

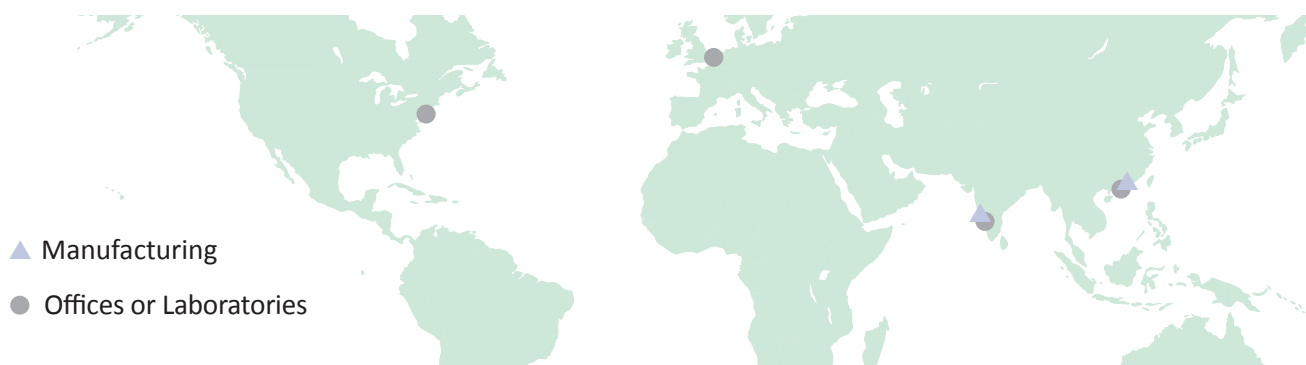


Cardolite
Chemistry for Tomorrow

| Coating Products Portfolio



About Us



Cardolite Corporation is a privately held manufacturer of a large variety of products derived from cashew nutshell liquid (CNSL), a renewable natural resource. The unique properties of CNSL are used to develop and produce a wide range of specialty curing agents, resins, and diluents for the coatings, adhesives, composites, foam and friction industries.

For over 35 years, Cardolite has focused on the production of high quality CNSL-based products with advanced CNSL technology manufacturing facilities in the world located in Zhuhai, Guangdong (China), and Mangalore, Karnataka (India). These Cardolite facilities adhere strictly to local and best practice health, safety, environmental, and security standards and are ISO 9000 registered. With sales offices, representatives, and distribution facilities in the Americas, Europe, and Asia, Cardolite prides itself on delivering high quality products and services across the globe.

Markets & Technologies

To support our customers in solving industry challenges, Cardolite continues to invest heavily on innovation that leverages the unique properties of CNSL technology. Cardolite operates three advanced research and technical service laboratories in the USA, China and India that use CNSL as a primary building block to develop and evaluate performance of specialty materials with demonstrated advantages over some traditional coating chemistries.



Product Lines

- Epoxy Curing Agents
 - Phenalkamines
 - Phenalkamides
 - Polyamides
 - Modified cycloaliphatic amines
- Epoxy Resins & Modifiers
 - Diluents & Accelerators
 - Flexibilizers
 - Hydrocarbon Resins
- Polyol and Diol Resins

Coatings Markets

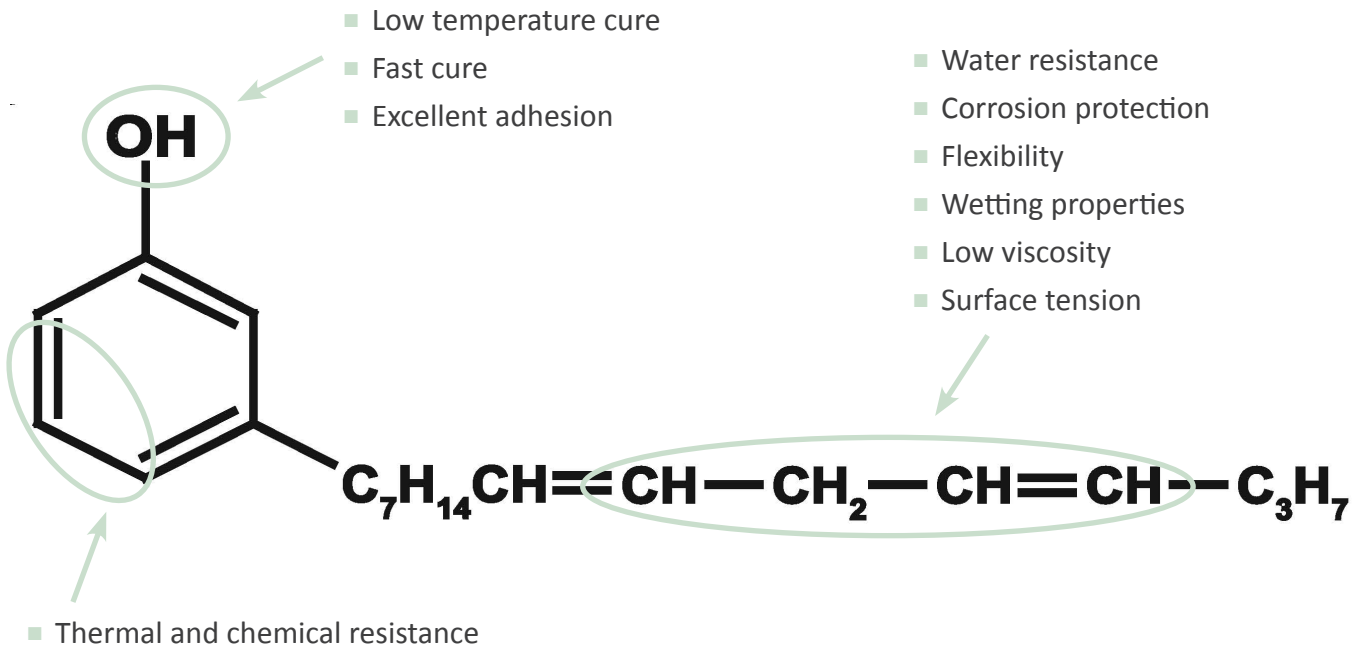
- Marine & Protective
- Industrial Coatings
 - OEM and general industrial
 - Transportation primers
 - Potable water
 - Food contact
- Concrete flooring
 - Primers and self-levelers
 - Top coats

Other Markets

- Adhesives & Sealants
 - Construction
 - Transportation
 - Electronics
- Composites
 - Prepreg, RTM, Hand lay-up
- Friction Particles & Resins
 - Brake pads, drum linings, train blocks
- Rigid and Flexible foams

CNSL Technology

Cardanol is a unique natural phenolic material obtained by distilling CNSL and serves as the primary building block for Cardolite curing agents. The molecule is composed of an aromatic ring with an OH group and a long aliphatic side chain, which bring valuable intrinsic benefits to coating materials.



