

Technical Data Sheet

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HELOXY™ Modifier 71

Product Description

HELOXY™ Modifier 71 is an undiluted amber colored, low-viscosity liquid, aliphatic epoxy ester resin that imparts increased flexibility and resistance to thermal shock when blended with conventional liquid bisphenol A based epoxy resins.

Application Areas/Suggested Uses

- Adhesives
- Body solders
- Caulking and sealing compounds
- Electrical casting and encapsulating
- Glass to metal glazing compositions
- Large castings
- Tooling compositions
- Filament winding

Benefits

- A low-viscosity flexibilizer that serves as a viscosity depressing agent.
- A product that improves impact strength and toughness to a conventional liquid bisphenol A epoxy resin.

Sales Specification

Property	Units	Value	Test Method/Standard
Weight per Epoxide	g/eq	390-470	ASTM D1652
Viscosity at 25°C	cP	400-900	ASTM D445
Color	Gardner	10	ASTM D1544

Typical Properties

Property	Units	Value	Test Method/Standard
Physical form		Clear amber liquid	
Density @ 25 °C	lbs/gal	8.2	
Gravity, Specific @ 25 °C		0.98	
Flash point	°C	140	

Curing Agents

Blends of HELOXY Modifier 71 and EPON™ Resin 828 can be cured with all curing agents except the polyamine adducts (i.e., EPIKURE™ Curing Agent 3282), which produce incompatible cured products.

Depending upon the ratio of resin blend and the hardener used, the elongation at break can range as high as 200-300%, although 50-100% is more common. The use of HELOXY Modifier 71 as the sole resin in a formulation is not recommended. As in the case of most common flexibilizers, high concentrations of HELOXY Modifier 71 tend to decrease the superior chemical resistance of unmodified epoxy resin systems. Also, experience has shown that optimum tensile properties are normally reached with elevated temperature cures because there is a tendency for room temperature amine cured systems to age harden. Results obtained with various curing agent systems reported in the following sections are intended as a guide when selecting an EPON Resin 828/HELOXY Modifier 71/ EPIKURE Curing Agent system for your specific application.

Cure with Aliphatic Amine Curing Agents

Blends of HELOXY Modifier 71 and EPON Resin 828 cured with aliphatic amines yield a wide range of flexible to semi-rigid polymers. The final properties of these polymers are affected by the type of amine curing agent and the ratio of HELOXY Modifier 71 to EPON Resin 828. Although most of the data presented in this technical bulletin is based on systems cured at elevated temperatures, data is included which show that EPI-CURE Curing Agents 3223 and 3200 are effective room temperature curing agents.

Table 1 illustrates the effect of the type of amine curing agent on tensile properties of several HELOXY Modifier 71/EPON Resin 828 blends cured for 4 hours at 125 °C.

The effect of aging on tensile properties was studied using EPI-CURE Curing Agents 3223 and 3200 at a given ratio of HELOXY Modifier 71 to EPON Resin 828 (75% HELOXY Modifier/ 25% EPON Resin). The results of this study are summarized in Table 2. In this second table, you will note that a more complete cure is achieved when the system is force cured, versus curing at ambient temperatures.

In Table 3, gel times are displayed for various HELOXY Modifier 71 and EPON Resin 828 blends cured with either EPIKURE Curing Agent 3223 or EPIKURE Curing Agent 3200 determined in one quart masses. You will note that either HELOXY Modifier 71 alone or blends of HELOXY Modifier 71 and EPON Resin 828 impart somewhat slower curing than EPON Resin 828, as evidenced by the significantly longer gel times.

Cure with an Aromatic Diamine

In Table 4, data on blends of HELOXY Modifier 71 and EPON Resin 828 cured with ANCAMINE® Z (4,4'-Methylenedianiline), an aromatic diamine, are summarized. You will note a wide range of tensile properties can be achieved depending on the ratio of EPON Resin 828 and HELOXY Modifier 71.

Cure with Acid Anhydrides

As with amine curing agents, acid anhydrides can be used with HELOXY Modifier 71 or blends of this resin with EPON Resin 828 to produce tough, flexible polymers. Curing agent accelerators or catalysts, such as EPIKURE Curing Agent 3253 or benzyl dimethylamine (Aceto Corporation), are used to reduce the required

cure time and cure temperature. Table 5 displays data on HELOXY Modifier 71 cured with two popular acid anhydrides. Table 6 displays tensile properties of several blends of HELOXY Modifier 71 and EPON Resin 828 cured with NADIC Methyl Anhydride. Again, you will note that adjusting the flexibilizer level in the EPON Resin 828 allows broad latitude in formulating a system with the desired tensile strength and elongation properties.

