HUNTSMAN

Enriching lives through innovation

Advanced Materials

Araldite® LY 556*/ Aradur® 917-1*/ Accelerator DY 070*

HOT CURING EPOXY MATRIX SYSTEM

Araldite® LY 556 is an epoxy resin
Aradur® 917-1 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 fibre impregnation properties and exhibits excellent mechanical, dynamic and thermal properties. It has an excellent chemical resistance especially to acids at temperatures up to 80 °C.		
PROCESSING	Filament Winding Pultrusion Pressure Moulding		
PRODUCT DATA	**Araldite® LY 556**		
	Aspect (visual)	clear liquid	
	Viscosity at 25 °C (ISO 12058-1)	10000 - 12000 **	[mPa s]
	Density at 25 °C (ISO 1675)	1.15 - 1.2	[g/cm^3]
	Epoxide index (ISO 3001)	5.30 - 5.45 **	[Eq/kg]
	Aradur® 917-1		
	Aspect (visual)	clear liquid	
	Viscosity at 25 °C (ISO 12058-1)	50 - 100 **	[mPa.s]
	Density at 25 °C (ISO 1675)	1.20 - 1.25	[g/cm^3]
	Accelerator DY 070		
	Aspect (visual)	clear liquid	
	Viscosity at 25 °C (ISO 12058-1)	≤ 50	[mPa.s]
	Density at 25 °C (ISO 1675)	0.95 - 1.05	[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 556, Aradur 917-1 and Accelerator DY 070 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. Because Aradur® 917-1 is sensitive to moisture, storage containers should be ventilated with dry air only. Araldite® LY 556 which has crystallized and looks cloudy can be restored to its original state by heating to 60 - 80 °C.

* *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 = Unied 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

Components	*Parts by weight*	*Parts by volume*
Araldite® LY 556	100	100
Aradur® 917-1	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)

[°C]	*[mPa s]*
at 25	600 - 900
at 40	200 - 300
at 60	< 75

VISCOSITY BUILD-UP (HOEPPLER, ISO 12058-1B)

Components [pbw]	*System 1*	*System 2*	*System 3*
Araldite® LY 556	100	100	100
Aradur® 917-1	90	90	90
Accelerator DY 070	0.5	1	2

[°C]	*[mPa s]*				
at 25	to 1500	*[h]*	15 - 17	11 - 12	1.5 - 2
	to 3000	*[h]*	28 -34	20 - 22	6 - 7
at 40	to 1500	*[h]*	14 - 16	7 - 9	3 - 4
	to 3000	*[h]*	18 - 21	9 - 11	4 - 5
at 80	to 1500	*[min]*	124 - 132	52 - 54	43 - 47
	to 3000	*[min]*	134 - 144	57 - 59	35 - 38
at 90	to 1500	*[min]*	58 - 60	35 - 37	22 - 26
	to 3000	*[min]*	62 - 64	38 - 40	23 - 25

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

[°C]		*System 1*	*System 2*	*System 3*
at 23	*[h]*	165 - 175	95 - 105	48 - 54
at 40	*[h]*	5 - 7	4 - 5	-

GEL TIME (HOT PLATE)

[°C]		*System 1*	*System 2*	*System 3*
at 80	*[min]*	230 - 270	140 - 160	65 - 75
at 100	*[min]*	65 - 75	35 - 45	20 - 22
at 120	*[min]*	21 - 25	10 - 12	5 - 7
at 140	*[min]*	7 - 9	3 - 5	1 - 3
at 160	*[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 80 °C
	or	1 - 3 h at 90 °C
	Post-cure either	4 - 8 h at 120 °C
	or	2 - 8 h at 140 °C
	or	2 - 8 h at 160 °C