Renewable



From the beginning, Cardolite products have been based on cashew nutshell liquid, a natural, non-food chain, and annually renewable biomaterial. The technology has been widely adopted because there are inherent performance benefits gained from using this starting raw material without sacrificing performance or cost. The relatively low viscosity of Cardolite products brings good workability to formulations as coatings trend towards higher solids and solvent free systems for the protection of applicators and the environment.

- Annually renewable
- Non-food chain
- High biocontent derivatives
- Low viscosity for low or zero V.O.C.
- High performance
- Cost effective

Phenalkamine Technology

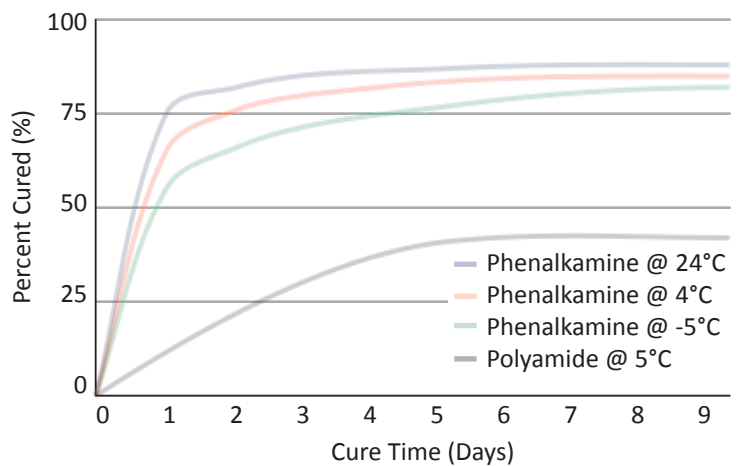
The Mannich reaction of CNSL, formaldehyde, and certain amines is called a phenalkamine. Phenalkamines share some similar advantages to other Mannich base curing agents, such as: extremely fast cure, low temperature cure (even below 0°C), good chemical resistance, good surface appearance, good moisture tolerance, and non-blushing properties. However, due to the long aliphatic side chain of cardanol, phenalkamines also have very good pot life, good flexibility, surface tolerance, and excellent water and salt water resistance. Many Cardolite phenalkamines are also approved for use in food contact and potable water coatings.

- Fast cure even at low temperatures
- Lower application failure risks
- Increased productivity
- Quick return-to-service
- Surface tolerance and corrosion protection
- Chemical resistance and durability

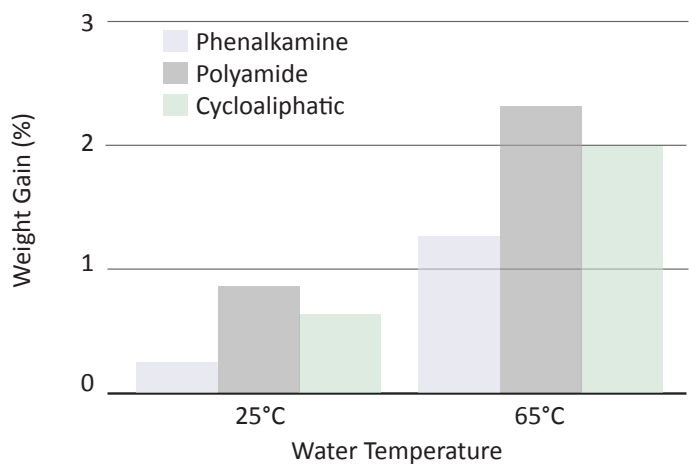
The high hydrophobicity of phenalkamines provided by the long linear side chain also brings many benefits to coating formulations compared with some other technologies. Water sensitivity of the phenolic hydroxyl and other formulation components can be counteracted, which reduces the chance the resin barrier will be broken and increases corrosion protection. Adhesion to poorly prepared or tough wet surfaces, such as water saturated concrete is especially good with phenalkamines because this hydrophobic effect ensures surrounding water does not influence the surface resin bond.



