CVC Thermoset Specialties

SUPPLYING SPECIALTY THERMOSETS WORLDWIDE

2019 Capabilities & Product Selection Guide

EPALLOY® Specialty Epoxy Resins

ERISYS® Epoxy Functional Reactive Modifiers

Hypro® Reactive Liquid Polymers

HyPox® Elastomer Modified Epoxy Resins

OMICURE® Curing Agents, Accelerators and Catalysts

Emerald Performance Materials®

Specialty Thermosets

Table of Contents

When your application requires high performance, turn to CVC Thermoset Specialties for resins, modifiers and additives.

CVC Thermoset Specialties provides specialty epoxies and other thermoset resins in demanding applications.

- Composites
- Adhesives
- Coatings
- Electrical Insulation

Automobile and aircraft frames, corrosion resistant pipes and valves, graphite golf club shafts and tennis racquet frames, electronic laminates, jet skis and marine hulls are just a few of the applications that benefit from our products.

The CVC Legacy

Emerald Performance Materials® created CVC Thermoset Specialties to combine the expertise of the Hypro® Reactive Liquid Polymer (RLP) Line, a proprietary technology developed by BFGoodrich, and the specialty epoxy materials from CVC Specialty Chemicals Inc. CVC Thermoset Specialties' technologies enhance thermoset performance in technically sophisticated applications around the world.

The Hypro RLP product family, previously sold under the Hycar® trade name, continues to grow and expand with new products and new application platforms in coatings, adhesives, composites, and electrical insulation.

CVC Specialty Chemicals had been creating and manufacturing specialty epoxy resins since 1982. Over the years, the company expanded its manufacturing and R&D capabilities, and its product offerings of specialty and elastomer-modified epoxies, epoxy-reactive modifiers, catalysts and accelerators for epoxy formulators.

Unique Chemistry Delivering Performance

CVC's specialty raw materials are critical building blocks for applications in coatings, adhesives, composites, civil engineering and electronics. These building blocks include five product platforms –

- **EPALLOY®** Specialty Epoxy Resins
- **ERISYS®** Epoxy Functional Reactive Modifiers
- **Hypro®** Reactive Liquid Polymers
- **HyPox®** Elastomer Modified Epoxy Resins
- **OMICURE®** Catalysts, Accelerators and Curing Agents

EPALLOY specialty epoxy resins deliver improved performance in high performance maintenance/marine coatings, adhesives, encapsulants and composites. CVC offers four families of specialty epoxy resins:

- EPALLOY 8000 - Phenol Novolac Epoxy
- EPALLOY 7000 - Bis-A Modified Novolac Epoxy and Blends
- EPALLOY 5000 - Cycloaliphatic Epoxy
- ERISYS - Resorcinol Epoxy and Resorcinol Novolac Epoxy

These specialty epoxy resins provide better chemical resistance, thermal performance, modulus, cure speed and UV resistance than standard liquid epoxy resins.

ERISYS epoxy functional reactive modifiers enhance performance, reduce viscosity, and improve handling and processing of epoxy formulations. CVC offers one of the broadest ranges of epoxy-functional modifiers:

- ERISYS GE 5, 6, 7 & 8 Series - Aliphatic Monoglycidyl Ethers
- ERISYS GE 10 Series - Aromatic Monoglycidyl Ethers
- ERISYS GE 20 Series - Aliphatic Diglycidyl Ethers
- ERISYS GE 30 Series - Aliphatic Triglycidyl Ethers
- ERISYS GS Series - Glycidyl Esters
- ERISYS GA Series - Glycidyl Amines
- ERISYS GE 40 & 60 Series - Aliphatic Polyglycidyl Ethers

Their benefits include enhanced flexibility and toughness, while maintaining chemical resistance and UV stability. Some of the products are high in bio-renewal content.

Hypro RLP Reactive Liquid Polymers are low molecular weight synthetic rubber with chemical functionality. These reactive additives incorporate rubber properties into epoxies, acrylates, vinyl esters and polyesters. They improve the toughness and low-temperature properties in coatings, adhesives, sealants and composites. Hypro reactive liquid polymers are butadiene homo-polymers and butadiene-acrylonitrile copolymers with terminal functionality.

- Hypro CTBN - Carboxyl-Terminated Butadiene-Acrylonitrile Copolymer
- Hypro ATBN - Amine-Terminated Butadiene-Acrylonitrile Copolymer
- Hypro ETBN - Epoxy-Terminated Butadiene-Acrylonitrile Copolymer
- Hypro VTBNX - Methacrylate(Vinyl)-Terminated Butadiene-Acrylonitrile Copolymer

The toughness shows in many attributes: crack resistance, fracture toughness, impact resistance, resilience, interlaminar adhesion, peel adhesion and thermo cycling.

HyPox elastomer modified epoxies enhance fracture toughness, low temperature mechanical properties, impact/crack/chip-resistance, peel strength and/or flexibility of epoxy coatings, adhesives, sealants and composites.

- HyPox R - Hypro CTBN Modified Epoxy Resin
- HyPox D - Dimer Acid Modified Epoxy Resin
- HyPox U - Urethane Modified Epoxy Resin

HyPox RF and RM elastomer-modified low viscosity epoxy resins combine high elastomer content with the convenience of handling epoxy resins.

OMICURE dicyandiamide, boron-based catalysts, and substituted urea catalysts are key components of latent, 1K heat cured epoxy systems.

- OMICURE - DDA Dicyandiamide
- OMICURE - Substituted Urea Accelerators
- OMICURE - Miscellaneous Catalysts, Curatives, Accelerators

They control the cure speed and reduce cure temperatures of dicyandiamide cured formulations and help optimize productivity, energy use, and ultimate physical properties.

EPALLOY® Specialty Epoxy Resins

Improved chemical resistance, thermal performance, modulus, cure speed and UV stability are just a few of the performance advantages with EPALLOY Specialty Epoxy Resins and blends over other standard resins. These products bring the critical difference to high performance coatings, composites and adhesives applications. Technologies and product lines include:

- Phenol Novolac Epoxy Resins (EPALLOY 8000 Series)
- Resorcinol and Resorcinol Modified Novolac Epoxy Resins (ERISYS RDGE & RN Series)
- Bis-A Modified Novolac Epoxy Resins (EPALLOY 7000 Series)
- Cycloaliphatic Epoxy Resins (EPALLOY 5000 Series)

Phenol Novolac Epoxy Resins

- Excellent chemical resistance
- High-functionality, cross-link density & T_g

	Product Name	Average Epoxy Functionality	Viscosity at 25°C, cP	EEW, g/eq	HCC, max %	Gardner Color, max	Description / Use
Bisphenol F Epoxy Resins	EPALLOY 8220	2.05	1,800 - 2,800	164 - 176	0.10	2	Lowest viscosity Bis-F resin. Near monomeric product for blends to prevent crystallization in Bis-A resins.
	EPALLOY 8230	2.15	3,500 - 4,700	164 - 176	0.10	3	Standard low viscosity non-crystallizing resin for excellent 100% solids coatings and composite applications. Resistant to 98% sulfuric acid and strong polar solvents.
Epoxy Phenol Novolac Resins	EPALLOY 8240	2.35	6,000 - 7,100	164 - 176	0.10	3	Lowest viscosity unmodified epoxy novolac available. Lower in viscosity than standard Bis-A resin. EPALLOY 8240 is preferred for secondary containment tank linings and industrial flooring.
	EPALLOY 8250	2.60	18,000 - 28,000	165 - 178	0.10	3	Mid-range functionality epoxy novolac with viscosity only slightly higher than standard Bis-A resin. For high temperature, highly corrosive applications. Preferred replacement for novolac based vinyl esters.
	EPALLOY 8280	2.8	1,100-1,700 @ 52°C	172 - 179	0.10	2	Mid-range functionality for improved T_g and corrosion resistance.
	EPALLOY 8330	3.60	20,000 - 30,000 @ 52°C	171 - 183	0.10	3	Standard epoxy novolac for highest chemical resistance and T_g.
	EPALLOY 8350	3.60	30,000 - 50,000 @ 52°C	175 - 184	0.10	3	Higher viscosity equivalent to 8330.
	EPALLOY 8370	3.90	15,000 - 35,000 @ 72°C	205 - 212	0.10	3	Highest functionality epoxy phenol novolac resin.

▸EPALLOY® Specialty Epoxy Resins (cont.)

Multifunctional and Faster Cure

	Product Name	Average Epoxy Functionality	Viscosity at 72°C, cP	EEW, g/eq	HCC, max %	Gardner Color, max	Description / Use
Multifunctional Epoxy Resin							
Modified Bisphenol A Epoxy Resin	EPALLOY 9000	3.0	5,500 - 6,500	160 - 180	0.8	2	High functionality, low melt viscosity resin for high temperature applications and T_g modification of other epoxy resins.

	Product Name	Viscosity at 52°C, cP	EEW, g/eq	HCC, max %	Gardner Color, max	Description / Use
Modified Bis-A Epoxy for Faster Cure						
Modified Bisphenol A Epoxy Resin	EPALLOY 7200	2,000 - 4,000	195 - 215	0.5	2	Modified BPA epoxy to provide for faster cure for all temperatures. Eliminates blushing in slower curing epoxies. Excellent for coatings.

Resorcinol Epoxy Resin

- Low-viscosity modifier
- Excellent chemical resistance

	Product Name	Average Epoxy Functionality	Viscosity at 25°C, cP	EEW, g/eq	HCC, max %	Gardner Color, max	Description / Use
Resorcinol Epoxy Resin	ERISYS RDGE	2.0	300 - 500	120 - 135	0.10	2	Resorcinol Diglycidyl Ether. Very low viscosity, high reactivity epoxy resin. Modifying resin for novolacs in corrosion resistant coatings and composites.

▸EPALLOY® Specialty Epoxy Resins (cont.)

