HUNTSMAN

Enriching lives through innovation

Advanced Materials

Araldite® MY 720*

A Medium Viscosity Multifunctional Epoxy Resin

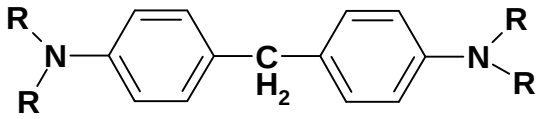
GENERAL

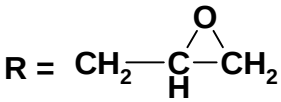
Araldite® MY 720 is a tetrafunctional epoxy resin suitable for high performance composites applications. Cured @ 120 °C (250 °F) to 175 °C (350 °F), Araldite® MY 720 provides outstanding performance characteristics at elevated temperatures. When post-cured @ 200 °C (400 °F), the system exhibits properties in excess of 220 °C (430 °F). Araldite® MY 720 systems can display Tgs.

CHEMICAL DESCRIPTION

N,N,N',N'-Tetraglycidyl-4,4'-methylenebisbenzenamine

CHEMICAL STRUCTURE





ADVANTAGES

- Exceptionally good long-term high temperature performance
- High mechanical strength retention
- Extremely low shrinkage
- Excellent chemical resistance
- Excellent radiation stability
- Outstanding heat resistance and deflection temperature

APPLICATIONS

- Advanced (carbon and boron fiber) composites structures
- High performance structural adhesives
- Structural laminating
- High energy radiation resistance components

* *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 = United 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.*

HUNTSMAN

Enriching lives through innovation

TYPICAL PROPERTIES (ARE BASED ON HUNTSMAN'S TEST METHODS. COPIES ARE AVAILABLE UPON REQUEST)	Visual Appearance	Clear, dark brown semi-solid
	Epoxy Value, eq./kg	7.5-8.5
	Epoxy Equivalent, g/eq.	117-134
	Viscosity @ 50 °C (122 °F), mPa s (cPs)	8.000-18.000
	Density @ 25 °C (77 °F), g/cm^3 (lb/gal.)	1.15-1.18 (9.6-9.8)
	Flash Point, Closed Cup, °C (°F)	>149 (>300)

FORMULATIONS

Hardeners

The final properties of an Araldite® MY 720 system depend on the hardener selection. Araldite® MY 720 can be cured with the following anhydride and aromatic amine hardeners:

Aradur® 906 = Nadic methyl anhydride
Aradur® 907 = Hexahydrophthalic anhydride
Aradur® 917 = Methyl tetrahydrophthalic anhydride
Aradur® 976-1 = 4,4' Diaminodiphenyl sulfone
Aradur® 9719-1 = 3,3' Diaminodiphenyl sulfone
Aradur® 5200 = Liquid Aromatic Amine

Caution

Care should always be taken when working with multifunctional epoxy resins like Araldite® MY 720. Excessive heat can cause violent exothermic reactions. When heating the Araldite® MY 720 in any large quantities, 80°C (176°F) should be the upper temperature limit.

Unfilled batches scaled up to 5 kg should be carefully investigated by the user for possible exotherms. In all cases, hot spots should be avoided when heating. Accelerators are not recommended where no solvents or fillers are used. If accelerators are evaluated, extreme caution should be exercised.

FORMULATIONS

Araldite® MY 720 / Aradur 976-1 Formulation

Ratio:	**parts by weight**
Araldite® MY 720	100
Aradur® 976-1	44

Procedure

When using Araldite® MY 720 and Aradur® 976-1 to produce an unfilled casting, the following procedure is suggested:

Carefully heat the Araldite® MY 720 to 125 °C (256 °F) and slowly stir in the Aradur® 976-1 until a clear mixture is obtained. (The total mass is 500g.) Maintain a temperature of 135 °C and degas the mixture for 20 minutes @ 30 inches of mercury. Then pour the material into molds and cure at the cure schedule below.