Phenalkamine Low Temperature Cure Data Comparison

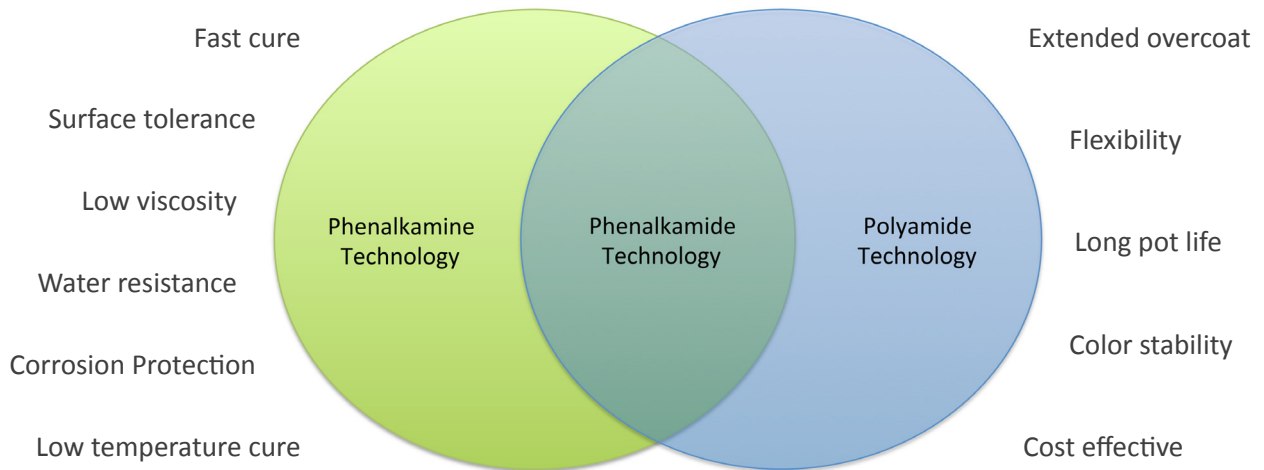


Comparative Water Resistance of Phenalkamines



Phenalkamide Technology

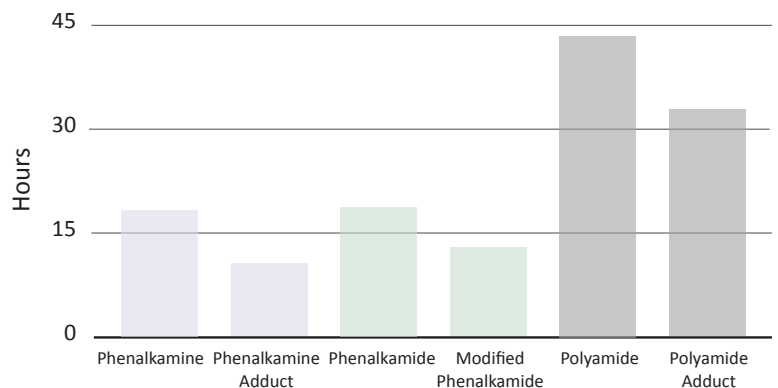
Cardolite phenalkamide technology is a new category of epoxy curing agent that fills a gap between polyamide and phenalkamine technology. By chemically combining the two technologies, phenalkamide curing agents offer the benefits of both while mitigating their limitations.



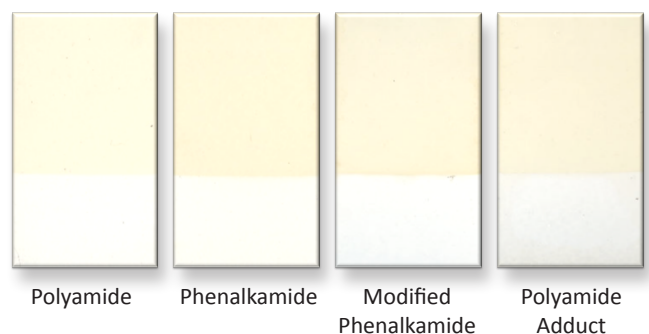
Phenalkamide technology can be used in many applications where polyamide technology currently prevails to bring a new level of performance, reliability, application latitude, and cost savings. General protective coatings, for example, that require good color stability and long overcoatability can avoid having separate summer and winter versions by using a phenalkamide based converter package. The overall system will have fast cure, low temperature cure, and excellent corrosion protection without the need for tertiary amines or anticorrosive pigments. A single formula's broader application latitude gives coating manufacturers protection from summer converter packages being used erroneously in low temperature conditions, and simplifies finished product and raw material inventory management.

- Universal coatings
- Formulation latitude
- No need for accelerators
- Remove or reduce anticorrosive pigments
- Cost savings!

Thin Film Dry Hard Time Comparison
(5°C with Liquid Epoxy Resin, EEW=191)



Color Stability after 72 hours QUVB
(8 hours light @ 50°C / 2 hours condensation @ 45°C)



Phenalkamine Curing Agents Typical Properties

Product	Type	Color ¹ (Gardner)	Viscosity ² @ 25°C (cPs)	Solids ³ (%)	Amine Value ⁴ (mg KOH/g)	AHEW	Thin Film* Dry Hard Times (hours)		
							25°C	5°C	0°C
NC-541	Unmodified	16	28,000	Solvent-free	330	130	5	15.5	23
NC-641	Unmodified	16	25,000	Solvent-free	304	130	4	13.5	21
NX-6070	Unmodified	17	10,000	Benzyl alcohol	276	143	4.2	20	20.5
LITE 2001	Unmodified	10	28,000	Solvent-free	330	132	3	12.5	19
NC-541X90	Solvent cut	16	4,000	90	300	144	5	13	21
LITE 2001X90	Solvent cut	10	3,800	90	300	144	9	17	31
NX-2041	Solvent cut	10	475	75	255	150	6	25	n/a
NC-541LV	Unmodified	15	2,300	Solvent-free	340	125	7	24+	36
NC-641LV	Unmodified	16	2,500	Solvent-free	370	125	3	14.3	20.5
LITE 2001LV	Unmodified	10	2,500	Solvent-free	340	125	7	17	29
LITE 2010LV	Unmodified	10	4,100	Solvent-free	247	125	3	13.5	19
NC-562	Adduct	14	1,300	65	185	174	3	9	11
LITE 2562	Adduct	9	1,500	65	180	174	2.5	7.5	11.5
NC-556X80	Adduct	14	4,500	80	330	135	3.5	12	19.5
NX-2015	Adduct	10	13,000	75	210	151	6	12	n/a
NX-2016	Adduct	15	12,000	75	208	151	2	6.5	11
NX-2018	Adduct	16	8,400	75	218	151	3	9	14
NX-5459	Adduct	15	1,650	70	205	164	4	12	18
NX-5050	Adduct	18	770	80	165	190	2	7.5	11
NX-5556M	Adduct	15	2,500	80	245	165	2	11	16
NX-5110	Adduct	8	2,500	80	245	165	3.1	9.6	23.5
GX-5135	Adduct	8	2,500	80	245	165	3	8	11
LITE 5262	Adduct	8	2,800	≤ 5% butanol	385	114	2.75	11	16
NX-5444	Adduct	8	4,300	80	218	190	1.5	6	6
NX-5445	Adduct	18	1,800	78	155	256	2	6.5	14.5

*200 micron with liquid epoxy (EEW 190), ¹ ASTM D1544, ² ASTM D2196, ³ ASTM D2369-98, ⁴ ASTM D2074