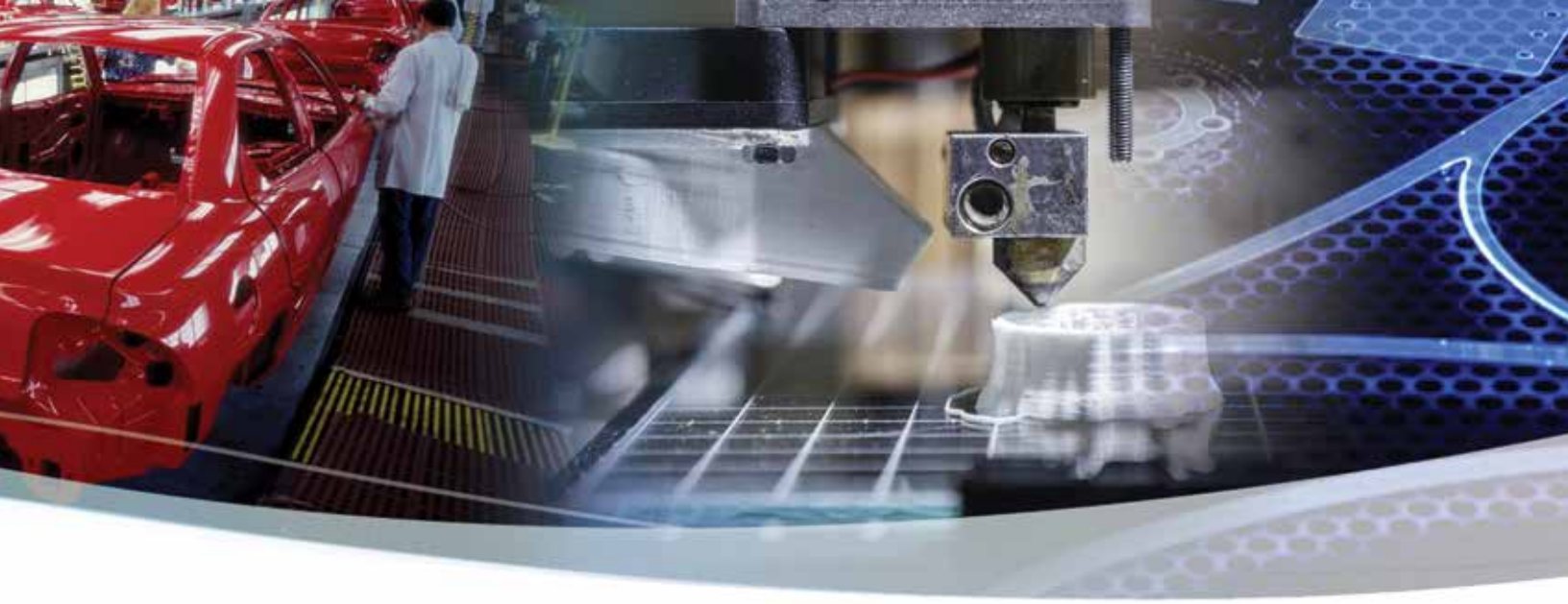
Resorcinol Modified Phenol Novolac Epoxy Resins

- Maximum chemical resistance

	Product Name	Average Epoxy Functionality	Viscosity at 25°C, cP	EEW, g/eq	HCC, max %	Gardner Color, max	Description / Use
Resorcinol Modified Phenol Novolac Epoxy Resins	ERISYS RF50	2.0	700 - 1,400	140 - 155	0.15	2	Non-crystallizing lowest viscosity resorcinol/phenol novolac epoxy resin.
	ERISYS RN25	2.4	5,000 - 6,500	152 - 165	0.10	5	Non-crystallizing medium viscosity resorcinol/phenol novolac epoxy resin.
	ERISYS RN3650	2.8	7,000 - 9,000	141 - 156	0.10	3	Highest functionality resorcinol modified phenol novolac epoxy resin. Maximum chemical resistance and T_g.

Bisphenol A/F Modified Phenol Novolac Epoxy Resins

	Product Name	Average Epoxy Functionality	Viscosity at 25°C, cP	EEW, g/eq	HCC, max %	Gardner Color, max	Description / Use
Bisphenol A Modified Phenol Novolac Epoxy Resins	EPALLOY 7138	2.0	5,500 - 7,500	175 - 185	0.10	1	Low viscosity non-crystallizing novolac modified Bis-A epoxy resin. Excellent replacement for high purity Bis-A resins in filament winding applications.
	EPALLOY 7170	2.05	7,000 - 10,000	177 - 187	0.10	2	Non-crystallizing Bis-A/F resin. 30% epoxidized Bis-F content.
Bisphenol F Modified Phenol Novolac Epoxy Resin	EPALLOY 9237-70	2.10	5,000 - 7,000	170 - 181	0.10	2	Non-crystallizing Bis-A modified Bis-F epoxy resin. Highest Bis-F content and highest T_g in this class.



▸EPALLOY® Specialty Epoxy Resins (cont.)

Cycloaliphatic Epoxy Resins

- Excellent for non-yellowing coatings, electrical insulating components
- Bis-A free epoxy resins

	Product Name	Viscosity at 25°C, cP	EEW, g/eq	HCC, max %	APHA Color, max	Description / Use
Hydrogenated Bisphenol A Epoxy Resins	EPALLOY 5000	1,300 - 2,500	210 - 230	0.2	100	UV Resistant, lower viscosity cycloaliphatic alternative to standard Bis-A resin. Applications include weatherable coatings as replacement to urethane coatings. Excellent adhesion to metal.
	EPALLOY 5001LC	2,000 - 4,500	200 - 220	0.3	3 Gardner	Faster cure version of EPALLOY 5000 through increased epoxy functionality. (Functionality = 2.4) Ideal for weatherable coatings.
Cycloaliphatic Glycidyl Ester	EPALLOY 5200	700 - 900	160 - 180	—	100	Low viscosity Cycloaliphatic Glycidyl Ester epoxy resin used mostly in applications for outdoor electrical insulation designed for medium and high voltage.

Other resin blends available upon request on a made-to-order basis.

Bisphenol A Epoxy Resin

- Medium Molecular Weight Bisphenol-A Epoxy Resin

	Product Name	Viscosity at 25°C, cP	EEW, g/eq	HCC, max %	Gardner Color, max	Description / Use
UNMODIFIED						
Undiluted Bisphenol A Epoxy Resin	EPALLOY 7192	O - V [1]	230 - 280	0.1	3	Undiluted high molecular weight semi-solid Bisphenol A epoxy resin well suited for tough, durable formulations with improved adhesion.

Other resin blends available upon request on a made-to-order basis.
(1) Gardner-Holdt Viscosity - 70% in Butyl Carbitol

▸EPALLOY® Specialty Epoxy Resins (cont.)

Resin Solutions

	Product Name	NV%	Viscosity at 25°C, cP	EEW on Solids, g/eq	HCC, max %	Gardner Color, max	Description / Use
EPALLOY 7200 SOLUTIONS *Modifying resin for high solids primers with fast tack free time.*							
Modified Bisphenol A Epoxy Resin Solutions	EPALLOY 7200 MIBK90	89 - 91	3,000 - 8,000	208 - 238	0.5	2	90% solids in Methyl Isobutyl Ketone
	EPALLOY 7200 X90	89 - 91	9,000 - 13,000	195 - 215	0.5	2	90% solids in Xylene
EPALLOY 8330 SOLUTIONS *Solutions of high functionality epoxy novolacs in solvents for film coatings.*							
Epoxy Phenol Novolac Solutions	EPALLOY 8330 MAK80	79 - 81	800 - 1,300	171 - 183	0.10	3	80% solids in Methyl n-Amyl Ketone
	EPALLOY 8330 MEK85	84 - 86	800 - 1,400	171 - 183	0.10	3	85% solids in Methyl Ethyl Ketone
EPALLOY 8350 SOLUTIONS							
Epoxidized Phenol Novolac Solutions	EPALLOY 8350 X80	79 - 81	1,200 - 3,000	175 - 184	0.1	3	80% solids in Xylene
EPALLOY 8370 SOLUTIONS							
Epoxidized Phenol Novolac Solutions	EPALLOY 8370 A85	84 - 86	5,000 - 7,000	205 - 212	—	3	85% solids in Acetone

Other resin solutions available upon request on a made-to-order basis.

ERISYS® Epoxy Functional Reactive Modifiers

ERISYS GE Series glycidyl ether modifiers are low molecular weight epoxy functional products based on alcohols, glycols and phenols. The product line covers a broad range of TSCA approved modifiers from monofunctional to multifunctional materials. Classified at right.

- Aliphatic Monoglycidyl Ethers (ERISYS GE 5, 6, 7 and 8 Series)
- Aromatic Monoglycidyl Ethers (ERISYS GE 10 Series)
- Aliphatic Diglycidyl Ethers (ERISYS GE 20 Series)
- Aliphatic Triglycidyl Ethers (ERISYS GE 30 Series)
- Aliphatic Polyglycidyl Ethers (ERISYS GE 40 and 60)
- Glycidyl Esters (ERISYS GS Series)
- Glycidyl Amines (ERISYS GA Series)

Monofunctional - Glycidyl Ethers

	Product Name	Viscosity at 25°C, cP	EEW, g/eq	Specific Gravity at 25°C, g/cc	HCC, max %	APHA Color, max	Flash Point °F	Description / Use
Aliphatic	ERISYS GE-5	2 max	145 - 155	0.91 - 0.92	0.10	100	>129	n-Butyl Glycidyl Ether. Most efficient epoxy functional diluent available.
	ERISYS GE-6	1 - 4	205 - 235	0.90 - 0.93	0.10	100	197	2-Ethylhexyl Glycidyl Ether. Excellent replacement for Butyl Glycidyl Ether as a low viscosity reactive diluent.
	ERISYS GE-7	1 - 6	220 - 235	0.89 - 0.91	0.05	100	>200	C_8-C_{10} Aliphatic Glycidyl Ether. Natural alcohol based. Used for high solids coatings, tooling and civil engineering applications.
	ERISYS GE-8	5 - 10	275 - 300	0.88 - 0.90	0.05	100	>200	C_{12}-C_{14} Aliphatic Glycidyl Ether. Natural alcohol based. Used in flooring, aggregate bonding and adhesives.
Aromatic	ERISYS GE-10	5 - 10	170 - 195	1.07 - 1.09	0.10	1 Gardner	>250	o-Cresyl Glycidyl Ether. Viscosity modifier for construction, flooring and casting. Excellent moisture tolerance.
	ERISYS GE-11	20 - 30	215 - 240	1.01 - 1.03	0.10	1 Gardner	>250	p-tertiary Butyl Phenyl Glycidyl Ether. Modifier for Bisphenol A resins to eliminate crystallization. Good electrical properties. Easier to handle vs. GE-10 or GE-13.
	ERISYS GE-13	4 - 7	150 - 165	1.10 - 1.13	0.10	2 Gardner	237	Phenyl Glycidyl Ether. Lowest viscosity aromatic modifier. Excellent for electrical applications and for preparing resin/curing agent adducts.

