

Advanced Materials

Araldite® GY 6010

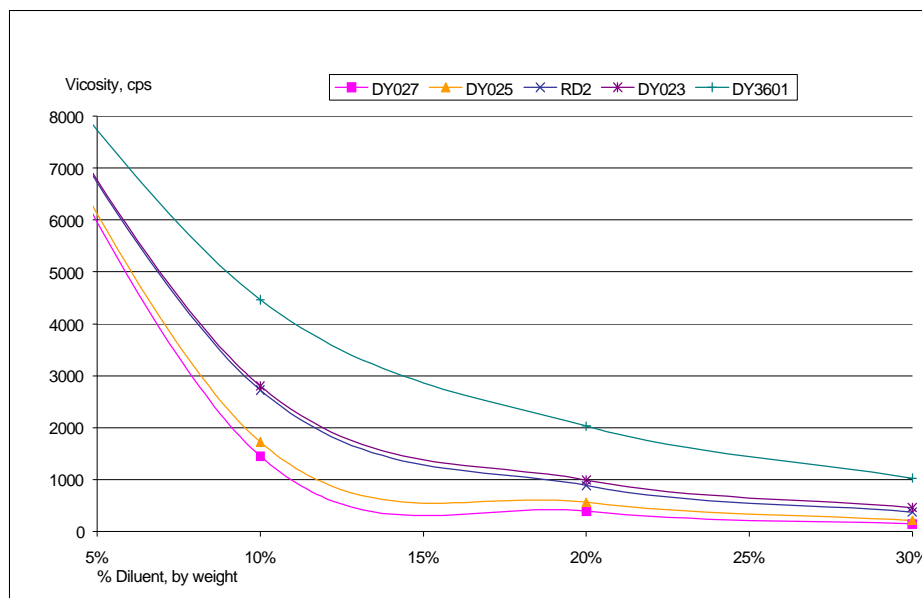
A MEDIUM VISCOSITY, UNMODIFIED LIQUID EPOXY RESIN

GENERAL	Araldite® GY 6010 is a general purpose unmodified liquid epoxy resin applied widely in both room temperature and heat cured systems. It is the standard from which a great number of variations were developed.	
CHEMICAL DESCRIPTION	Araldite® GY 6010 is an unmodified liquid epoxy resin based on bisphenol A and epichlorohydrin.	
APPLICATIONS	Coatings Electrical Civil Engineering	Matrix Adhesives
ADVANTAGES	Superior mechanical and electrical properties Excellent chemical resistance Good heat resistance Excellent adhesion Outstanding versatility Easy to cure with a variety of different type hardeners Compatible with many different fillers, diluents and accelerators Conforms to FDA listings in 21 CFR 175.300	
TYPICAL PROPERTIES*	Visual Appearance Color, Gardner, max Epoxy Value, eq./kg Epoxy Equivalent, g/eq. Viscosity @ 25°C (77°F), mPa s (cPs) Density @ 25°C (77°F), g/cm ³ (lb/gal.) Flash Point, Closed Cup, °C (°F)	Clear, no contamination 1 5.2 - 5.5 182 - 192 11,000 - 13,000 1.15 - 1.18 (9.6 - 9.8) 254 (490)

* Typical properties are based on Huntsman's test methods. Copies are available upon request.

REDUCING VISCOSITY OF Araldite® GY 6010

The graph below represents the viscosity of modified Araldite® GY 6010 vs % diluent (by weight) for five reactive diluents.



The addition of reactive diluents to Araldite® GY 6010 influences wet properties of coatings and performance of the cured films. Depending on the diluent used, it is expected that:

- 1) The viscosity and the reactivity of the system will be reduced.
- 2) Mechanical properties of the cured system will be impaired.
- 3) Thermal stability of the system will be reduced.
- 4) Resistance to water and aqueous solutions at elevated temperatures will be reduced.
- 5) Resistance to acids and organic solvents at ambient temperatures will be reduced.

The extent to which the above properties are affected depends on the reactive diluent content and its chemical nature.