Cure Schedule

2 hrs. @ 80 °C (176 °F)+ 1 hr. @ 100 °C (212 °F)+
4 hrs. @ 150 °C (302 °F)+ 7 hrs. @ 200 °C (392 °F)

FORMULATIONS (CONTINUED)

Cured Properties

Tested @	**25 °C (77 °F)**	**150 °C (302 ° F)**
Tensile strength psy (Mpa)	8.450 (58.3)	6.460 (44.6)
Tensile modulus psi, (GPa)	5.4 x 10^5 (3.7)	3.8 x 10^5 (2.6)
Tensile elongation	1.8%	1.9%
Flexural strength psi, (MPa)	13.000 (89.7)	12.300 (84.8)
Flexural modulus psi, (GPa)	5.0 x 10^5 (3.4)	3.9 x 10^5 (2.7)
Ultimate compressive strength psi, (MPa)	34.000 (234.5)	
Compressive yield strength psi, (MPa)	29.000 (200.0)	
Compressive modulus psi, (GPa)	2.8 x 10^5 (1.9)	
Charpy-impact, unnotched	5.7 ft-lb.	
Heat deflection temperature	238 °C (460 °F)	
Tg	177 °C (350 °F)	

Araldite® MY 720 / Aradur® 906 Formulation

Ratio	**parts by weight**
Araldite® MY 720	100
Aradur® 906	100*

* When adding an accelerator (DY 062), the hardener ratio (Aradur® 906) can be reduced to 100 pbw.

Procedure

Heat the resin to about 70 °C (158 °F), add the hardener and stir until homogeneous. If an accelerator is used with the system, cool the mixture to room temperature before adding the accelerator. For preparation of wet lay-up laminates, a pouring temperature between 40 °C (104 °F) and 80 °C (176 °F) is recommended.

Variation of Pot Life with Temperature:

System	**Viscosity End point***	**Pot Life Hours**		
	CPs, mPa s	**40 °C**	**60 °C**	**80 °C**
Araldite® MY 720	500	-	2	1-2
Aradur® 906	1.500	-	4-6	2
	5.000	10-18	6-9	2
Araldite® MY 720	500	-	0.5-1.5	0.5-1.0
Aradur® 906	1.500	-	1.5-4.0	1
Accelerator DY 062	5.000	3-11	3-6	1

* The pot life is defined as the time it takes for the system to reach the viscosity end point.

Curing

The system can be gelled in two hours @ 100 °C (212 °F) or one hour @ 120 °C (248 °F). Cure is achieved after eight hours @ 160 °C (320 °F) or three hours @ 180 °C (356 °F). Post-curing several hours @ 200 °C (392 °F) will develop higher heat distortion temperatures.

Cured Properties:

See comparison with Aradur® 907 under next formulation example.

FORMULATIONS (CONTINUED)

Araldite® MY 720 / Aradur® 907 Formulation

Ratio	**parts by weight**
Araldite® MY 720	100
Aradur® 907	100

Procedure

Heat the resin and hardener separately to 50-60 °C (122-140 °F); add the hardener to the resin and stir until homogeneous. The recommended pouring temperature for preparation of wet lay-up is between 40 °C (104 °F) and 80 °C (176 °F).

Variation of Pot Life with Temperature

	Viscosity End Point*		**Pot Life Hours**	
System	(cPs, mPa s)	40 °C	60 °C	80 °C
Araldite® MY 720	500	-	1.25	0.75
Aradur® 907	1.500	2-6	2-5	1.25
	5.000	4-12	4-7	1.50

* The pot life is defined as the time it takes for the system to reach the viscosity end point.

Initial Viscosity, cPs, mPa s

@ 40 °C (104 °F)	750
@ 60 °C (140 °F)	180
@ 80 °C (176 °F)	30

Cured Properties of Araldite® MY 720 / Aradur® 906 and 907:

	Araldite® MY 720 Aradur® 906	**Araldite® MY 720 Aradur® 907**
Deflection temperature	180-200 °C[(1)] 250-260 °C[(2)]	174-190 °C[(3)]
Deflection temperature 1 kHz @ 20 °C	3.7-3.9	3.6-3.8
Loss tangent (tan δ) 1 kHz @ 20 °C	0.005-0.01	0.009-0.013

[(1)] Curing for 20 minutes 1 hour @ 120 °C and 2 - 3 hours @ 180 °C
[(2)] Post cure 24 hours @ 200 °C
[(3)] Curing for 30 minutes @ 120 °C and 15 hours @ 180 °C. Post cure gives no advantage.

