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Advanced Materials

Araldite® ECN 1273* / Araldite® ECN 1280*
Araldite® ECN 1299* / Araldite® ECN 9511*

NOVALAC EPOXY RESIN

GENERAL

Araldite® ECN resins are derived from an ortho cresolformaldehyde novolac which is then reacted with epichlorohydrin to form a polyepoxide. The molecular weight of the novolac determines the molecular weight of the polyepoxy resin whose functionality may range from 2.5 to 5.5.

The major difference between polyepoxides and conventional epoxy resins (derived from bisphenol-A) is the availability of more than two reactive groups.

APPLICATIONS

The materials are recommended for high temperature adhesives, castings, coatings, electrical applications (fluidized bed coatings and molding powder), laminating uses (dry lay-up or vacuum bag laminates), tooling applications, and filament winding.

These materials are especially recommended in applications where improved thermal properties and high resistance to solvents and chemicals are desired.

TYPICAL PROPERTIES

	ECN 1273	ECN 1280	ECN 1299	ECN 9511
Molecular weight, approx.	1080	1170	1270	540
Weight per epoxide	225	230	235	200
Epoxy value, Eq./100gm	.445	.435	.425	0.5
Melting point, °C	73	80	99	35
Weight per gallon, lb.	9.7	9.8	9.9	9.3

HANDLING & MIXING

All hardeners used to cure conventional epoxy resins can be used to cure the ECN resins. Generally, Araldite® ECN resins exhibit a shorter gel time and cure faster than conventional epoxy resins under the same conditions.

It may be advantageous for particular applications to prepare solutions of these resins. This is easily accomplished since the resins are soluble in many of the more common solvents. For example:

- Acetone
- PMA
- Toluene-MIBK
- Xylene-MIBK

Toluene
Chloroform
Ethylene Chloride

Table 1 **Gel Time Minutes @ 140 °C (282 °F)**

Formulation	phr*	ECN 9511	ECN 1299
Aradur® 906	89.0	45	-
Accelerator 064	2.0		

Table II is designed to act as a guide for the user. The table exhibits the wide variations in reactivities achieved using Araldite® ECN 9511 and different hardeners. By proper choice of hardener and cure temperature, a gel time of one minute to a shelf life of several months can be obtained.

*parts by weight per hundred parts of resin.

Table 2 **Gel Time Minutes @ 90 °C (294 °F)**

Hardener	phr*	ECN 9511
Aradur® 906***	89.0	49
Aradur® 907	77.0	65
HET Anhydride	110.0	26
BF_3 mea	2.0	780
Piperidine	6.0	45

* parts by weight per hundred parts of resin
** 40 gram mass
*** With Accelerator 064 (DMP-30), 2.0 phr
# With Accelerator 066 (DMP-10), 0.5 phr

TYPICAL PROPERTIES OF CURED NON-REINFORCED SYSTEMS

Physical Properties	Deflection Temperatures	
ASTM Heat Deflection Temperature, °C	Araldite® ECN 9511	285 °C
	Araldite® ECN 1273	>300 °C
a) Hardener: Aradur® 906	Araldite® ECN 1280	>300 °C
	Araldite® ECN 1299	>300 °C
b) Specimen Size 1/2”x5”x1/8”		
c) Cure	1 hr @ 120 °C+	
	1 hr @ 150 °C+	
	1 hr @ 180 °C+	
	12 hrs @ 215 °C+	
	24 hrs @ 215 °C	

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TYPICAL ELECTRICAL PROPERTIES USING ECN @ 25 °C (77 °F)

Formulation	A		B		C	
	Aradur® 907	77 phr	Aradur® 906	89 phr	BF3.MEA	5phr
	DMP-10	.5phr	Accelerator	2 phr		
			#MBDMA			
Cure	1 hr @ 100 °C (212 °F)+ 4 hrs @ 121 °C (250 °F)		1 hr @ 120 °C (248 °F)+ 1 hr @ 150 °C (302 °F)+ 12 hrs @ 180 °C (356 °F)+ 16 hrs @ 215 °C (419 °F)		3/4 hr @ 93 °C (200 °F)+ 2 hrs @ 174 °C (345 °F)	
Dielectric Constant						
	Dry	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
60 HZ	3.18	3.21	3.42	3.48	3.58	3.62
10^3 HZ	3.14	3.18	3.40	3.45	3.54	3.59
10^5 HZ	3.03	3.06	3.31	3.36	3.44	3.47
$2.5x10^7$ HZ	2.98	3.00	3.20	3.25	3.34	3.38
Dissipation Factor						
	Dry	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
60 HZ	0.0056	0.0067	0.0041	0.0045	0.0059	0.0063
10^3 HZ	0.0103	0.0102	0.0056	0.0055	0.0065	0.0069
10^5 HZ	0.0119	0.0118	0.0142	0.0015	0.0133	0.0148
$2.5x10^7$ HZ	0.0077	0.0084	0.0102	0.0113	0.0100	0.0109
Volume Resistivity,						
25 °C (77°F)						
ohm-cm	$2.4x10^{17}$	$9.5x10^{16}$	$1.0x10^{18}$	-	$2.2x10^{17}$	$1.5x10^{16}$