HARDENERS

The final properties of a cured Araldite® GY 6010 system at ambient temperature depend, to a great extent, on the hardener selection. Because of its versatility, Araldite® GY 6010 can be cured with most types of hardeners such as:

Type	Huntsman Araldur®	Mixing Ratio phr*	Pot Life 100g mass @ 25° C (77° F) Hrs:Min
Modified Aliphatic amines	Araldur® 956	25	0:35
	Araldur® 943	20	0:15
	Araldur® 3440	35-45	0:35
	Araldur® 3441	60-80	0:75
Cycloaliphatic amines	Araldur® 2964	50	0:35
	Araldur® 2963	45	0:45
	Araldur® 1341	60	0:25
	Araldur® 265	50	0:40
	Araldur® 355	26	0:30
	Araldur® 847	40	0:40
Aromatic amine	Araldur® 3100	31	
	Araldur® 3150	29	0:45
Polyamides	Araldur® 815	35+	10:00
	Araldur® 825	35+	6:30
	Araldur® 840	35+	3:30
	Araldur® 283	70	2:30
	Araldur® 360	60	7:30
	Araldur® 3640	49	4:00
Anhydrides	Araldur® 906 NMA	80-90	-
	Araldur® 917 MTHPA	80-90	-

*per hundred parts by weight resin

+Depending on desired properties it can be 35-100 phr

CURING TIME

The curing time depends on the hardener used, the temperature applied and the mass of the resin/hardener mix. We recommend the following cure schedules for achieving the optimum properties of Araldite® GY 6010 systems.

Aradur® 906*	2 hr @ 10°C (212°F) +2-4 hr @ 150-200°C (302-398°F)
TETA Hardener	7 days @ room temperature or 24 hr @ 40°C or 2-9 hr @ 100°C (212°F)
Aradur® 956	7 days @ room temperature or 24 hr @ 40°C (104°F) or 2-8 @ 100°C (212°F)
Aradur® 825	7 days @ room temperature or 2-8 hr @ 100°C (212°F)
Aradur® 976-1	Gel @ 120-150°C (248-302°F) + 2-4 hr @ 175-200°C (347-392°F)

* Accelerators such as Accelerator 960-1, DY 062 (benzyl dimethyl amine), etc., are usually used with Aradur® 906.

FORMULATIONS**Product** **Parts by weight**

Araldite® GY 6010	100
Aradur® 2964	50

Physical Properties

Viscosity mixed @25°C, cPs	1000
Gel time, min., @25°C	30
Dust dry time, hr, @25°C	4
Full-cure time, hr, @25°C	7
Flow @25°C	Very good
Transparency	Clear
Surface appearance	Smooth, glossy
Exudation	None
Impact test	
2 months @ 20°C (68°F), in/lb	70
2 months @ 60°C (140°F), in/lb	70
Mandrel test	15mm mandrel
2 months @ 20°C (68°F)	180°
2 months @ 60°C (140°F)	60°
Boiling water test 6 hr @ 96°C (205°F)	
Adhesion on sandblasted mild steel sheet	Unchanged
After curing @ 20°C (68°F)/100% RH	
Full-time cure, hrs.	Approx. 30
Surface appearance	Smooth, glossy
Transparency	Clear
Exudation	None

FORMULATIONS (CONTINUED)	Chemical Resistance	Test time, Months													
		¼	½	1	2	3	4	5	6	7	8	9	10	11	12
	Water, deionized	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Seawater, synthetic	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Sulfuric acid, 10%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Sulfuric acid, 30%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Sulfuric acid, 70%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Hydrochloric acid, 10%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Hydrochloric acid, 20%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Hydrochloric acid, 36%	+	+	+	+	A	D								
	Acetic acid, 5%	+	+	+	+	D									
	Acetic acid, 10%	+	A	D											
	Ammonia, 10%	+	+	+	+	+	+	A	A	A	A	A	D		
	Ammonia, 25%	+	+	A	D										
	Caustic soda, 20%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Acetone	D													
	Butanol	D													
	Butyl acetate	+	+	+	+	+	+	+	+	+	+	+	+	+	(+)
	Diacetone alcohol	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ethyl glycol	A	A	A	A	A	A	A	A	A	A	A	D		
	Ethanol, 50%	+	+	+	A	A	A	A	A	A	A	A	A	A	A
	Ethanol, 96%	D													
	Octanol	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Xylene	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Toluene	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Benzene	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Trichloroethylene	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Crude oil	+	+	+	+	+	+	+	+	+	+	+	+	+	+