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) (ISO 11357-2, DSC, 10 K/MIN)	*Cure:*		*T_G DSC [°C]*	*T_G TMA [°C]*
	4 h 80 °C + 4 h 120 °C		140 - 144	125 - 128
	4 h 80 °C + 8 h 120 °C		144 - 148	125 - 128
	4 h 80 °C + 4 h 140 °C		145 - 150	130 - 135
	4 h 80 °C + 8 h 140 °C		148 - 153	135 - 145
	4 h 80 °C + 4 h 160 °C		150 - 155	140 - 145
	4 h 80 °C + 8 h 160 °C		150 - 155	140 - 145
TENSILE TEST (ISO 527)	Tensile strength	[MPa]		83 - 93
	Elongation at tensile strength	[%]		4.2 - 5.6
	Ultimate strength	[MPa]		80 - 90
	Ultimate elongation	[%]		5.0 - 7.0
	Tensile modulus	[MPa]		3100 - 3300
FLEXURAL TEST (ISO 178)	Flexural strength	[MPa]		125 - 135
	Deflection at maximum load	[mm]		10 - 18
	10 days in H_2O 23 °C	[MPa]		110 - 120
	Flexural strength	[mm]		8 - 18
	Deflection at maximum load			
	60 min in H_2O/100 °C			
	Flexural strength	[MPa]		125 - 135
	Deflection at maximum load	[mm]		10 - 18
FRACTURE PROPERTIES BEND NOTCH TEST (ISO 13586)	Fracture toughness K1C	[MPa√m]		0.56 - 0.6
	Fracture energy G_{1C}	[J/m^2]		88 - 96
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 (ISO 11359-2)	*Mean value:*			
	α from 20 - 100 °C	[10^{-6}/K]		55 - 57
	α from 100 - 130 °C	[10^{-6}/K]		67 - 70
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	[MPa]	520 - 550
	Deflection at maximum load	[mm]	5 - 6
	Flexural modulus	[MPa]	16500 - 16700
	10 days in H_2O 23 °C		
	Flexural strength	[MPa]	390 - 410
	Deflection at maximum load	[mm]	4 - 5
	60 min in H_2O/100 °C		
	Flexural strength	[MPa]	460 - 480
	Deflection at maximum load	[mm]	5 - 6
TENSILE TEST (ISO 527)	Tensile strength	[MPa]	345 - 375
	Ultimate elongation	[%]	1 - 2
	Tensile modulus	[MPa]	25500 - 26000
INTERLAMINAR SHEAR STRENGTH (ASTM D 2344)	Short beam: E-glass unidirectional specimen Laminate thickness t = 6.4 mm Fibre volume content: 60 %		
	Shear strength:	[MPa]	75 - 77
WATER ABSORPTION (ISO 62)	*Immersion:*		
	1 day H_2O 23 °C	[%]	0.15 - 0.20
	10 days H_2O 23 °C	[%]	0.25 - 0.30
	30 min H_2O 100 °C	[%]	0.01 - 0.05
	60 min H_2O 100 °C	[%]	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		90 °C
	Post-cure		8 h at 140 °C
Carbon HT	Roving		Carbon fibre high tensile, Torayca T 300 B - 6000 - 50 B
	Fibre volume content		64 %
	Gelation temperature		90 °C
	Post-cure		8 h at 140 °C

Transverse tensile test		*E-Glass*	*Carbon HT*
Tensile strength	[MPa]	48 - 55	77 - 85
Tensile strain	[%]	0.25 - 0.33	0.9 - 1.0
Elastic modulus	[MPa]	18000 - 20000	9300 - 9900
Transverse compressive test			
Compressive strength	[MPa]	165 - 175	190 - 206
Compressive strain at brak	[%]	1.2 - 1.4	2.7 - 3.4
Elastic modulus	[MPa]	20000 - 22000	9700 - 9900
Torsional test			
Shear strength	[MPa]	77 - 82	76 - 80
Shear angle	[%]	2.7 - 3.1	3.3 - 4.0
Shear modulus	[MPa]	6100 - 7100	6000 - 6300

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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Huntsman Advanced Materials
(Switzerland) GmbH
Klybeckstrasse 200
4057 Basel
Switzerland

Tel: +41 (0)61 299 11 11
Fax: +41 (0)61 299 11 12

www.huntsman.com/advanced_materials
Email: advanced_materials@huntsman.com

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