▸ERISYS® Epoxy Functional Reactive Modifiers (cont.)

Difunctional- Glycidyl Ethers

- Reduce viscosity – maintain physical properties better than monofunctional diluents
- Use higher concentrations

	Product Name	Viscosity at 25°C, cP	EEW, g/eq	Specific Gravity at 25°C, g/cc	HCC, max %	APHA Color, max	Flash Point °F	Description / Use
Aliphatic Diglycidyl Ether	ERISYS GE-20	10 - 18	125 - 137	1.05 - 1.07	0.10	100	>230	Neopentyl Glycol Diglycidyl Ether. Aliphatic difunctional modifier for filament winding, coatings and electrical applications.
	ERISYS GE-21	10 - 18	120 - 130	1.09 - 1.11	0.10	100	>230	1,4-Butanediol Diglycidyl Ether. Aliphatic difunctional modifier for improved flexibility over GE-20 at comparable viscosity.
	ERISYS GE-22	45 - 75	145 - 165	1.07 - 1.09	0.10	100	>230	Cyclohexanedimethanol Diglycidyl Ether. Cycloaliphatic difunctional modifier with outstanding weatherability. Excellent for machinery grouts and adhesives.
	ERISYS GE-25	15 - 23	143 - 156	1.06 - 1.08	0.10	100	300	1,6-Hexanediol Diglycidyl Ether. Aliphatic difunctional epoxy reactive diluent.
	ERISYS GE-29	275 - 500	250 - 300	1.46 - 1.51	0.50	5 Gardner	>230	Dibromo Neopentyl Glycol Diglycidyl Ether. High bromine containing, low viscosity, difunctional epoxy for flame retardant adhesives and encapsulants.
	ERISYS EGDGE	13 - 30	109 - 132	1.14 - 1.16	—	150	>266	Ethylene Glycol Diglycidyl Ether. Used as a crosslinker for acid functional acrylic polymers.

Flexibilizers

- Reduce viscosity, increase flexibility and elongation – improve impact resistance & toughening
- Lower T_g and modulus

	Product Name	Viscosity at 25°C, cP	EEW, g/eq	Specific Gravity at 25°C, g/cc	HCC, max %	Gardner Color, max	Flash Point °F	Description / Use
Aliphatic Di & Triglycidyl Ethers	ERISYS GE-24	60 - 70	310 - 330	1.05 - 1.07	0.10	60 APHA	>300	Polypropylene Glycol Diglycidyl Ether. Diepoxide of an aliphatic polyglycol used as a diluent and/or flexibilizer in high viscosity, brittle epoxy formulations.
	ERISYS GE-35	300 - 500	550 - 650	1.01 - 1.03	—	8	>200	Castor Oil Triglycidyl Ether. Low viscosity trifunctional flexibilizer. Provides increased impact and thermal shock resistance to epoxy formulations. Low moisture pick-up.
	ERISYS GE-35H	300 - 500	550 - 650	1.01 - 1.08	—	8	>200	Castor Oil Glycidyl Ether. Lower modulus version of GE-35.
	ERISYS GE-36	200 - 320	620 - 680	1.02 - 1.04	0.10	2	>200	Propoxylated Glycerin Triglycidyl Ether. Aliphatic trifunctional flexibilizer. Used in severe thermal cycling conditions.
	ERISYS GE-38	1,070 - 1,390	160 - 180	1.21 - 1.25	0.7	3	200	Polyglycerol-3-Polyglycidyl Ether. Flexible epoxy. Not TSCA registered.

▸ERISYS® Epoxy Functional Reactive Modifiers (cont.)

Multifunctional- Glycidyl Ethers

- Increase cross-link density and lower viscosity
- Use at much higher levels

	Product Name	Viscosity at 25°C, cP	EEW, g/eq	Specific Gravity at 25°C, g/cc	HCC, max %	Gardner Color, max	Flash Point °F	Description / Use
Aliphatic Triglycidyl Ether	ERISYS GE-30	100 - 200	135 - 150	1.14 - 1.16	0.10	100 APHA	>200	Trimethylolpropane Triglycidyl Ether. Low viscosity, high functional epoxy modifier. Excellent for 100% solids adhesives and coatings.
	ERISYS GE-31	200 - 300	150 - 170	1.19 - 1.21	0.10	4	>200	Trimethylolethane Triglycidyl Ether. Low viscosity high functional epoxy modifier. Use to increase crosslink density and enhance chemical resistance.
Polyfunctional Glycidyl Ether	ERISYS GE-40	900 - 1,200	156 - 170	1.27 - 1.33	1.5	2	>300	Pentaerythritol Glycidyl Ether. Medium viscosity tetrafunctional reactive modifier. Compatible with most standard epoxy resins at all concentrations. Not TSCA registered.
	ERISYS GE-60	8,000 - 18,000	160 - 195	1.27 - 1.30	0.50	7	>320	Sorbitol Polyglycidyl Ether. Aliphatic polyfunctional modifier to impart higher reactivity and crosslink density to epoxy resin formulations and crosslink acid functional polymers. Bis-A replacement alternative.
	ERISYS GE-61	4000 - 7000	160 - 195	–	–	3	–	Sorbitol Polyglycidyl Ether.100% water soluble used as a crosslinker in acrylics and polyurethane dispersions.

Glycidyl Esters

	Product Name	Viscosity at 25°C, cP	EEW, g/eq	Specific Gravity at 25°C, g/cc	HCC, max %	Gardner Color, max	Flash Point °F	Description / Use
Glycidyl Esters	ERISYS GS-110	5 -15	238 - 256	0.95 - 0.97	0.30	50 APHA	>250	Glycidyl Ester of Neodecanoic Acid. Efficient and economical diluent for viscosity reduction.
	ERISYS GS-120	400 - 900	390 - 470	0.97 - 1.00	2.0	9	>200	Diglycidyl Ester of Dimer Acid. Flexibilizing modifier for rigid epoxy resin systems.

Glycidyl Amine

	Product Name	Viscosity at 25°C, cP	EEW, g/eq	Specific Gravity at 25°C, g/cc	HCC, max %	Gardner Color, max	Flash Point °F	Description / Use
Glycidyl Amine	ERISYS GA-240	1,600 - 3,000	95 - 110	1.14 - 1.16	0.3	5	>420	Epoxidized meta-Xylenediamine. Will increase crosslink density of modified systems. An alternative to MY-720 in tetra-functional epoxy matrix. Safer alternative to polyaziridines in acrylic emulsions.

▸Hypro® Reactive Liquid Polymers (RLP)

Hypro Reactive Liquid Polymers (RLP) are synthetic rubber with chemical functionality. They incorporate rubber properties into brittle thermoset resins, adhesives, coatings and composites.

Hypro RLP combine the benefits of a low molecular weight butadiene-acrylonitrile rubber with terminal chemical functionality. They impart toughness, improve adhesion, and extend performance to low temperatures. The toughness shows in many attributes: crack resistance, fracture toughness, impact resistance, resilience, interlaminar adhesion, peel adhesion and thermal cycling.

▸The Hypro RLP Toughening Mechanism

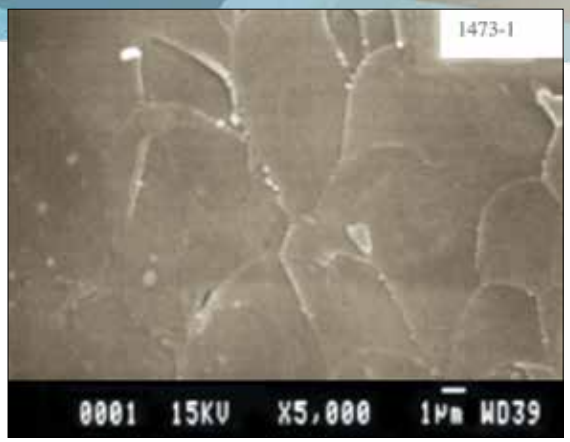
With the proper selection of acrylonitrile content, RLP will be soluble with thermoset resins. When the resin system cures, the Hypro RLP terminal functionality reacts into the thermoset resin, and the synthetic rubber precipitates to form discreet rubber particles. These micron-scale particles absorb strain energy. **Picture 1** shows a magnification of cured epoxy resin. It is a brittle, glassy resin. **Picture 2** shows the same epoxy modified with Hypro RLP. The discrete rubber particles provide the toughening and the epoxy matrix maintains the strength of the unmodified epoxy.

▸Typical Levels – Hypro RLP Toughened Systems

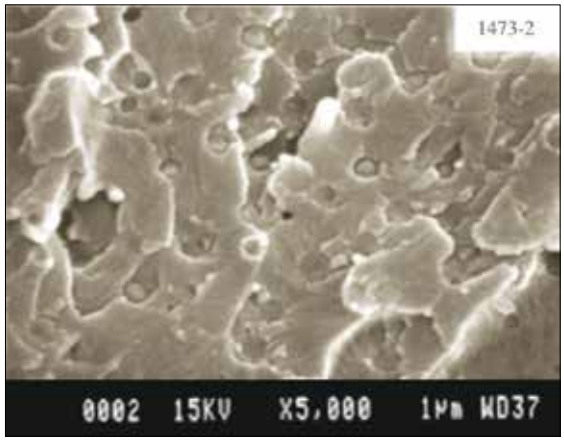
The optimum Hypro RLP level varies with the type of resin. The general guidelines are that most systems require 5 phr to provide enough rubber particles for significant toughening and that above 20 phr enough RLP remains soluble with the resin, and it acts as a flexibilizer in addition to a toughening agent.