Key Properties	M&P	TP	IC	CF	TC	FDA 175.300
Low temperature cure, surface tolerant, excellent anticorrosion	XX		X			X
Lower free amine version of NC-541, with better film appearance	XX		X			
Low temperature cure, corrosion protection, high solids	XX		X			
Light color, excellent anticorrosion	XX		X			
Solvent cut for good handling	XX		X			X
Light color, solvent cut for good handling	XX		X			
Very low viscosity, excellent anticorrosion properties	XX		X			
Low viscosity for high solids	XX		X			X
EDA-free version of NC-541LV	XX		X			
Low viscosity, light color	XX		X			
Low viscosity, light color, excellent film at extreme conditions	XX		X			
Fast cure, non-blushing, excellent corrosion protection and adhesion	XX	XX	XX			
Light color version of NC-562	XX	XX	XX			
Fast cure and hardness development, high solids		XX	X			X
Light color, fast cure, excellent anticorrosion properties	XX	X	X			
Fast cure, higher viscosity, excellent anticorrosion properties	XX	X	X			
Fast cure, cost effective	XX	X	X			
Fast cure, high solids	XX		X			X
Very fast cure, high solids, low viscosity	X	X				
Excellent corrosion protection, similar properties to NC-562	XX	XX	XX			
Light color version of NX-5556M	XX	XX	XX			
Faster version of NX-5110, high solids	XX	XX	XX			
Very high solids, fast cure, excellent corrosion protection	XX	XX	XX			
Fast hardness development, good flexibility, high solids	X	XX	XX			
Very fast cure, high solids, low viscosity	XX					

X - recommended, XX - highly recommended, M&P - Marine & Protective (immersed), TP - Transportation Primers, IC - Industrial Coatings, CF - Solvent-free Concrete Floors, TC - Top Coats

Phenalkamine Curing Agents Typical Properties

Product	Type	Color ¹ (Gardner)	Viscosity ² @ 25°C (cPs)	Solids ³ (%)	Amine Value ⁴ (mg KOH/g)	AHEW	Thin Film* Dry Hard Times (hours)		
							25°C	5°C	0°C
NC-540	Unmodified	15	2,000	Solvent-free	535	81	3.5	13	19
NC-558	Unmodified	14	900	Solvent-free	340	95	10	27	32
NC-658	Unmodified	14	1,000	Solvent-free	300	95	6.5	22	28
NC-557	Unmodified	14	1,100	Solvent-free	355	95	7	16.5	27.5
NX-2003	Unmodified	10	620	Solvent-free	360	95	4.5	18.5	22
NX-2003D	Unmodified	13	700	Solvent-free	357	95	4.5	15	24
NX-5454	Unmodified	11	1,080	Solvent-free	275	133	2	7.5	10
NX-5653	Unmodified	11	1,064	Solvent-free	366	132	2.1	6.6	10.3
NX-6654	Unmodified	11	1,200	Solvent-free	325	132	2.3	8.8	12.6
NX-6019	Unmodified	11	1,100	Solvent-free	275	133	2.5	10	11.5
NX-5198	Unmodified	11	140	95	300	179	2.4	13	n/a
LITE 2002	Unmodified	10	450	Solvent-free	360	104	6	20	30.5
LITE 2002LP	Unmodified	10	700	Solvent-free	360	104	7	21	39
NX-2007	Unmodified	4	265	Benzyl alcohol	310	113	2	16	23.5
NX-2009	Unmodified	7	370	Benzyl alcohol	310	95	4	12	20.5
Ultra LITE 2009	Unmodified	1	330	Benzyl alcohol	277	95	6	22	32
Ultra LITE 2012	Unmodified	1	150	Benzyl alcohol	330	95	6.5	n/a	n/a
Ultra LITE 2009SF	Unmodified	1	5,900	Solvent-free	404	62	7	22	n/a
Ultra LITE 2009H	Unmodified	1	150	Benzyl alcohol	355	95	5	19	30
Ultra LITE 2009HSF	Unmodified	2	500	Solvent-free	550	62	n/a	n/a	n/a
NX-4943	Unmodified	14	1,800	Solvent-free	488	82	4	14	23
NX-5567	Specially modified	15	770	85	561	66	3	10	15
NX-5594	Unmodified	14	950	Solvent-free	395	76	2.5	8	11
GX-6027	Unmodified	7	950	Solvent-free	395	76	3	8.8	10
GX-5618	Ketimine modified	11	500	≤ 4% butanone	330	104	7.5	n/a	n/a

*200 micron with LER (EEW 190), ¹ ASTM D1544, ² ASTM D2196, ³ ASTM D2369-98, ⁴ ASTM D2074

Key Properties	M&P	TP	IC	CF	TC	FDA 175.300
Low viscosity, surface tolerant, solvent free				X		
Low viscosity, excellent adhesion to unprepared substrates	X		X	XX		
Lower free EDA version of NC-558	X		X	XX		
Fast cure, excellent adhesion, solvent free				XX		
Fast cure, excellent adhesion, light color, solvent free	XX		X	XX		
Fast cure, excellent adhesion, solvent free	XX		X	XX		
Very fast cure, excellent film appearance, solvent free	X		XX	XX		
Phenol-free version of NX-5454	X		XX	XX		
European REACH compliant version of NX-5653	X		XX	XX		
Better labeling version of NX-5454	X		XX	XX		
Fast cure, very low viscosity, cost effective			X			
Low viscosity, light color, excellent anticorrosion	XX		X			
LITE 2002 with Improved pot life	XX		X			
Fast cure and hardness, good flow and yellowing resistance			X		XX	
Good film appearance, yellowing resistance, fast cure, cost effective			X		XX	
Excellent film appearance, yellowing resistance, cost effective			X		XX	
Lower viscosity, longer pot life version of Ultra LITE 2009			X		XX	
Undiluted Ultra LITE 2009			X		XX	
Fast hardness development, good yellowing resistance			X		XX	
Undiluted Ultra LITE 2009H			X		XX	
Excellent chemical resistance, solvent free	XX					
Excellent chemical resistance, fast cure	XX					
Very fast cure, excellent cathodic disbondment resistance	XX	XX	XX			
Light color version of NX-5594	XX	XX	XX			
Fast cure with good pot life, low viscosity	XX		X			