FORMULATIONS (CONTINUED)

Araldite® MY 720 Adhesive Formulations

Formulation, pbw	1	2
Araldite® MY 720	100	100
Aradur® 906	120	---
Methylene bisbenzamine (MDA)	---	44
Formvar 7/70*	22	14

* Monsato Company, St. Louis, MO

Preparation

Test panels prepared by spreading the adhesive systems, as solutions in acetone or methyl cellosolve, onto 2023 T, Alcad Aluminum. The test joints were 1 inch by ½ inch overlap. Cure conditions at constant pressure, 100 psi: 1hout at 140°C (248 °F) following by 2 hours at 180 °C (356 °F) and 2 hours at 200 °C (393 °F).

Average Breaking Tensile Shear Strength, Psi

Formulation	1	2	1	2	1	2
Test @	**25°C**	**25°C**	**150°C**	**150°C**	**200°C**	**200°C**
Initial	2400	2240	1460	1770	960	1520
192 hr. @ 200 °C	1824	2510	1460	2160	1346	1826
1000hr. @ 200 °C	1444	2364	1708	1836	1160	1512
Strength Retention	**%**	**%**	**%**	**%**	**%**	**%**
192 hr. @ 200 °C	76	112	100	122	140	120
1000hr. @ 200 °C	60	105	117	104	121	100

Araldite® MY 720 in Advanced Composites

Two basic processes are used for the manufacturing of composite prepregs, i.e., the hot melt and the solution impregnation process. An example of the latter method follows below.

Ratio:	**parts by weight**
Araldite® MY 720	100
Aradur® 976	44

Solution Preparation

Warm Araldite® MY 720 to 40 °C (104 °F) and stir in an Acetone/Methyl Ethyl Ketone mix (50:50) until a 30-35% solids weights solution is obtained. This solution can be cooled to room temperature or left at 40 °C. Then the Aradur® 976-1 is added and dissolved. Continue rapid stirring until the solution is homogeneous (a paint shaker will dissolve the Aradur® 976-1 in less time). This solution should be stored at >4 °C (40 °F) and is stable for six months.

Impregnating/Prepregging

Unidirection graphite yarn is passed through the above solution and wound onto a drum winder yielding a tape. It is advisable to measure the viscosity and gel time of the resin / hardener system from time to time in order to keep the properties of the resulting prepreg constant. The impregnated tape is air dried up to one hour and B-staged for three minutes at 120 °C (245 °F). Staging is usually done in a drying tower with different steps staging cycles depending on the efficiency of the drying tower. The resulting prepreg has good drape and tack characteristics and can be stored at 0 °C (32 °F) for 3-4 months. The best way of checking the quality of the finished prepreg is to determine the degree of flow and its solvent and resin content.

Molding and Curing of Prepregs

Generally, prepregs are adaptable to vacuum bag, pressure bag, matched die, press autoclave, and tape winding processing method, by combining heat and pressure for the curing. Resin flow and gel time are precisely controlled to fit each specific molding process.

The above prepreg example was compression molded with the following step cure cycle:

- Room temperature to 177 °C (350 °F) @ 3 °C (5 °F) per minute
- Hold 90 minutes @ 177 °C (350 °F)
- Apply 100 psi at the gel point (10-20 minutes into the hold)
- Cool to room temperature
- Post cure 4 hours @ 204 °C (400 °F)

Testing

All composite samples in question are based on 30 weight percent resin content, using the following test methods:

Test	**Panels**	**ASTM**
Short Beam Shear	20 ply 0°	D-2344
Flexural Properties	10 ply 0°	D-790
Matrix Tensile	14 ply oriented at +45/90 - 45/90 tested	D-3039 in 0° direction

Properties of Glasscloth Laminates

Wet lay-up 12 ply glasscloth laminate pressed to 3.2mm (1/8 inch) stops.