Epoxy composites and structural adhesives typically have < 15 phr, and sealants and coatings typically have >25 phr. Unsaturated polyester composites tend to have < 3 phr, and vinyl ester tends to have 5-to-10 phr. Acrylic adhesives and sealants tend to have multiple toughening agents and the Hypro RLP may be up to 20 phr.

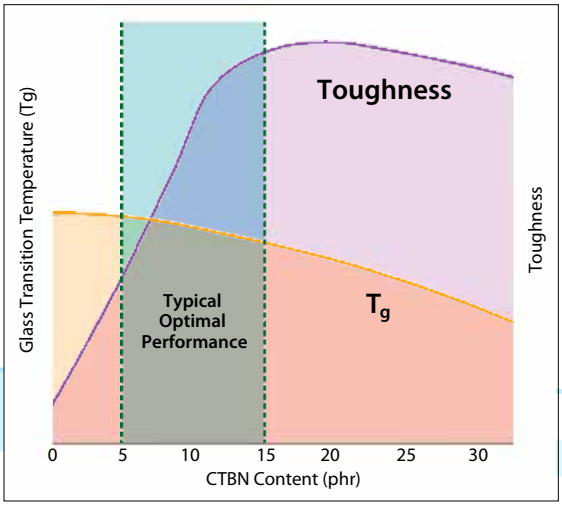
Figure 1 graphically depicts the general guideline for RLP incorporation, demonstrating the relationships between CTBN content, T_g and toughness.



Picture 1. *Cured, Unmodified Epoxy Resin*



Picture 2. *Hypro RLP-Modified Epoxy Resin*



Reference bibliography #12, 19 and 23

Figure 1. *General Guideline for Hypro RLP incorporation*

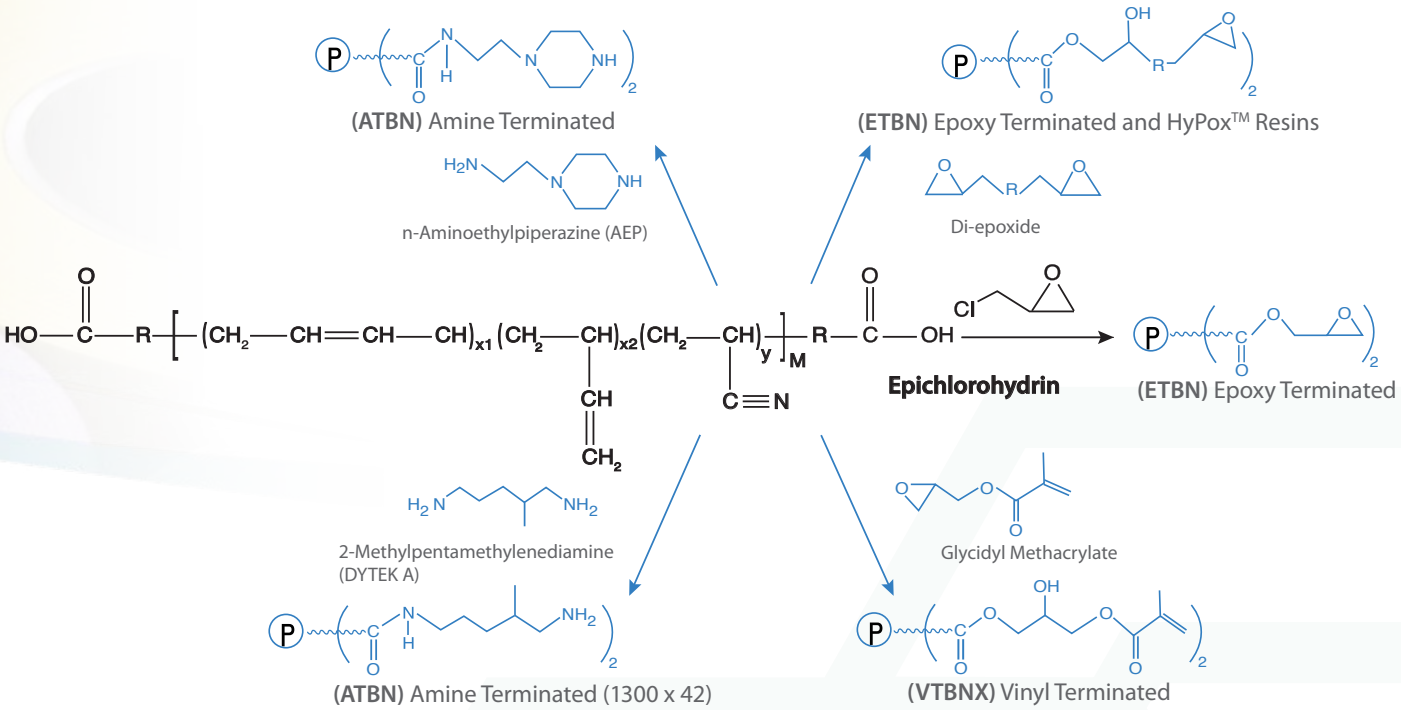


Figure 2. *Hypro CTBN and Derivitives Chemical Structure*

▸Hypro® Reactive Liquid Polymers (cont.)

Hypro CTBN typically requires chemical modification for effective incorporation into thermoset chemistries. Choice of terminal chemistry will depend on the application and end-use.

CVC Thermoset Specialties offers CTBN with alternative terminal reactivity (**Figure 2**) and the HyPox elastomer-modified epoxy resins for easy incorporation by formulators.

The Hypro CTBN can be used directly in epoxy-anhydride systems and in unsaturated polyester. Other thermoset systems require chemical modification.

Amine Terminated Butadiene-Acrylonitrile (ATBN) are typically used as co-curatives to epoxies and isocyanates in ambient-cure adhesives, coatings, sealants and in some heat-cured composites.

Methacrylate (Vinyl) Terminated Butadiene-Acrylonitrile (VTBNX) can be the primary toughening agent in acrylic adhesives, sealants, and composites and as complementary toughening agents in vinylester and in unsaturated polyester composites and adhesives.

Epoxy-Terminated Butadiene-Acrylonitrile (ETBN) include both glycidyl esters of a CTBN and epoxy adducts of CTBN. Some of these are sold as HyPox Elastomer-Modified Epoxy Resins. The Hypro ETBN and the HyPox resins are toughening agents for epoxy coatings, adhesives and composites. Other specialty applications are as toughening agents for cyanate esters and for unsaturated polyester. Many formulators perform custom reactions with the Hypro CTBN to meet the requirements of their systems.

Guidelines for Pre-Reacting Hypro® RLP Adducts

The Hypro CTBN synthetic rubbers are butadiene polymers and butadiene-acrylonitrile copolymers with carboxyl groups at the polymer chain ends. Most formulators use a pre-reacted CTBN to attain the optimum benefits. The pre-reaction may be a simple modification of the carboxyl to another reactive moiety or a reaction with resins (typically epoxy or vinyl ester) to make a master batch ready for dilution.

The typical process steps

1. Choose the epoxy resin most compatible with the final product.
2. Choose the Hypro CTBN for the desired compatibility and performance.
3. Combine a molar excess (10:1) or weight excess (60:40) of epoxy to CTBN
4. Heat and react under dry nitrogen with agitation until the acid number is <1.
    a. Typical temperatures range from 60°C with catalyst to 175°C for solid resins
    b. Typical time is 30 minutes-to-7 hours and varies with temperature and catalyst
5. Dilute with additional epoxy resin to the desired CTBN concentration, typically 6-to-12phr for composites and structural adhesives.

Processing options

- Catalysts increase the reaction rate, and the resultant adduct tends to increase in viscosity with time. Catalyst options include triphenyl phosphine (preferred), ethyltriphenylphosphoniumiodide, benzyl dimethyl amine, and other esterification catalysts.
- Epoxy resin can be co-reacted with CTBN to form an adduct. Addition of these adducts in the epoxy matrix increases ductility and toughness after cure.

Other processing notes

- Solid epoxy-CTBN adducts can be made by adducting solid epoxy resin or by advancing liquid epoxy and CTBN with BPA or by vulcanizing CTBN-epoxy adducts.
- Vinyl ester-CTBN adducts can be one step—combine epoxy resin, CTBN, and methacrylic acid and react or multi-step—react epoxy and CTBN before adding and reacting methacrylic acid. This typically requires a stabilizer.
- Water-dispersed CTBN-epoxy adducts for electrodeposition coating require several subsequent steps after producing the CTBN-epoxy adduct.

▸Hypro® Reactive Liquid Polymers (cont.)

Carboxyl-Terminated Butadiene (CTB) and Butadiene-Acrylonitrile (CTBN) Polymers

Carboxyl-terminated butadiene (CTB) and butadiene-acrylonitrile (CTBN) copolymers improve toughness, low-temperature properties, chemical and water resistance in epoxy, coating, vinyl ester, SMC/BMC, acrylic, plasitisol and other thermoset systems. Global standard as a chemical intermediate for adducts for thermoset systems.