X - recommended, XX - highly recommended, M&P - Marine & Protective (immersed), TP - Transportation Primers, IC - Industrial Coatings, CF - Solvent-free Concrete Floors, TC - Top Coats

Phenalkamide Curing Agents Typical Properties

Product*	Type	Color ¹ (Gardner)	Viscosity ² @ 25°C (cPs)	Solids ³ (%)	Amine Value ⁴ (mg KOH/g)	AHEW	Thin Film* Dry Hard Times (hours)	
							25°C	5°C
LITE 3000	Unmodified	8	2,400	70	180	256	5	17
LITE 3000NH	Unmodified	8	1,800	70	185	256	3.5	17
LITE 3005	Unmodified	11	1,700	70	160	256	8	18
LITE 3025	Unmodified	8	34,000	Solvent- free	345	103	8.5	n/a
LITE 3040	Unmodified	8	5,000	Solvent- free	380	118	7.3	29
LITE 3060	Unmodified	8	850	Solvent- free	455	104	5	17.5
LITE 3100	Modified	8	4,500	80	260	150	4	13
LITE 3100NH	Modified	8	4,200	80	265	150	4	8
LITE 3117	Modified	8	4,500	80	270	150	3.5	16

*Phenalkamides are available in different solvent cuts and in benzyl alcohol.

Specialty Non-CNSL Curing Agents Typical Properties

Product	Type	Color ¹ (Gardner)	Viscosity ² @ 25°C (cPs)	Solids ³ (%)	Amine Value ⁴ (mg KOH/g)	AHEW	Thin Film* Dry Hard Times (hours)	
							25°C	5°C
NT-1541	Polyamide	9	5,000 @ 75°C	Solvent-free	215	198	n/a	n/a
NT-1541X70 NT-1541I73	Polyamide	8 8	1,600 1,800	70 73	150 157	283 271.5	10 10	n/a n/a
NT-1515	Polyamide	8	4,000 @ 75°C	Solvent-free	235	198	n/a	n/a
NT-1515X70	Polyamide	8	500 @ 40°C	70	165	283	10	n/a
NT-1542	Polyamide	7	40,000	Solvent-free	350	103	8	n/a
NT-1544	Polyamide	8	10,000	Solvent-free	380	97	9	n/a
NT-1545	Polyamide	8	3,000	Solvent-free	380	103	11	n/a
NT-1550	Polyamide	8	3,500	>95 ⁵	265	133	6	n/a
NX-5701	Modified Mannich Base	8	900	Benzyl alcohol	300	117	3	13
NT-5901	Modified Cyclo- aliphatic	1	450	Benzyl alcohol	264	113	7.5	n/a

*200 micron with liquid epoxy (EEW 190), ¹ASTM D1544, ²ASTM D2196, ³ASTM D2369-98, ⁴ASTM D2074, ⁵ASTM D2369-98 at 85°C

Key Properties	M&P	TP	IC	CF	TP
First generation phenalkamide combining and balancing the benefits of phenalkamine and polyamide technologies.	X		XX		XX
LITE 3000 cut in non-HAPs solvent.	X		XX		XX
Cost effective and direct replacement of standard high molecular weight polyamide curing agents. NX-5052 is the undiluted version of LITE 3005.	X		XX		XX
Direct replacement of standard medium molecular weight polyamides with faster dry time and hardness development and better UV resistance.	X		XX		XX
Low viscosity, excellent flexibility and overcoatability, and good dry color stability and corrosion protection. Suitable for high solids coatings.	X	XX	XX		XX
Solvent free, very low viscosity, good color stability, excellent cathodic disbondment protection and adhesion to metal and concrete.	X	X	XX	XX	XX
Fast cure speed, high solids, and low use level	X	XX	XX		XX
LITE 3100 cut in non-HAPs solvent.	X	XX	XX		XX
Modified LITE 3100 with excellent intercoat adhesion at low temperatures and high humidity.	X	XX	XX		XX

Key Properties	M&P	TP	IC	CF	TC
Similar to standard high viscosity polyamides	X		XX		XX
NT-1541 in xylene NT-1541 in isopropanol	X		XX		XX
Standard high viscosity polyamide	X		XX		XX
NT-1515 in xylene	X		XX		XX
Standard medium viscosity polyamide	X		XX		XX
Standard medium-low viscosity polyamide	X		XX		XX
Low viscosity polyamide	X		XX		XX
Special modified polyamide	X		XX		XX
Low viscosity, excellent chemical resistance	XX		XX		
Low viscosity, good yellowing resistance			X		XX

X - recommended, XX - highly recommended, M&P - Marine & Protective (immersed), TP - Transportation Primers, IC - Industrial Coatings, CF - Solvent-free Concrete Floors, TC - Top Coats

Waterborne Technology

The NX-8000 Series is the first CNSL-based waterborne curing agent product line available in the market. This new technology enables very hydrophobic polymers to be stably packaged in water without the help of solvents. The hydrophobic side chain of cardanol promotes excellent corrosion protection matching the performance of existing solvent-based systems. The low temperature molecular mobility of cardanol-derived curing agents helps crosslink density and substrate wetting, which results in outstanding adhesion over various metal substrates.



Moreover, Cardolite's line of waterborne curing agents provides excellent formulation latitude. High PVC (pigment volume concentration) formulations are easily reduced with water to conventional spray viscosities, pigmentation can be done on both epoxy and amine sides, and good compatibility is achieved with solid epoxy dispersions and in the case of NX-8101, also with standard bisphenol A/F liquid epoxy resins.

Cardolite also offers water soluble curing agents diluted in 1-methoxy-2-propanol and other solvents upon request, for use in waterborne zinc rich primers or other water-based applications. They are low in viscosity, show excellent stability with zinc dust, provide excellent adhesion and corrosion protection, and deliver fast cure and recoatability with long pot life.