(+) = slight softening initially but regenerate very rapidly
 + = resistant
 A = attacked
 D = destroyed Hot Curing Casting Applications

Systems containing GY 6010 and polyamide hardeners such as Aradur® 939 reacting rapidly at relatively moderate temperatures (e.g., 5 min @ 100°C), provide excellent properties after curing at 150°C. Table 1 provides information on the effect of cure times on Adhesive Tensile Shear Strength.

The mixing ratio of Aradur® 939 is not critical and can be varied. As might be expected, the physical properties are dependent on the amount of hardener that is used. Table 2 illustrates several variations in the mix ratio.

Product	Parts by weight
Araldite® GY 6010	100
Aradur® 939	35
Physical Properties	
Viscosity of mixture @ 25°C, cPs	120,000
Gel time (1g on cure plate), sec	
@ 100°C	300
@ 121°C	124
@ 150°C	54

FORMULATIONS
(CONTINUED)

Cure schedule: Gel @ 90°C + 3 hrs @ 150°C

Mechanical Properties @ 25°C (ultimate)

Heat deflection temperature, °C	97
Tensile strength, psi	11,500
Elongation, %	4.6
Tensile modulus, psi x 10 ⁵	4.9
Weight loss after 48 hrs @ 200°C, %	2.0

Electrical Properties

Volume resistivity (ohm-cm)	
@ 25°C	1.1 x 10 ¹⁶
@ 100°C	9.0 x 10 ¹²
@ 150°C	1.3 x 10 ⁹

Table 1: Effect of Cure Time/Temp. on Adhesive Tensile Shear Strength

Parts by Weight		
Araldite® GY 6010	100	
Aradur® 939	35	
Cure: 6.5 min @ 150°C		
Tensile shear strength, psi		
@ 25°C	1620	
@ 82°C	1050	
@ 149°C	100	
Cure: 10 min @ 159°C		
Tensile shear strength, psi		
@ 25°C	1630	
@ 82°C	1050	
Tensile shear strength (psi)	Tested @	
Cure: 10 min @:	25°C	82°C
100°C	560	-
121°C	560	880
150°C	1560	1050
177°C	1630	820

Table 2: Effect of Mix Ratio on Physical/Mechanical Properties

Aradur® 939 (phr) with Araldite® GY 6010	Gel time @ 150°C, sec	HDT, °C	Tensile Shear Strength @ 25°C, psi
25	76	78	1270
30	58	90	-
35	54	97	1620
40	45	95	1480
45	41	90	1690

FDA STATUS	Araldite® GY 6010 is included in Section 175.300 of Title 21 of the Code of Federal Regulations (21 CFR 175.300) for resinous and polymeric coatings.
PACKAGING & STORAGE	Araldite® GY 6010 is supplied in bulk and in 500 pound steel drums. This product has a minimum shelf life of four years when stored in unopened sealed containers in a dry location at room temperature. Like most liquid epoxy resins, Araldite® GY 6010 may crystallize when stored below room temperature. Heating the resin to 60-70°C (140-160°F), preferably in a water bath, for several hours, will reliquify it and restore its original properties.
HANDLING/SAFETY PRECAUTIONS	<p>Warning : Causes irritation. May cause allergic skin reaction.</p> <p>Avoid contact with eyes, skin or clothing. Avoid breathing vapor, mist or spray. Use with adequate ventilation. Promptly remove wet, contaminated clothing and wash before reuse. Wash after handling. Store in a cool, dry area in closed containers.</p> <p>Read Material Safety Data Sheet Before Using. For Industrial Use Only.</p>
FIRST AID	<p>In case of contact :</p> <p>Eyes : Immediately flush with water for at least 15 minutes. Call a physician.</p> <p>Skin : Promptly wash thoroughly with mild soap and water.</p> <p>Inhalation : Remove to fresh air. Give oxygen if breathing is difficult.</p> <p>Ingestion : If conscious, give plenty of water. Get medical attention.</p>

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