Product Name	Acrylonitrile %	Viscosity* at 27°C, cP	Carboxyl Equiv. phr	Acid Number, mgKOH/g	Molecular Weight	Functionality	Gardner Color, max	Glass Transition, T_g, °C	Specific Gravity at 25°C, g/cc	Solubility Parameter, $(cal/cm^3)^{1/2}$	Description / Use
Hypro 2000X162 CTB	0	50,000	0.045	25	4,200	1.9	3	-77	0.907	8.14	Chemical intermediate to incorporate polybutadiene into other resins.
Hypro 1300X31 CTBN	10	65,000	0.050	30	3,800	1.9	5	-66	0.924	8.46	Copolymer with 10% acrylonitrile, increased compatibility with filled systems.
Hypro 1300X47 CTBN	10	6,750	0.050	30	3,800	1.9	5	-66	0.920	--	Hypro 1300X31 with 18% styrene, increased toughness, crack resistance, and adhesion promoter in UPE.
Hypro 1300X8 CTBN	18	135,000	0.052	29	3,550	1.9	9	-52	0.948	8.82	Most popular balance of compatibility, viscosity, and toughening.
Hypro 1300X13 CTBN	26	500,000	0.057	32	3,150	1.9	5	-39	0.960	9.15	Higher level of acrylonitrile, good compatibility with Bis-A, Bis-F, and phenol-novolac epoxies.
Hypro 1300X9 CTBNX	18	160,000	0.067	38	3,600	2.4	4	-52	0.955	8.87	CTBN with 2.4 functionality, excellent for composites and vinyl ester resins.
Hypro 1300X18 CTBNX	22	350,000	0.070	39	3,400	2.4	5	-46	0.961	8.99	CTBN with 2.4 functionality, excellent for composites and vinyl ester resins.

Note 1 - Hypro 1300X8 is also available as Hypro 1300X8F with an FDA compliant stabilizer.
Note 2 - Hypro 1300X13 is also available as Hypro 1300X13F with an FDA compliant stabilizer and as 1300X13NA (lower sodium version) and 1300X13CL (lower chloride version).
* Viscosity reflects mid-point.

▸Hypro® Reactive Liquid Polymers (cont.)

Amine-Terminated Butadiene (ATB) and Butadiene-Acrylonitrile (ATBN) Polymers

Amine-terminated butadiene (ATB) and butadiene-acrylonitrile (ATBN) copolymers enhance toughness, flexibility, low-temperature properties and adhesion to substrates in two part amine cured epoxies, and impact resistance and adhesion to substrates in two part coatings. Typical uses include structural adhesives, coatings and linings for improved corrosion resistance, construction joint sealers and mastics, powder coatings and filament-wound pressure vessels.

Product Name	Acrylonitrile %	Viscosity* at 27°C, cP	AHEW, g/eq	AEW,* g/eq	Amine Value, mgKOH/g	Molecular Weight	Functionality	Gardner Color, max	Glass Transition, T_g, °C	Specific Gravity at 25°C, g/cc	Free Amine, %	Description / Use
Hypro 2000X173 ATB	0	185,000	950	950	59	4,450	1.9	3	-80	0.915	4.0	Amine-terminated polybutadiene, lowest polarity, excellent compatibility with fillers, cross-links at double bonds, reacts at terminal amine moiety.
Hypro 1300X21 ATBN	10	160,000	1,200	1,200	47	4,050	1.9	8	-65	0.938	2.0	Co-curative in polyurethane and epoxy adhesives and sealants. Excellent low-temperature properties.
Hypro 1300X16 ATBN	18	200,000	900	900	62	3,800	1.8	8	-51	0.956	3.5	Most popular balance of compatibility, viscosity, and toughening. Excellent in adhesives, composites and coatings.
Hypro 1300X35 ATBN	26	500,000	700	700	80	3,500	1.8	10	-38	0.978	7.0	Highest level of acrylonitrile, best compatibility with polar components.
Hypro 1300X45 ATBN	18	375,000	1,850	1,850	30	3,800	1.8	8	-55	0.955	<0.1	Hypro 1300X16 with no residual amine (AEP), designed for electrodeposition and powder coatings.
Hypro 1300X42 ATBN	18	100,000	225	450	125	3,800	1.8	10	-59	0.942	10.0	Similar to Hypro 1300X16 with primary amine (2-methylpentamethylenediamine)–No AEP.

For Hypro 1300X42 ATBN, a primary amine terminated material, Weight per Active Hydrogen is AEW/2.

* Viscosity and AEW reflect mid-point.

▸Hypro® Reactive Liquid Polymers (cont.)

Epoxy-Terminated Butadiene (ETB) and Butadiene-Acrylonitrile (ETBN) Glycidyl Ester Polymers

Glycidyl-esters of butadiene (ETB) and butadiene-acrylonitrile (ETBN) copolymers incorporate 100% rubber toughening into epoxy matrix without pre-reaction or additional epoxy resin. Excellent for epoxy composites and adhesives. Contains no Bisphenol A or Bisphenol A Diglycidyl Ether (BADGE).

Product Name	Acrylonitrile %	Viscosity* at 27°C, cP	Viscosity* at 52°C, cP	EEW,* g/eq	Acid number, mgKOH/g	Molecular Weight	Gardner Color, max	Glass Transition, Tg, °C	Solids, %	Description / Use
Hypro 2000X174 ETB	0	20,000	3,500	2,800	<0.1	4,350	7	-77	100	Lowest viscosity epoxy-functional rubber toughener, good compatibility with fillers.
Hypro 1300X68 ETBN	18	300,000	20,000	2,500	<0.1	3,700	8	-52	100	Balanced viscosity and compatibility, excellent for mix-and-use epoxy adhesives and for composites.
Hypro 1300X63 ETBN	26	725,000	40,000	2,000	<0.1	3,300	11	-39	100	Best compatibility with Bis-A, Bis-F, and novalac epoxies for shelf stable systems.

Hypro 2000X174, 1300X68 and 1300X63 are developmental products and specification ranges are subject to change based on manufacturing history.
* Viscosity and EEW reflect mid-point.

Epoxy-Terminated Butadiene-Acrylonitrile (ETBN) Resin Adducts

Epoxy-terminated butadiene-acrylonitrile (ETBN) resin adducts with no excess epoxy. The Hypro ETBN have much higher rubber content when compared to HyPox CTBN-modified epoxies.

Product Name	Acrylonitrile %	Viscosity* at 25°C, cP	Viscosity* at 50°C, cP	EEW,* g/eq	Acid number, mgKOH/g	Molecular Weight	Specific Gravity at 25°C, g/cc	Elastomer Content, %	Solids, %	Description / Use
Hypro 1300X40 ETBN	18	1,450	N.A.	2,300	<1.5	4,230	0.945	40	50 (styrene)	Toughening agent for vinyl ester, acrylic, UPE resins and composites. Improves crack-resistance and appearance in Sheet Molding Compounds (SMC).

* Viscosity and EEW reflect mid-point.

▸Hypro® Reactive Liquid Polymers (cont.)

Methacrylate (Vinyl) Terminated Butadiene (VTB) and Butadiene-Acrylonitrile (VTBNX) Polymers

Methacrylate (vinyl) terminated butadiene (VTB) and butadiene-acrylonitrile (VTBNX) liquid rubber for low temperature toughness, impact resistance and improved resilience in acrylic adhesives, sealants and coatings and in vinyl ester composites. The new, LC versions have less color and are more stable for longer shelf life.

Product Name	Acrylonitrile %	Acid Number, mgKOH/g	Viscosity* @ 27°C, cP	Molecular Weight	Functionality	Gardner Color, max	Glass Transition, T_g, °C	Specific Gravity at 25°C, g/cc	Solubility Parameter, $(cal/cm^3)^{1/2}$	Solids, %	Description / Use
Hypro 2000X168LC VTB	0.0	4.0	80,000	4,450	1.9	3	-80	0.929	8.40	100	Lowest T_g, lowest viscosity, most effective for lower temperature properties. More stable, less color.
Hypro 1300X33LC VTBNX	18.0	4.0	250,000	3,900	2.4	4	-49	0.967	8.90	100	Best balance of viscosity, low temperature properties and improved adhesion. More stable, less color.
Hypro 1300X43LC VTBNX	21.5	4.0	400,000	3,700	2.4	5	-45	0.981	9.09	100	Excellent improvement in adhesion, resilience, toughness. More stable, less color.

Hypro 2000X168LC is a developmental product and specification ranges are subject to change based on manufacturing history. Properties in the table reflect target properties only.
* Viscosity reflects mid-point.

▸HyPox® Elastomer Modified Epoxy Resins

Elastomer modification to epoxy resins is a valuable way to merge the benefits of alternate polymer chemistry with the convenience of conventional 1 or 2 part epoxy handling and performance. CVC offers CTBN modification for toughening and chip resistance, Dimer Acid modification for flexibility and Urethane modification for adhesion to difficult surfaces.

These are grouped under the series designation:

- Dimer Acid Modified Epoxy Resins (HyPox D Series)
- Urethane Modified Epoxy Resins (HyPox U Series)
- CTBN Modified Resins (HyPox R Series)

Each resin system is further divided by resin base: "A" for Bisphenol A, "F" for Novolacs and "M" for Glycols