Waterborne Curing Agents Typical Properties

Product	Type	Color ¹ (Gardner)	Viscosity ² @ 25°C (cPs)	Solids ³ (%)	Amine Value ⁴ (mg KOH/g)	AHEW	25°C Thin Film* Dry Hard Times (hours)
NX-8101	Waterborne	8	35,000	50% in water	160	270	1.5
NX-8401	Waterborne	white emulsion	8,000	55% in water	135	290	2.8
NX-8501	Waterborne	8	5,600	80% in water	204	165	1.8
NX-8110W80	Waterborne	9	7,200	80% in water	295	136	2.2
NX-8111W80	Waterborne	10	10,800	80% in water	277	144	2.1
NX-8101PM80	Waterborne	11	2,000	80% in 1-methoxy-2-propanol	265	168	1.8
NX-8107PM80	Waterborne	9	1,890	80% in 1-methoxy-2-propanol	263	199	3.3
NX-8108PM80	Waterborne	10	3,749	80% in 1-methoxy-2-propanol	219	252	3.3

*200 micron with epoxy dispersion, stoichiometric ratio: 0.8, use D.I Water diluted mixture to 50% solids content

¹ASTM D1544, ²ASTM D2196, ³ASTM D2369-98, ⁴ASTM D2074

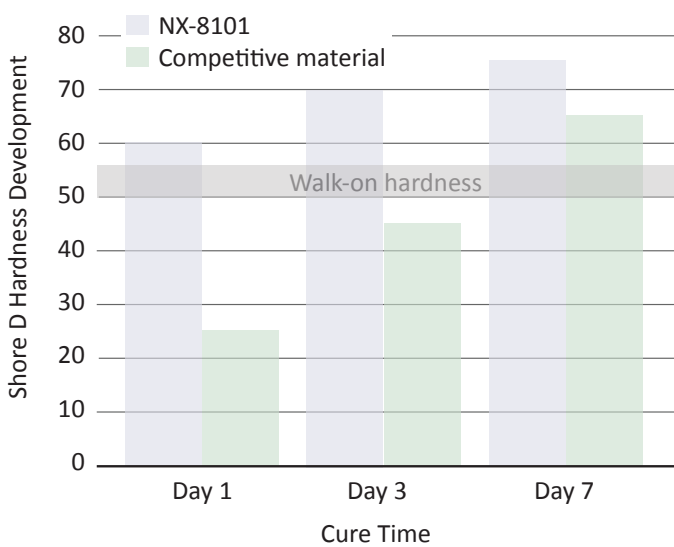
NX-8101 Advantages:

- Completely solvent-free!
- Excellent corrosion protection and adhesion over dry and damp concrete and to different metal substrates
- Fast cure even at 10°C and 80% relative humidity
- Good compatibility with standard liquid epoxy and solid epoxy dispersions
- Visible end of pot life
- Good stain resistance (household and industrial products)

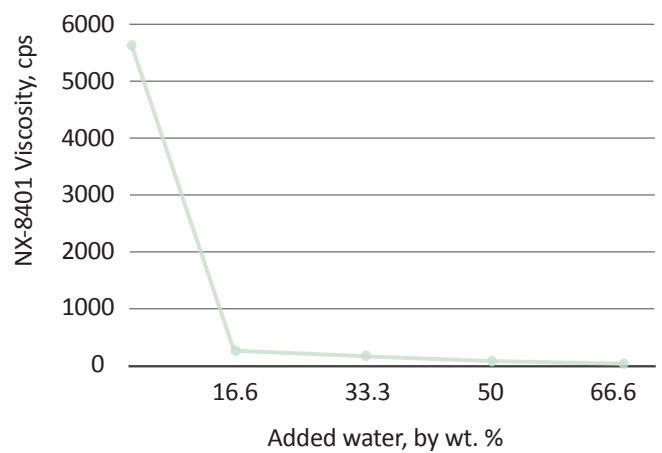
NX-8401 Advantages:

- Solvent-free and easily diluted with water
- Good compatibility with various epoxy dispersions
- Excellent adhesion to various metals
- Superior anticorrosion properties even after short cure cycles and at lower film thickness
- Fast recoatability with topcoats
- Very long pot life with improved flexibility
- Good color stability
- Easily disperses pigments and fillers

NX-8101 Shore D Hardness at 10°C and 80%RH



NX-8401 Dilution Curve with Water



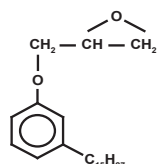
Key Properties	M&P	TP	IC	CF	TC
Fast hardness development, excellent corrosion protection	X	XX	XX	XX	
Easily reducible in water, excellent corrosion protection, long pot life	X	XX	XX	X	X
Excellent corrosion protection to multiple substrates, good color stability	X	XX	XX		XX
Fast cure, long pot life, excellent corrosion protection	X	XX	XX		
Fast cure, long pot life, excellent corrosion protection	X	XX	XX		
Suitable for zinc rich primers, fast cure and excellent corrosion protection	X	XX	XX		
Suitable for zinc rich primers, longer pot life, better zinc dust stability, excellent corrosion protection	X	XX	XX		X
Suitable for zinc rich primers, longer pot life, better zinc dust stability, excellent corrosion protection	X	XX	XX		X

X - recommended, XX - highly recommended, M&P - Marine & Protective (immersed), TP - Transportation Primers, IC - Industrial Coatings, CF - Solvent-free Concrete Floors, TC - Top Coats

Epoxy Resins, Diluents, and Modifiers



Cardolite NC-513/Ultra LITE 513/LITE 513E

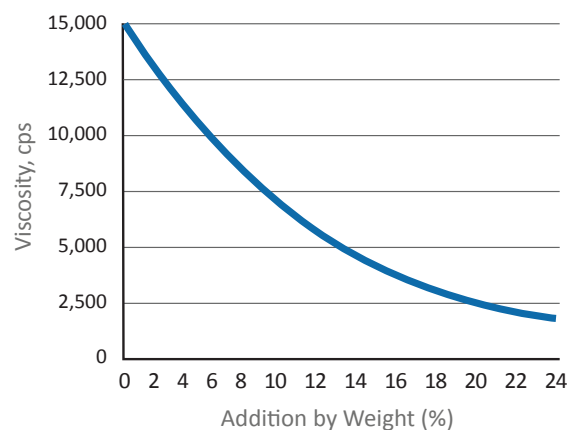


Cardolite NC-513, Ultra LITE 513, and LITE 513E are monofunctional reactive epoxy diluents that can be used to increase the flexibility and impact, and chemical and water resistance of epoxy coatings.