Cure with Lewis Acids

Table 7 compiles tensile properties on a 75/25 by weight blend of HELOXY Modifier 71/ EPON Resin 828, cured with various levels of boron trifluoride monoethylamine. In this study, four parts of boron trifluoride monoethylamine appears to be the optimal level of Lewis acid.

Accelerators

Another study was undertaken to determine the effect of phenolic accelerators on the properties of HELOXY Modifier 71 systems. Our laboratory determined that a formulator could add up to 5 parts of phenol per 100 parts of HELOXY Modifier 71 with no effect on tensile elongation. Higher levels of phenol decrease tensile strength and exhibit a deleterious effect on chemical resistance.

FDA Status

HELOXY Modifier 71 is not listed under the Code of Federal Regulations (21 CFR); therefore, Hexion cannot recommend its use for food contact applications.

Performance Properties

Table 1 / Tensile properties of HELOXY Modifier 71 / EPON Resin 828 blends cured with aliphatic amine curing agents – Cure schedule: 4 hours at 125 °C

Resin Blend		Curing Agent	Concentration, phr ²	Tensile Properties ¹	
HELOXY Modifier 71	EPON Resin 828			Ultimate strength, psi	Ultimate elongation, %
100	0	EPIKURE Curing Agent 3223	5.2	150	39
80	20	EPIKURE Curing Agent 3223	6.3	1180	53
60	40	EPIKURE Curing Agent 3223	7.4	4240	6
40	60	EPIKURE Curing Agent 3223	8.4	5680	2
100	0	EPIKURE Curing Agent 3200	10.8	200	60
80	20	EPIKURE Curing Agent 3200	13.2	1540	99
60	40	EPIKURE Curing Agent 3200	15.5	4140	48
40	60	EPIKURE Curing Agent	18.0	8840	9

3200

¹ Based on ASTM D638. Crosshead speed: 20 inches/minute.² Parts of curing agent per 100 parts of resin.**Table 2 / Effect of aging on tensile properties of a HELOXY Modifier 71 / EPON Resin 828 system (75% HELOXY Modifier 71/25% EPON Resin 828)**

Curing Agent	Concentration phr ²	Cure Schedule		Aging Conditions		Tensile Properties ¹		
		Time	Temp. °C	Time	Temp. °C	Ultimate strength psi	Ultimate elongation psi	Crosshead speed in./min.
EPIKURE Curing Agent 3200	13.8	4 hours	125	–	–	2610	100	20
EPIKURE Curing Agent 3200	13.8	4 hours	125	3 days	100	2600	88	20
EPIKURE Curing Agent 3200	13.8	4 hours	125	8 days	100	2760	80	20
EPIKURE Curing Agent 3200	13.8	4 hours	125	30 days	100	3170	99	20
EPIKURE Curing Agent 3200	13.8	4 hours	125	30 days	23	2790	86	20
EPIKURE Curing Agent 3200	13.8	7 days	25	–	–	1900	100	2
EPIKURE Curing Agent 3200	13.8	7 days	25	13 days	25	1450	77	2
EPIKURE Curing Agent 3200	13.8	7 days	25	23 days	25	1350	75	2
EPIKURE Curing Agent 3223	6.6	7 days	25	–	–	1600	35	2
EPIKURE Curing Agent 3223	6.6	7 days	25	7 days	82	2500	25	2

¹ Based on ASTM D638.² Parts of curing agent per 100 parts of resin.**Table 3 /Gel times for various HELOXY Modifier 71/EPON Resin/EPIKURE Curing Agent combinations (one quart mass at room temperature)**

HELOXY Modifier 71	EPON Resin 828	Curing Agent	Concentration phr ¹	Gel Time minutes
100	0	EPIKURE Curing Agent 3200	10.5	185

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100	0	EPIKURE Curing Agent 3223	5.2	185
75	25	EPIKURE Curing Agent 3200	13.8	60
75	25	EPIKURE Curing Agent 3223	6.6	80
0	100	EPIKURE Curing Agent 3200	22.0	15-20
0	100	EPIKURE Curing Agent 3223	12.0	15-20

¹ Parts of curing agent per 100 parts of resin.

Table 4 / Tensile properties of HELOXY Modifier 71/EPON Resin 828 blends cured with ANCAMINE® Z (4,4'-Methylenedianiline) – Cure schedule: 2 hours at 80 °C, 3 hours at 150 °C

Resin Formulation			Tensile Properties ¹	
HELOXY Modifier 71	EPON Resin 828	ANCAMINE® Z Concentration, phr ²	Ultimate strength, psi	Ultimate elongation, %
100	0	10.0	430	86
80	20	12.3	2160	47
60	40	14.5	6770	13
40	60	16.3	9540	5
0	100	20.0	13000	5

¹ Based on ASTM D638. Crosshead speed: 20 inches/minute.