Dimer Acid Modified Epoxies

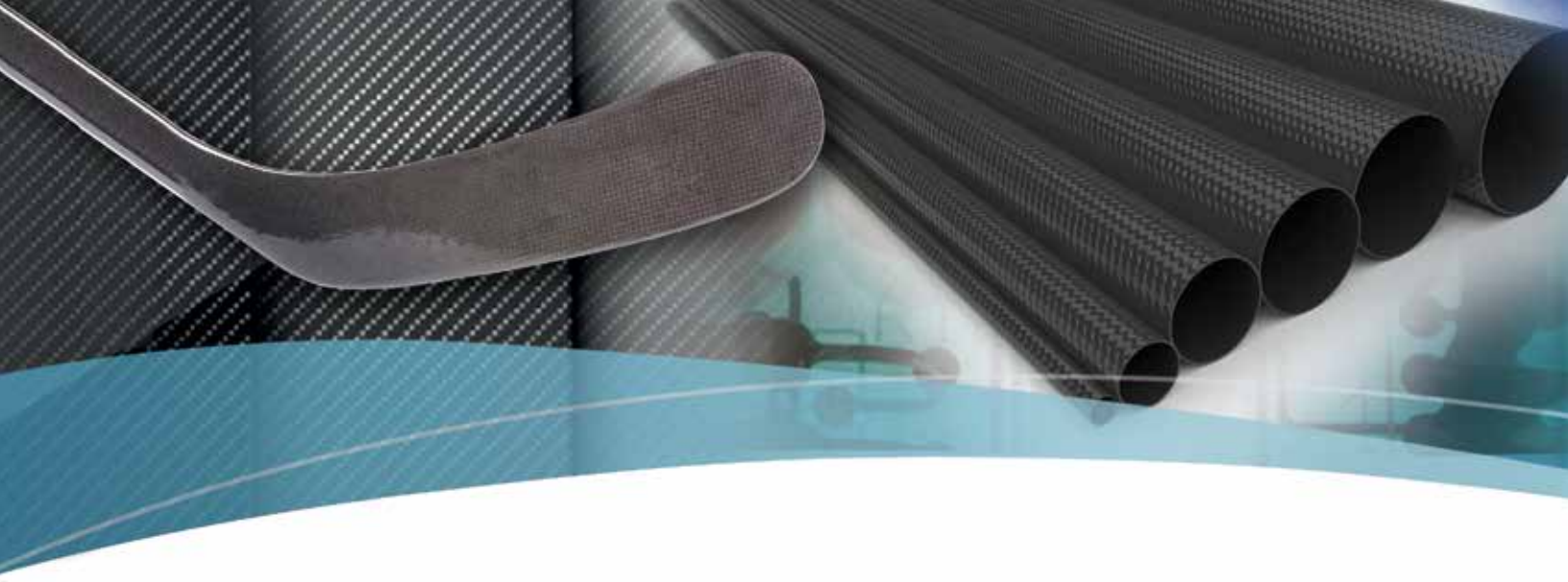
	Product Name	Elastomer Content %	Viscosity* at 52°C, cP	EEW,* g/eq	Gardner Color, max	Acid No., max	Description / Use
Dimer Acid Modified Epoxy Resin	HyPox DA323	40	50,000	660	12	0.1	Bis-A epoxy resin adduct with Dimer Acid. Semi-solid at room temperature. Improves impact resistance, thermal shock and has excellent compatibility with all standard resins and curing agents.

* Viscosity and EEW reflect mid-point.

Urethane Modified Epoxies

	Product Name	Elastomer Content %	Viscosity* at 25°C, cP	EEW,* g/eq	Gardner Color, max	Description / Use
Urethane Modified Epoxy Resin	HyPox UA10	12	650,000	215	2	Improved adhesion to vinyl and other elastomers.
	HyPox UA11	5	35,000	215	2	Improved adhesion to vinyl and other elastomers.

* Viscosity and EEW reflect mid-point.



▸HyPox® Elastomer Modified Epoxy Resins (cont.)

CTBN Modified Epoxies

	Product Name	Elastomer Content %	Viscosity* at 25°C, cP	EEW,* g/eq	Gardner Color, max	Acid Number, mgKOH/g	Description / Use
Bisphenol A Modified	HyPox RA 95	5 - 7	22,500 @ 52°C	200	4	0.2	Bis-A epoxy resin adduct with solid CTBN for good high-temperature performance and green strength. Is used as a tackifier for adhesives and composites.
	HyPox RA 840	40	190,000	340	10	0.1	Bis-A epoxy resin adduct with 1300X8 CTBN used as a reactive toughener to increase toughness, impact resistance, and peel adhesion in liquid Bis-A systems.
	HyPox RA 1340	40	450,000	350	10	0.1	Bis-A epoxy resin adduct with 1300X13 CTBN used as a reactive toughener to increase toughness, impact resistance, and peel adhesion. Excellent compatibility in liquid Bis-A systems.
	HyPox RA 16213	29	240,000 @ 27°C	265	—	1	Bis-A epoxy resin adduct with 2000X162 CTB and 1300X13 CTBN. Best combination of rubber toughening and solubility with liquid epoxy with excellent properties at -40°C with Dicyandiamide cured adhesives.
Bisphenol F Modified	HyPox RF 1320	20	38,000	215	6	0.1	Bis-F epoxy resin adduct with 1300X13 CTBN to increase toughness, impact resistance, and peel adhesion for low-viscosity epoxy phenol novolac systems.
	HyPox RF 1341	40	225,000	308	—	0.2	Bis-F epoxy resin adduct with 1300X13 CTBN. Higher rubber content for lower dosing level than RF1320 to increase toughness, impact resistance, and peel adhesion for low-viscosity epoxy phenol novolac systems.
	HyPox RF 928	20	55,000	210	10	0.1	Epoxy Phenol Novlac resin adduct with 1300X13 CTBN with 2.3 functionality. Increases toughness, impact resistance, and peel adhesion for medium-viscosity, higher T_g, epoxy phenol novolac systems.
	HyPox RF 933	20	150,000	220	10	0.1	Epoxy Phenol Novlac resin adduct with 1300X13 CTBN with 2.6 functionality. Highest functionality for best chemical and heat resistance to increase toughness, impact resistance, and peel adhesion.
Glycol Modified	HyPox RM 20	50	6,000	290	10	0.1	Neopentyl Glycol Diglycidyl ether adduct with 1300X8 CTBN having lower viscosity than liquid Bis-A epoxy resin. Increases flexibility, impact resistance, resilience to fatigue and improves adhesion.
	HyPox RM 22	50	20,000	340	10	0.1	Cyclohexanedimethanol Diglycidyl ether adduct with 1300X13 CTBN having higher viscosity and better compatibility than RM20. Increases flexibility, impact resistance, resilience to fatigue and improves adhesion.
Solid Bisphenol A Modified	HyPox RK 84L	32	—	1,375	Amber	—	Solid Bis-A epoxy resin modified 1300X13 CTBN useful as a reactive toughener for structural reinforcement in solid Bis-A systems.
	HyPox RK 820	20	—	950	Amber	—	Solid Bis-A epoxy resin modified 1300X8 CTBN useful as a reactive toughener for structural reinforcement in solid Bis-A systems.

* Viscosity and EEW reflect mid-point.

▸OMICURE® Curing Agents, Accelerators & Catalysts

Accelerating the cure speed or lowering the cure temperature is the role of these versatile additions. Whether the need is for acceleration of Dicyandiamide (Dicy) and anhydrides or catalytic cures of epoxy resins, a CVC product is available to fit your needs for latency or cure profile.

These products include:

- Dicyandiamide (OMICURE DDA Series)
- Substituted Urea Accelerators for Dicyandiamide (OMICURE U Series)
- Boron-Based Catalysts (OMICURE B Series)

Curing Agents

Dicyandiamide Curing Agent – Typical use levels in DGEBA from 5-10 phr.

- Common curative for 1k epoxy systems
  - composites and prepregs
  - automotive, adhesives and coatings

	Product Name	Onset Melting Point (°C)	Particle Size				Color	Typical Flow Control Content	Description / Use
			Mean Particle Size	10%	50%	90%			
Dicyandiamide Curing Agent	OMICURE DDA 5	207- 212	4µ	<2µ	<7µ	<10µ	White	2 to 3%	Ultra-fine particle size Dicyandiamide for the most critical applications. Provides for excellent dispersability, maximum reactivity, uniform cure, and low settling potential.
	OMICURE DDA 10	207- 212	12µ	<4µ	<11µ	<30µ	White	1.5 to 2.5%	Fine particle size with good dispersability, reactivity and uniform cure.
	OMICURE DDA 50	207- 212	21µ	<7µ	<16µ	<40µ	White	1.5 to 2.5%	Intermediate particle size product provides for cost effective, stable, one part systems for elevated temperature cure applications.

Aromatic Amine Curing Agent

	Product Name	MP, °C	Color	Use Level PHR	Gardner Color, max	Glass Transition, T_g °C	Description / Use
Aromatic Amine/ Curing Agent	OMICURE 33-DDS	167-175	Tan to Off-White	36	—	—	Safer replacement for MDA. 33-DDS cured systems can yield higher compressive strength, higher HDT and less brittleness than MDA.

▸OMICURE® Curing Agents, Accelerators & Catalysts (cont.)

OMICURE Substituted Urea Accelerators

Accelerators used with Dicyandiamide to lower required cure temperatures and increase speed of reaction

- Lower the reaction temperature and time for dicy-epoxy cure
  - reduces stability (shelf life) of mixed systems
- Optimum level ≈ 1-5 phr

	Product Name	Typical Peak Melting Point (°C)	Color	Use level PHR with Dicyandiamide(1)	Particle Size (percent through 325 screen)		Time to Double in Viscosity @ 25°C(2) (weeks)	Time to Cure to 95% Full Cure(3)		T_g (°C)(2)	Description / Use
					Regular Grade	M Grade (micronized)		at 120°C	at 140°C		
Substituted Urea Accelerators	OMICURE U-405M	126 - 136	off-white	1 - 5	80	95	10	22	9	118	Phenyl Dimethyl Urea
	OMICURE U-24M	180 - 195	off-white	1 - 5	80	95	10	20	7	127	2,4-Toluene bis Dimethyl Urea - Isomer Grade
	OMICURE U-410M	180 - 195	off-white	1 - 5	80	95	10	18	7	123	80/20 Toluene bis Dimethyl Urea - Technical Grade
	OMICURE U-52M	220 - 230	off-white	1 - 5	80	95	55	27	12	127	4,4'-Methylene bis (phenyl dimethyl urea) Isomer Grade
	OMICURE U-35M	190 - 210	off-white	1 - 5	80	95	134	46	15	124	Cycloaliphatic bisurea
	OMICURE U-210M (Monuron)	172 - 182	off-white	1 - 5	80	95	16	29	15	121	N-(4-chlorophenyl) N, N-Dimethyl Urea

(1) with DGEBA (EEW=190) and dicy
(2) substituted urea @ 3phr; dicy @ 8phr; with DGEBA (EEW=190)
(3) Cure - DSC scan at 20°C/minute to 275°C, substituted urea @ 3phr; dicy @ 8phr, with DGEBA (EEW=190)
(4) some unmicronized products are available as made to order

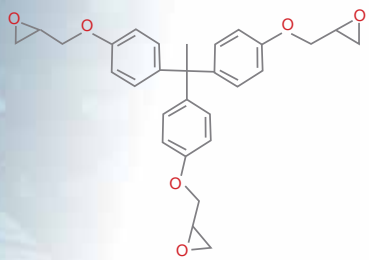
Catalysts

	Product Name	MP, °C	Color	Use Level PHR	Gardner Color, max	Glass Transition, T_g, °C	Description / Use
Curing Agents and Accelerators	OMICURE 24EMI	liquid	Brown	0.1-10(1)	16	—	Accelerator for Anhydrides and catalyst for high temperature epoxies. Faster reactivity vs. BDMA or tertiary amine substituted phenols.
	OMICURE BC-120	25-35	Amber/Brown	0.1-10(1)	—	130(2)	Can be used as sole curing agent or as accelerator for Anhydrides, Dicyandiamide or Aromatic Amines. Clear, compatible formulations. Very long room temperature shelf life.