These reactive diluents have very low viscosity, which make them ideal for

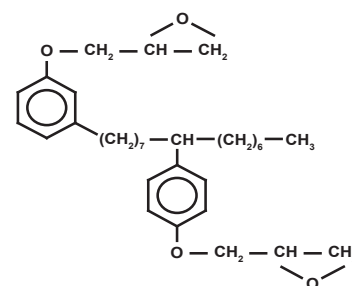
helping formulate high solids and solvent free coatings. Good reactivity means these diluents react completely into the coating network. Ultra LITE 513 is a lower viscosity, higher purity, and very low color version of NC-513; they are both identical in chemical make-up and excellent alternatives to traditional glycidyl ethers. LITE 513E is a very low total chlorine version of NC-513 suitable for electronic applications.

**NC-513 Family Dilution Curve
(25°C with Liquid Epoxy Resin, EEW=191)**



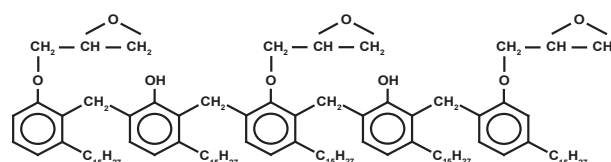
Cardolite NC-514/NC-514S

Cardolite NC-514 and NC-514S are flexible difunctional glycidyl ether epoxy resins. NC-514S is lower in viscosity. The chain of 8 carbons separating the aromatic groups allows this resin to be used in conjunction with traditional epoxy resins or as a sole resin to increase coating flexibility, abrasion resistance, and water and chemical resistance without adversely affecting other properties.



Cardolite NC-547

Cardolite NC-547 is a polyglycidyl ether epoxy novolac resin derived from cardanol. This resin can be used in conjunction with standard epoxy resins to bring additional flexibility and longer pot life to coatings without adversely affecting chemical and water resistance.

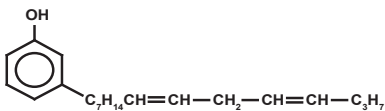


Epoxy Resin, Diluent, and Modifier Typical Properties

Product	Type	Color ¹ (Gardner)	Viscosity ² (cPs)	EEW ³	HyCl ⁴ (%)
NC-513	Reactive diluent	9	40-70	425-575	≤ 2
LITE 513E	Reactive diluent	5	20-40	360-410	Total Chlorine ≤ 1000ppm
Ultra LITE 513	Reactive diluent	1	20-35	350-425	≤ 0.5
NC-514	Epoxy resin	17	25,000	350-500	≤ 2
NC-514S	Epoxy resin	12	2,000	350-500	≤ 0.5
NC-547	Epoxy novolac resin	18	28,000	550-850	≤ 2.5

¹ ASTM D1544, ² ASTM D2196 at 25°C, ³ ASTM D1652, ⁴ ASTM D1726 HyCl

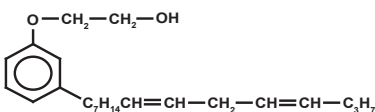
Cardolite NX-202x Product Family



Cardolite NX-202x products are low viscosity multipurpose resin modifiers. The long hydrophobic aliphatic side chain of the cardanol gives these products a very low viscosity and provides excellent early water resistance and corrosion protection. Used as epoxy diluents and accelerators, high

viscosity solvent or solvent free formulations can achieve higher solids, and faster cure without sacrificing other performance properties. NX-2021 is the standard modifier grade while NX-2022 is higher in purity. NX-2024 and NX-2025 are the lower odor and lighter initial color versions of NX-2021 and NX-2022 respectively. Ultra LITE 2023, NX-2023(D), and NX-2026 are the wet color stable versions of the NX-202x product family.

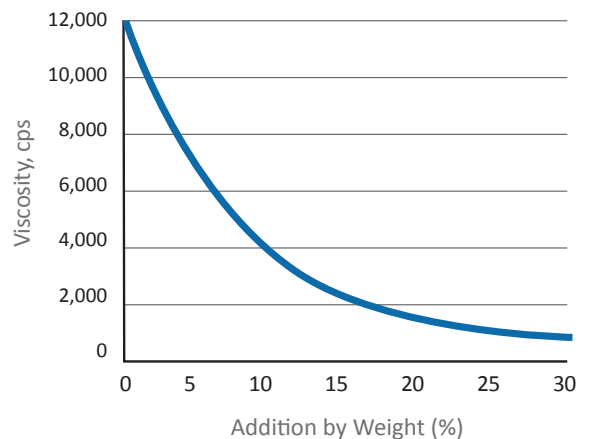
Cardolite LITE 2020/Ultra LITE 2020*



Cardolite LITE 2020 and Ultra LITE 2020 are low viscosity multi-

purpose resin modifiers. These resins are ideal for formulating environmentally friendly high solids or solvent free coatings. Due to their unique chemical structure, they are more efficient than traditional hydrocarbon resins in reducing viscosity despite being higher in viscosity. Their hydrophobic nature allows for good corrosion resistance and early water resistance. Ultra LITE 2020 is a lower color version of LITE 2020.

**NX-202x and LITE/UL 2020 Dilution Curve
(25°C with Liquid Epoxy Resin, EEW=191)**



Cardolite LITE 2100*/LITE 2100R**

Cardolite LITE 2100(R) are low color and low viscosity CNSL modified hydrocarbon resins. They are designed to enable high solids and solvent free formulations by lowering the viscosity of epoxy resins more efficiently than typical phenol based hydrocarbon resins and by improving overall system compatibility for better film formation. These products show good hardness development while providing improved flexibility and impact resistance. Their high hydrophobicity results in excellent water resistance, and more importantly, excellent corrosion protection on immersed and vapor exposed surfaces. Both products show very good UV resistance with excellent gloss retention for use in lighter color coatings.

