD-UP (HOEPPLER, 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]*				
at 78	to 1500	*[h]*	10 - 12	3.5 - 4.5	1.5 - 2
	to 3000	*[h]*	33 - 37	16 - 18	6 - 7
at 104	to 1500	*[h]*	19 - 21	7 - 8	3 - 4
	to 3000	*[h]*	23 - 26	9 - 10	4 - 5
at176	to 1500	*[min]*	95 - 105	52 - 57	32 - 35
	to 3000	*[min]*	105 - 115	60 - 65	35 - 38
at 194	to 1500	*[min]*			14 - 16
	to 3000	*[min]*			15 - 17

POT LIFE (TECAM, 65 % RH, 100 G) 10 KG METAL CONTAINER

[°F]		*System 1*	*System 2*	*System 3*
at 73	*[h]*	165 - 175	95 - 105	48 - 54
at 104	*[h]*	5 - 7	4 - 5	-

GEL TIME (HOT PLATE)

[°F]	*[min]*	*System 1*	*System 2*	*System 3*
at 176	*[min]*	230 - 270	140 - 160	65 - 75
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	2 - 4 h at 176 °F
or	1 - 3 h at 194 °F
Post-cure either	4 - 8 h at 248 °F
or	2 - 8 h at 284 °F
or	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_G) (IEC 1006, 10 K/MIN)

Cure:	*T_G DSC [°F]*	*T_G TMA [°F]*
4 h 176 °F + 4 h 248 °F	284 - 291	257 - 262
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_2O 23 °C	[Kpsi]	16.0 – 17.4
Flexural strength	[mm]	8 - 18
Deflection at maximum load		
60 min in H_2O/100 °C		
Flexural strength	[Kpsi]	18.1 – 19.6
Deflection at maximum load	[mm]	10 - 18

FRACTURE PROPERTIES BEND NOTCH TEST (PM 258-0/90)

Fracture toughness K1C	[vin*lb/in^2]	615 - 659
Fracture energy G_{1C}	[In*lb/in^2]	0.50 – 0.55

WATER ABSORPTION (ISO 62)

Immersion:		
1 day H_2O 23 °C	[%]	0.10 - 0.15
10 days H_2O 23 °C	[%]	0.30 - 0.40
30 min H_2O 100 °C	[%]	0.10 - 0.15
	[%]	

	60 min H_2O 100 °C		0.15 - 0.20
COEFFICIENT OF LINEAR THERMAL EXPANSION (DIN 53 752)	*Mean value:*		
	α from 68 - 212 °F	[10^{-6}/°F]	31 - 32
	α from 212 - 266 °F	[10^{-6}/°F]	37 - 39
POISSON'S RATIO		[μ]	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^2, fibre volume content 42 - 47 %.

FLEXURAL TEST (ISO 178)	Flexural strength	[Kpsi]	75.4 – 79.8
	Deflection at maximum load	[mm]	5 - 6
	Flexural modulus	[Kpsi]	2393 - 2422
	10 days inH_2O 73 °F		
	Flexural strength	[Kpsi]	56.6 – 59.5
	Deflection at maximum load	[mm]	4 - 5
	60 min in H_2O/212 °F		
	Flexural strength	[Kpsi]	66.7 – 69.6
	Deflection at maximum load	[mm]	5 - 6
TENSILE TEST (ISO 3268 - 1978)	Tensile strength	[Kpsi]	50.0 – 54.4
	Ultimate elongation	[%]	1 - 2
	Tensile modulus	[Kpsi]	3698 - 3770
INTERLAMINAR SHEAR STRENGTH (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
WATER ABSORPTION (ISO 62)	*Immersion:*		
	1 day H_2O 73 °F	[%]	0.15 - 0.20
	10 days H_2O 73 °F	[%]	0.25 - 0.30
	30 min H_2O 212 °F	[%]	0.01 - 0.05
	60 min H_2O 212 °F	[%]	0.03 - 0.07

TENSILE, COMPRESSIVE AND TORSIONAL TEST (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

Transverse tensile test		*E-Glass*	*Carbon HT*
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

Transverse compressive test		
	[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	
Torsional test			
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® 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® LY 1556 which has crystallized and looks cloudy can be restored to its original state by heating to 60 - 80 °C.

Aradur® 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® 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.

PRECAUTIONARY STATEMENT

Huntsman Advanced Materials Americas LLC maintains up–to-date Material Safety Data Sheets (MSDS) on all of its products. These sheets contain pertinent information that you may need to protect your employees and customers against any known health or safety hazards associated with our products. Users should review the latest MSDS to determine possible health hazards and appropriate precautions to implement prior to using this material.

First Aid!
Refer to MSDS as mentioned above.

KEEP OUT OF REACH OF CHILDREN

FOR PROFESSIONAL AND INDUSTRIAL USE ONLY

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