(1) low levels to accelerate acid anhydrides, mid-range or higher levels as sole curing agent. Determine optimum concentration empirically.
(2) with DGEBA, EEW=190; @ 8phr

Chemical Structures

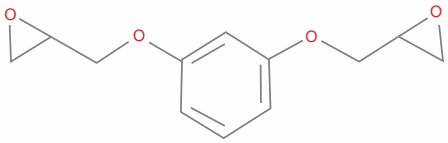
MULTIFUNCTIONAL EPOXY



EPALLOY® 9000

Tris hydroxyl phenyl ethane
CAS no: 87093-13-8

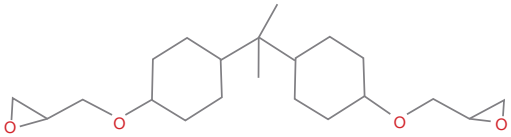
RESORCINOL EPOXY RESIN



ERISYS® RDGE, RDGE-H

Resorcinol diglycidyl ether
CAS no: 101-90-6

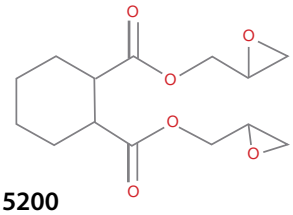
HYDROGENATED BISPHENOL A EPOXY RESIN



EPALLOY® 5000

Hydrogenated Bisphenol-A diglycidyl ether
CAS no: 30583-72-3

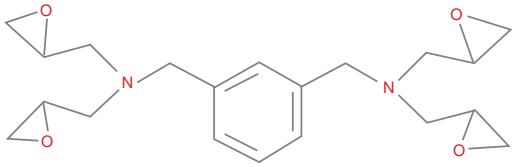
CYCLOALIPHATIC GLYCIDYL ESTER



EPALLOY® 5200

Hexahydro phthalic acid diglycidyl ester
CAS no: 5493-45-8

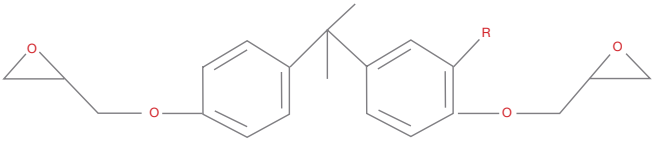
GLYCIDYL AMINE



ERISYS® GA 240

Glycidyl amine of m-xylenediamine
CAS no: 63738-22-7

MODIFIED BISPHENOL A EPOXY RESIN



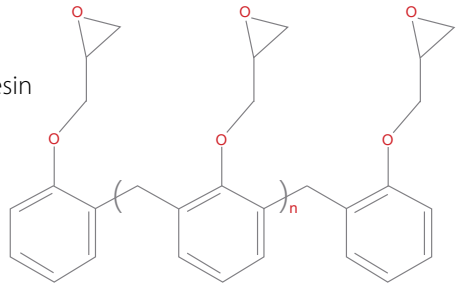
EPALLOY® 7200

Modified Bisphenol-A diglycidyl ether

PHENOL NOVOLAC EPOXY RESINS

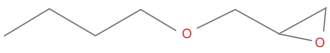
EPALLOY® 8000 Series

Phenol novolac epoxy resin



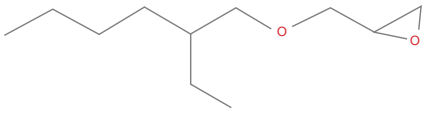
▸Chemical Structures (cont.)

ALIPHATIC MONOGLYCIDYL ETHERS



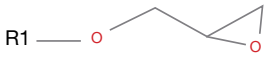
ERISYS® GE 5

n-Butyl glycidyl ether
CAS no: 2426-08-6



ERISYS® GE 6

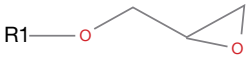
2-Ethyl hexyl glycidyl ether
CAS no: 2461-15-6



R1 = C8-C10

ERISYS® GE 7

C_8-C_{10}- glycidyl ether
CAS no: 68609-96-1

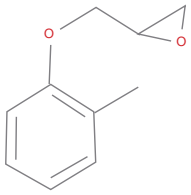


R1= C12-C14

ERISYS® GE 8

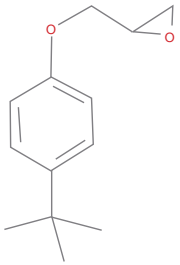
C_{12}-C_{14} glycidyl ether
CAS no: 68609-97-2

AROMATIC MONOGLYCIDYL ETHERS



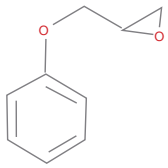
ERISYS® GE 10

Cresyl glycidyl ether
CAS no: 2210-79-9



ERISYS® GE 11

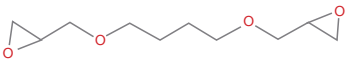
p-tert butyl glycidyl ether
CAS no: 3101-60-8



ERISYS® GE 13

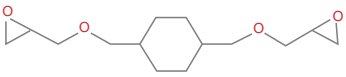
Phenyl glycidyl ether
CAS no: 122-60-1

ALIPHATIC DIGLYCIDYL ETHER MODIFIERS



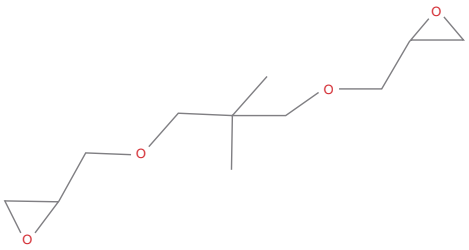
ERISYS® GE 21

1,4-Butanediol diglycidyl ether
CAS no: 2425-79-8



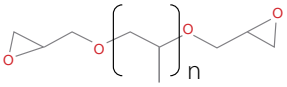
ERISYS® GE 22 & 22S

1,4-Cyclohexane dimethanol diglycidyl ether
CAS no: 14228-73-0



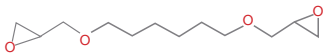
ERISYS® GE 20

Neopentyl glycol diglycidyl ether
CAS no: 17557-23-2



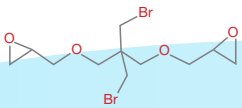
ERISYS® GE 24

Polypropylene glycol(400) diglycidyl ether
CAS no: 26142-30-3



ERISYS® GE 25

1,6-Hexanediol diglycidyl ether
CAS no: 16096-31-4



ERISYS® GE 29

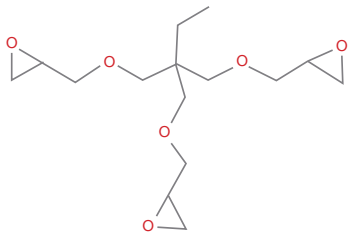
Dibromo Neopentyl glycol diglycidyl ether
CAS no: 31452-80-9

ERISYS® EGDGE

Ethylene glycol diglycidyl ether
CAS no: 2224-15-9

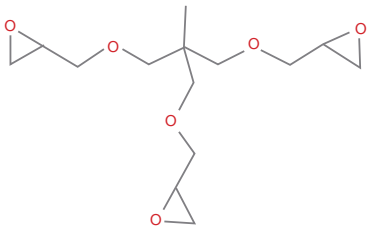
Chemical Structures (cont.)

ALIPHATIC TRIGLYCIDYL ETHER MODIFIERS



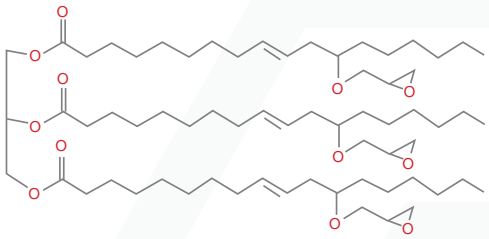
ERISYS® GE 30

Trimethylol propane triglycidyl ether
CAS no: 30499-70-8



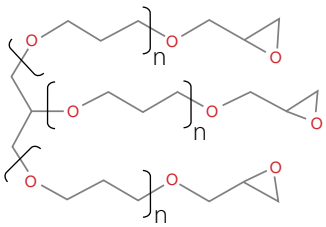
ERISYS® GE 31

Trimthylol ethane triglycidyl ether
CAS no: 68460-21-9



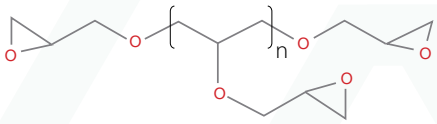
ERISYS® GE 35 & 35H

Castor oil glycidyl ether
CAS no: 74398-71-3



ERISYS® GE 36

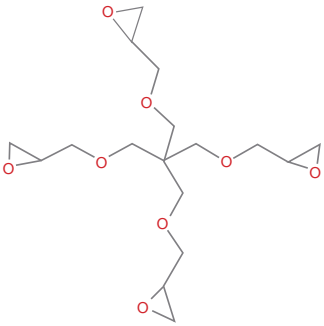
Propoxylated glycol triglycidyl ether
CAS no: 37237-76-6
Approximate MW = 2000



ERISYS® GE 38

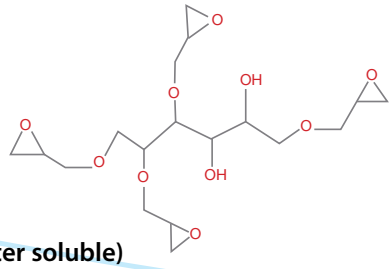
Poly glycerol-3- polyglycidyl ether
CAS no: 118549-88-5