² Parts of curing agent per 100 parts of resin.

Table 5 /Tensile properties of HELOXY Modifier 71 cured with anhydrides

Curing Agent	Concentration phr ²	EPIKURE Curing Agent 3253, phr ²	Cure Schedule		Tensile Properties ¹	
			Time	Time., °C	Ultimate strength, psi	Ultimate elongation, %
NMA ³	47	1.8	3 hours	100	1250	70
NMA	23.5	2.1	3 hours	100	416	80
DDSA ⁴	69	4.6	2 hours	110	1280	120

¹ Based on ASTM D638. Crosshead speed: 2 inches/minute.

² Parts of curing agent or accelerator per 100 parts of resin.

³ NADIC Methyl Anhydride (Anhydrides and Chemicals, Inc.).

⁴ Dodecenylsuccinic Anhydride (Anhydrides and Chemicals, Inc.).

Table 6 / Tensile properties of HELOXY Modifier 71/EPON

Resin 828 blends cured with NADIC methyl anhydride ¹

HELOXY Modifier 71	EPON Resin 828	NMA, phr ³	Tensile Properties ²	
			Ultimate strength, psi	Ultimate elongation, %
100	0	44.8	800	70
80	20	54.6	5090	17
60	40	64.3	9500	6
40	60	72.3	8890	3

¹ 1% weight of benzyldimethylamine was added as a catalyst. The cure schedule was 4 hours at 120 °C, plus an additional 4 hours at 200 °C to assure maximum cure of the systems.

² Based on ASTM D638. Crosshead speed: 2 inches/minute.

³ Parts of curing agent per 100 parts of resin.

Table 7/ Tensile properties of HELOXY Modifier 71 and an HELOXY Modifier 71 / EPON Resin 828 blend cured with boron trifluoride monoethylamine¹

HELOXY Modifier 71	EPON Resin 828	BF ₃ MEA, phr ³	Cure Schedule		Tensile Properties ²	
			Time	Temp., °C	Ultimate strength, psi	Ultimate elongation, %
100	0	3	2 hours	120	130	35
			+1 hour	170		
			+3 hours	200		
75	25	3	2 hours	120	600	37
			+2 hours	200		
75	25	4	2 hours	120	630	43
			+2 hours	200		
75	25	5	2 hours	120	290	57
			+2 hours	200		

¹ Harshaw Chemical Company or Pacific Anchor Chemical.

² Based on ASTM D638. Crosshead speed: 2 inches/minute.

³ Parts of curing agent per 100 parts of resin.

Safety, Storage & Handling

Please refer to the MSDS for the most current Safety and Handling information.

Please refer to the Hexion web site for Shelf Life and recommended Storage information.

CAUTION: Hexion has found that HELOXY Modifier 71 will have a viscosity/epoxide equivalent weight increase of about 10% per month when stored at 30 °C (86 °F). As this occurs, the compatibility with other

epoxy resins, such as EPON Resin 828, will decrease. We recommend the product be stored at 13 °C (55 ° F), or lower, in order to maintain a reasonable shelf life. Also, the oldest production of HELOXY Modifier 71 should be consumed first. Typical storage/ stability time and temperatures are listed as follows:

Storage temperature	Estimated shelf life
55°F	1 year
75°F	5 months
90°F	2 1/2 months
105°F	1 month

It should be noted that, if the product is subjected to excessive heating while compounding, the shelf life could be significantly reduced. Your manufacturing processes should be modified accordingly.

Exposure to these materials should be minimized and avoided, if feasible, through the observance of proper precautions, use of appropriate engineering controls and proper personal protective clothing and equipment, and adherence to proper handling procedures. None of these materials should be used, stored, or transported until the handling precautions and recommendations as stated in the Material Safety Data Sheet (MSDS) for these and all other products being used are understood by all persons who will work with them. Questions and requests for information on Hexion Inc. ("Hexion") products should be directed to your Hexion sales representative, or the nearest Hexion sales office. Information and MSDSs on non-Hexion products should be obtained from the respective manufacturer.

Packaging

Available in bulk and drum quantities.

Contact Information

For product prices, availability, or order placement, please contact customer service:

www.hexion.com/Contacts/

For literature and technical assistance, visit our website at: www.hexion.com

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