Ratio	**parts by weight**	**parts by weight**
Araldite® MY 720	100	100
Aradur® 906	120	---
Aradur® 907	---	110
Curing schedule	1.5 hr @ 120 °C 4 hr @ 180 °C	1 hr @ 100 °C 2 hr @ 180 °C
Resin to glass weight ratio	41:59	39:61
Flexural strength, psi	68.000-75.000	71.000-77.000
@ room temperature, MPa	469-517	489-531
Flexural strength, psi @ room temp. after 2 hrs immersion in boiling water, MPa	67.000-74.000 468-510	70.000-75.000 482-517
Flexural strength, psi	---	30.000-35.000
@ 170 °C, MPa	---	207-241
Flexural strength, psi	45.000-51.000	---
@ 190 °C, MPa	310-351	---
Flexural strength, psi @ 190 °C after conditioning 24 hours @ 190 °C, MPa	55.000-61.000 379	--- ---

PACKAGING & STORAGE

Araldite® MY 720 is packed in 145 pound drums. This resin has a minimum shelf life of 18 months if stored at a temperature of 40°F.

Storage Stability

Araldite® MY 720 Viscosity and Epoxy Value Stability

The table below compares the stability of Araldite® MY 720 when stored @ 25 °C (77 °F) and at 50 °C (122 °F) for a period of 12 months.

	Stored @ 25°C (77°F)		**Stored @ 50°C (122°F)**	
	Viscosity, cPs		**Viscosity, cPs**	
Months Stoarge	**(mPa s) 50 °C (122 °F)**	**Epoxy Value Eq/100g**	**(mPa s) 50 °C (122 °F)**	**Epoxy Value Eq/100g**
0 (initial)	15.130	0.80	15.130	0.80
1	17.245	0.79	14.867	0.78
2	14.734	0.76	20.024	0.75
4	15.968	0.80	45.197	0.74
5	16.438	0.80	73.443	0.75
8	16.706	0.79	108.027	0.73
7	13.890	0.79	---	---
9	18.432	0.78	---	---
10	22.213	0.77	---	---
11	23.741	0.74	---	---
12	24.955	0.77	---	---

Based on the above data, it is recommended to store Araldite® MY 720 @ 4 °C (40 °F). Huntsman stores all of the Araldite® MY 720 at this recommended storage temperature.

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.

The behaviour of the products referred to in this publication in manufacturing processes and their suitability in any given end-use environment are dependent upon various conditions such as chemical compatibility, temperature, and other variables, which are not known to Huntsman Advanced Materials. It is the responsibility of the user to evaluate the manufacturing circumstances and the final product under actual end-use requirements and to adequately advise and warn purchasers and users thereof.

Products may be toxic and require special precautions in handling. The user should obtain Safety Data Sheets from Huntsman Advanced Materials containing detailed information on toxicity, together with proper shipping, handling and storage procedures, and should comply with all applicable safety and environmental standards.

Hazards, toxicity and behaviour of the products may differ when used with other materials and are dependent on manufacturing circumstances or other processes. Such hazards, toxicity and behaviour should be determined by the user and made known to handlers, processors and end users.

Except where explicitly agreed otherwise, the sale of products referred to in this publication is subject to the general terms and conditions of sale of Huntsman Advanced Materials LLC or of its affiliated companies including without limitation, Huntsman Advanced Materials (Europe) BVBA, Huntsman Advanced Materials Americas Inc., and Huntsman Advanced Materials (Hong Kong) Ltd.
Huntsman Advanced Materials is an international business unit of Huntsman Corporation. Huntsman Advanced Materials trades through Huntsman affiliated companies in different countries including but not limited to Huntsman Advanced Materials LLC in the USA and Huntsman Advanced Materials (Europe) BVBA in Europe.

Araldite and Aradur are registered trademarks of Huntsman Corporation or an affiliate thereof.

Main Office :
Huntsman Advanced Materials (Switzerland) GmbH
Klybeckstrasse 200
4057 BASEL
Switzerland
+41 61 966 3333