POLYFUNCTIONAL GLYCIDYL ETHER



ERISYS® GE 40

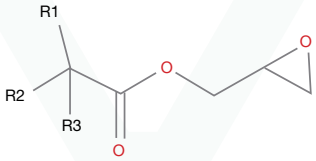
Pentaerythritol polyglycidyl ether
CAS no: 30973-88-7



ERISYS® GE 60 &
GE 61 (100% water soluble)

Sorbitol polyglycidyl ether
CAS no: 68412-01-1

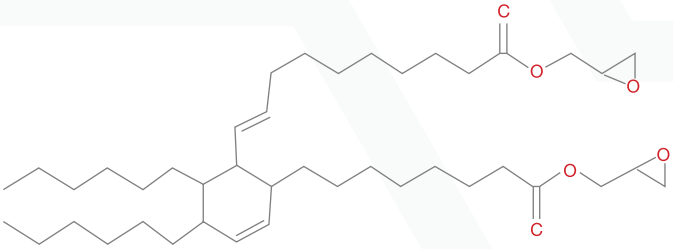
GLYCIDYL ESTER MODIFIERS



R1=1, R2+R3= 7

ERISYS® GS 110

Glycidyl ester of neodecanoic acid
CAS no: 26761-45-5



ERISYS® GS 120

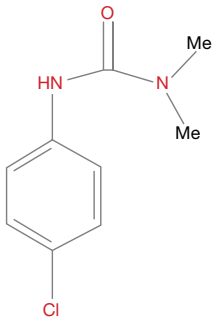
Dimer Acid Diglycidyl Ester
CAS no: 68475-94-5

Chemical Structures (cont.)

OMICURE® SUBSTITUTED UREA ACCELERATORS

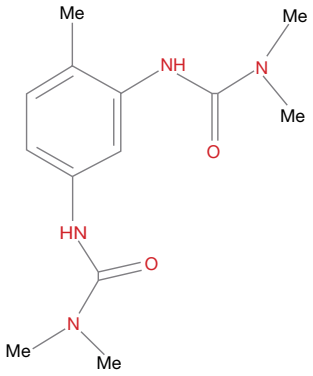
OMICURE® U-210M

CAS no: 150-68-5



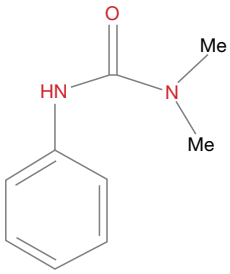
OMICURE® U-24M & U-410M

CAS no: 17526-94-2



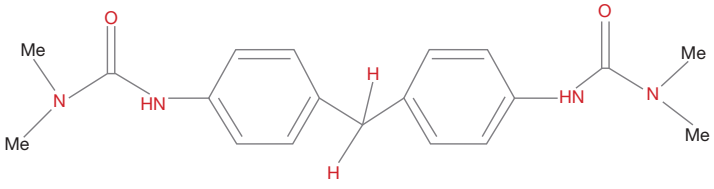
OMICURE® U-405M

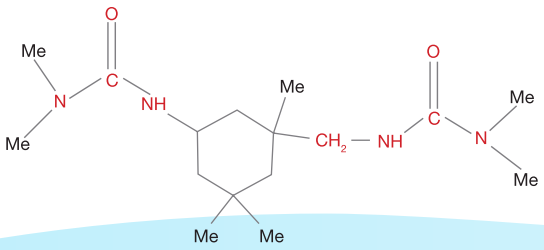
CAS no: 101-42-8



OMICURE® U-52M

CAS no: 10097-09-3





OMICURE® U-35M

CAS no: 39992-90-0

Contact Us

CVC Thermoset Specialties

CVC offers assistance to solve the most demanding applications. Whether you need to develop a 100% solids coating, an impact-resistant composite, one-component structural adhesive, a performance latex coating, or flexible potting compound, CVC can bring innovative products and technology to meet your need with our strong technical support and a diverse experience base.

Contact us for more information and solutions to your formulating challenges!

Website: **www.cvcthermoset.com**
Phone: (856) 533-3000
Toll Free: (800) 296-0040
Fax: (856) 533-3003

Emerald Performance Materials

At Emerald, our aim is to provide applications expertise and solutions that deliver extraordinary performance, value, and quality to our customers. Emerald's two business groups and six operations around the world offer a wide range of consumer and industrial specialties, as well as applications support to help you produce market-leading products.

For more information, visit **www.emeraldmaterials.com**

Emerald Kalama Chemical

Emerald Kalama Chemical offers a wide spectrum of material solutions that bring value and performance to adhesives, foods, beverages, fragrances, cosmetics, home care, rubber, vinyl, and other consumer and industrial products. We are recognized for our extensive market and applications expertise and work with our customers to innovate new chemistries, meet consumer demands, and stay ahead of shifting regulations.

Contact Emerald Kalama Chemical for more information.

Website: **www.emeraldkalama.com**
Phone: (360) 954-7100
Fax: (360) 954-7201

CVC Thermoset Specialties Sales & Distribution Network

UNITED STATES

Northeast

Bedford Specialty Sales, Inc.
Shirley, MA
Tel (978) 425-6214
Web: www.bedfordsales.com

E.M. Sullivan Associates, Inc.
Broomall, PA
Tel (610) 725-8717
Web: www.emsullivan.com

Gillen Company, LLC
Cuddy, PA
Tel (412) 257-3300

Southeast

Kohl Marketing
Roswell, GA
Tel (770) 753-4979
Web: www.kohlmarketing.com

Midwest

Cal-Chem
Royal Oak, MI
Tel (248) 268-4652
Web: www.cal-chemusa.com

Cemsac Corporation
Ellisville, MO
Tel (636) 391-2600
Web: www.cemsac.com

Dar-Tech, Inc.
Maple Heights, OH
Tel (800) 228-7347
Web: www.dar-techinc.com

Resin Sales, Ltd.
Northbrook, IL
Tel (847) 564-0248
Web: www.resinsalesltd.com

West

Dowd and Guild, Inc.
San Ramon, CA
Tel (925) 820-7222
Web: www.dowdandguild.com

CANADA

Chemroy, an Azelis Company
Brampton, Ontario
Tel (905) 789-0701
Web: www.chemroy.com

BRAZIL

Kryll Advanced Materials
São Paulo, Brazil
Tel +55 11 2729 6362
Tel +55 11 2729 6361
Web: www.kryll.com.br

MEXICO

GTM Chemicals
Mexico City, Monterrey,
Guadalajara & Tijuana
Tel +52 55 5321 5700
Web: www.gtmchemicals.com

ASIA PACIFIC

Brenntag Australia/New Zealand
Sydney, Australia
Auckland, New Zealand
Tel/Australia +61 3 9559 8333
Tel/New Zealand +64 9 275 0745
Web: www.brenntag-asia.com

Heng Hsin Company, Ltd.
Taipei, Taiwan, R.O.C.
Tel +886 2 2541 8641
Web: www.henghsin.com.tw

Megachem Ltd.
Singapore/Malaysia/Indonesia
Tel +65 6933 9999
Web: www.megachem.com

Megachem Specialty Chemicals (I) Pvt. Ltd.
Mumbai, India
Tel +91 22 4026 0957
Web: www.megachem.com

Chori Glex Co. Ltd.
Japan
Tel/Tokyo +81 3 5715 4350
Tel/Osaka +81 6 6203 7763
Web: www.c-glex.co.jp

Shenzhen Jiadida New Technology Materials Co. Ltd.
Shenzhen, China
Tel/Shenzhen +86 755 8212 4697
Tel/Shanghai +86 21 5236 3391
Web: www.jiadida.com

Trachem Corporation
Seoul, Korea
Tel +82 2 2248 6290
Web: www.trachem.com

EUROPE

Azelis Nordics
Lyngby, Denmark
Tel +45 4526 3333
Web: www.azelis.com

Azelis Italia S.p.A.
Milan, Italy
Tel +39 02 484791
Web: www.azelis.it

Richard Baker Harrison Ltd.
Manchester, UK
Tel +44 0 161 938 3000
Web: www.rbhltd.com

IMCD Benelux BV
Rotterdam, The Netherlands
Tel +31 10 290 8600
Web: www.imcd.nl

IMCD Benelux NV
Mechelen, Belgium
Tel +32 15 29 49 50
Web: www.imcd.be

IMCD Deutschland GmbH & Co. KG
Cologne, Germany
Tel +49 221 77 65 0
Web: www.imcd.de

IMCD Espana Especialidades Quimicas, S.A.
Barcelona, Spain
Tel +34 93 241 38 58
Web: www.imcd.es

IMCD France SAS
Cedex, France
Tel +33 1 49 33 31 31
Web: www.imcd.fr

IMCD Switzerland AG
Zurich, Switzerland
Tel +41 43 244 80 00
Web: www.imcd.ch

USNER GmbH
Hallein, Austria
Tel +43 6245 81 516
Web: www.usner.at

MIDDLE EAST/SOUTH AFRICA

Petrus Chemicals & Materials (1986) Ltd.
Herzelia, Israel
Tel +972 9 9587670, ext. 228
Web: www.petrus.co.il

IMCD SA (Pty) Ltd.
Johannesburg, S. Africa
Tel +27 11 570 4260
Web: www.imcdgroup.com

Sales Offices

AMERICAS
CVC Thermoset Specialties
844 N. Lenola Road
Moorestown, NJ 08057

Tel (856) 533-3000
Fax (856) 533-3003

ASIA PACIFIC
CVC Thermoset Specialties
1708 Shui On Centre
6-8 Harbour Road
Wanchai, Hong Kong

Tel +852 2598-7990

EUROPE/MIDDLE EAST/AFRICA
CVC Thermoset Specialties
Mijnweg 1
6167 AC Geleen
Netherlands

Tel +31 88 888 0500

Web: www.cvcthermoset.com

019 –August 2019