Epoxy Diluent and Modifier Typical Properties

Product	Type	Color ¹ (Gardner)	Viscosity ² (cPs)
LITE 2020	Nonreactive resin modifier	≤ 14	30-115
Ultra LITE 2020	Nonreactive resin modifier	≤ 2	60
LITE 2100	Hydrocarbon resin modifier	≤ 4	450-750
LITE 2100R	Hydrocarbon resin modifier	≤ 4	500-1,500
NX-2021	Nonreactive resin modifier	≤ 18	45-75
NX-2022	Nonreactive resin modifier	5 - 8	40-60
Ultra LITE 2023	Nonreactive resin modifier	1	40-100
NX-2023	Nonreactive resin modifier	≤ 6	40-100
NX-2023D	Nonreactive resin modifier	≤ 15	80-140
NX-2024	Nonreactive resin modifier	4 - 9	45-60
NX-2025	Nonreactive resin modifier	≤ 5	≤ 60
NX-2026	Nonreactive resin modifier	≤ 2	≤ 60

¹ ASTM D1544, ² ASTM D2196 at 25°C

* LITE 2020/Ultra LITE 2020 and LITE 2100 not approved for sale in Europe.

**LITE 2100R is the REACH version of LITE 2100.

CNSL Polyol Resins



Cardolite CNSL-based polyols have unique qualities compared to widely known polyester and polyether polyols, and other natural oil based polyols. CNSL polyols are very hydrophobic because of the long aliphatic chain of cardanol compared to typical commercially available polyols. This hydrophobicity provides excellent water resistance and less moisture sensitivity during cure with isocyanate for increased durability of the final polyurethane system. In addition, CNSL polyols show fast cure with isocyanates minimizing the amount of catalysts required and allowing for quick return-to-service.

Different from other renewable polyols obtained from soy and castor oil, CNSL polyols have an aromatic structure that translates into excellent thermal resistance and chemical resistance to acid and alkaline solutions. Moreover, the combination of aromaticity and long aliphatic chain delivers hydrolytic stability and mechanical strength to CNSL-based polyols.

Cardolite diols offer a wide range of mechanical properties to meet different application requirements. Diol grades suitable as building blocks for prepolymers show excellent compatibility with polyether diols, polyBD, tackifier, and EVA giving formulators greater latitude to achieve desired properties and meet cost targets. For both uses as binders or as part of prepolymers, Cardolite diols provide excellent hydrolytic stability and reduced moisture sensitivity.

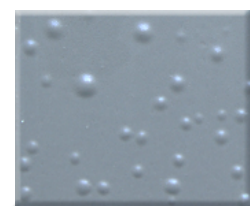
Advantages:

- Excellent water and moisture resistance
- Quick return-to-service
- Excellent acid and alkali resistance
- Can be tailored for different applications
- Available in low to high functionality
- Very good hydrolytic stability
- Suitable for a variety of coatings:
 - two-component ambient cured
 - one-component blocked or moisture cured
 - building block for prepolymers
- Cost effective!

Coating Immersion in 10% NaOH



CNSL Polyol - 30 Days



Castor oil Polyol - 6 Days

Polyols and Diols Typical Properties

Product	Type	Color ¹ (Gardner)	Viscosity ² (cPs)	Hydroxyl Value ³ (mg KOH/g)	Hydroxyl Eq. Weight ⁴ (g/mole)
NX-9001	CNSL Polyol	18	2,000	175	320
NX-9001LV	Low viscosity CNSL Polyol	18	1,000	175	320
LITE 9001	Low color CNSL Polyol	6	2,000	175	320
NX-9005	Non-CNSL Branched Polyol	≤ 5	3,000	170	330
NX-9007	CNSL Branched Polyol	14	2,900	175	320
NX-9008	High strength CNSL Polyol	10	3,000	320	175
NX-9011	Tough non-CNSL Polyol	≤ 5	1,800	224	250
NX-9014	High UV Resistance non-CNSL Polyol	≤ 5	1,200	256	219
NX-9201	CNSL Polyester Diol	14	1,400	75	748
NX-9203	CNSL Polyester Diol	14	3,000	85	660
NX-9201LP	Lower reactivity NX-9201	14	1,300	70	801
NX-9203LP	Lower reactivity NX-9203	14	2,000	115	488
NX-9207	High strength Non-CNSL Polyester Diol	Pale yellow	Waxy solid	132	425
NX-9208	High strength CNSL Polyester Diol	Pale brown	Waxy solid	78	719
NX-9212	CNSL Polyether Diol	≤ 5	450	55	1020

¹ ASTM D1544, ² ASTM D2196 at 25°C, ³ ASTM D1957, ⁴ Calculated

NCO Blocking Agent Technology

High purity and light color cardanol, NX-2026, is an effective isocyanate blocking agent that can be used to replace petro-based phenols. NX-2026 blocked NCO systems should be lower in viscosity and require lower deblocking temperatures than phenol. Moreover, cardanol can act as a flexibilizer in the final matrix.

Blocking Agent	NCO Type	Deblock Temperature (°C)
NX-2026*	PPG prepolymer (10.4% NCO)	128
Phenol	PPG prepolymer (10.4% NCO)	140

*Properties on page 16





<http://www.cardolite.com>

Cardolite Corporation

140 Wharton Road
Bristol, PA 19007
United States of America
T: +1-800-322-7365
F: +1-973-344-1197

Cardolite Specialty Chemicals Europe NV

Wijmenstraat 21K / 2
B-9030 Mariakerke (Gent)
Belgium
T: +32 (0) 92658826
F: +32 (0) 92658824

Cardolite Specialty Chemicals India LLP

Plot No. IP-1 & IP-2, Mangalore Special Economic Zone
Bajpe, Mangalore, 574 142
India
T: +91 (0) 824 2888 300

Cardolite Chemical Zhuhai Ltd.

1248 Ninth Shihua Road
Gaolan Port Economic Zone
Zhuhai, Guangdong 519050
P.R. China
T: +86-756-726-9066
F: +86-756-726-9067