TYPICAL PROPERTIES OF CURED REINFORCED RESINS

Formulations	A		B		C		D	
(pbw)	ECN 9511	100	ECN 1273	100	ECN 1299	100	ECN 1299	100
	Aradur® 9006	75.5	Aradur® 906	67.1	Aradur® 906	64.3	Aradur® 906	64.3
	#MBDMA	2.0	#MBDMA	2.0	#MBDMA	1.0		
Prepreg Characteristics								
Style / finish	**Volan A**							
Oven Dwell,								
min/°F (C°)	9/212 (100)		4/212 (100)		3/212 (100)		3.5/212 (100)	
Laminate Construction								
No. of Piles	**12**							
Cure, min./°F								
(°C)/ psi	20/383 (195)/		20/401(205)/		20/392 (200)/95		20/392 (200)/	
	Contacts with stops		Contacts with stops				Contacts with stops	
Postcure, hr/								
°F (°C)	24/419 (215)		24/419 (215)		24/419 (200)		24/419 (215)	
Nominal Thickness,								
±0.005 in.								
(± .13mm)	0.103 (2.62mm)		0.104 (2.64mm)		0.093 (2.36mm)		0.102 (2.59mm)	
Resin Content, %	27		26		24		24	

* Parts by weight per hundred parts of resin
\# Methylbenzyldimethylamine
** As is
*** After water immersion, 24 hrs @ 25°C (77°F)

PROPERTIES OF CURED LAMINATES

	A	B	C	D
	psi (Kg/cm^2)	**psi (Kg/cm^2)**	**psi (Kg/cm^2)**	**psi (Kg/cm^2)**
Flexural Properties				
tested @ 25 °C (77 °F)				
Ultimate strength	71,800 (5,050)	70,000 (4,900)	67,800 (4,600)	56,400 (3,960)
Elastic modulus	3.09x10^5 (2.17x10^5)	2.79x10^5 (1.96x10^5)	3.28x10^5 (2.32x10^5)	2.80x10^5 (1.97x10^5)
Flexural Properties				
tested @ 260 °C (500 °F)				
Ultimate strength	13,000 (914)	15,800 (1,110)	20,400 (1,430)	22,900 (1,610)
Elastic modulus	0.96x10^6 (6.75x10^4)	1.02x10^6 (7.17x10^4)	1.45x10^6 (1.02x10^5)	1.12x10^6 (7.86x10^4)
Flexural Properties*				
tested @ 260 °C (500 °F)				
Ultimate strength	30,100 (2,110)	16,200 (1,140)	21,700 (1,520)	10,200 (717)
Elastic Modulus	1.89x10^6 (1.33x10^5)	1.98x10^6 (1.39x10^5)	2.33x10^6(1.64x10^5)	1.17x10^6 (8.22x10^4)
Comprehensive Properties				
Ultimate strength				
@ 25 °C (77 °F)	70,800 (4,980)	66,500 (4,680)	88,100 (6,200)	56,600 (3,980)
@ 260 °C (500 °F)	22,600 (1,590)	35,800 (2,380)	56,600 (3,980)	42,500 (2,990)
@ 260 °C (500 °F)	39,600 (2,780)	34,900 (2,450)	39,600 (2,780)	34,000 (2,390)
Tensile Properties	**A**	**B**	**C**	**D**
tested @ 25 °C (77 °F)	**psi (Kg/cm^2)**	**psi (Kg/cm^2)**	**psi (Kg/cm^2)**	**psi (Kg/cm^2)**
Ultimate strength	52,100 (3,670)	50,900 (3,580)	-	49,000 (3,450)
Elastic modulus	1.33x10^6 (2.34x10^5)	3.22x10^6 (2.26x10^5)	-	3.32x10^6 (2.33x10^5)

* after aging 8 days at 260°C

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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