



Cardolite
Chemistry for Tomorrow

| Friction Product Portfolio



Cardolite Corporation

Cardolite Corporation manufactures a large variety of products derived from cashew nutshell liquid (CNSL), a renewable natural resource. In addition to manufacturing products for the epoxy industry, Cardolite produces a wide variety of liquid binder resins, friction particles, and specialty chemicals for the friction industry.

For over 35 years, Cardolite has focused on the production of quality CNSL based materials used in the friction industry. The company's customer base includes both aftermarket (AM) and original equipment manufacturing (OEM) companies. With sales offices, representatives, and distribution facilities in North America, South America, Europe, and Asia, Cardolite prides itself on delivering high quality products and service across the globe.

Cardolite Corporation manufactures products for the friction industry in Zhuhai, Guangdong (China) and Mangalore, Karnataka (India). With well over 15,000 T/yr of total resin and particle capacity, our facilities are designed to support the most demanding customers. Cardolite manufacturing sites are ISO 9000 registered and adhere strictly to local and best practice health, safety, environmental, and security standards.

Cardolite continues to invest heavily in new product development, technical application support, and manufacturing capability for its friction product line. These investments, along with customer cooperation, will ensure the needs of the friction industry continue to be met by renewable CNSL based products.



Friction Particles



CNSL friction particles (sometimes referred to as “friction dust”) come in different types and are used as friction modifiers in disc brake pads, drum brake linings, train blocks, clutches and industrial friction materials. These particles have a resilient nature that reduces the friction material hardness and improves conformance to the mating surface. At elevated temperatures, friction particles exposed at the rubbing surface decompose. The decomposition helps stabilizing friction coefficient and reduces friction material wear. The inclusion of friction particles also helps to control noise. Cardolite friction particles are used in low steel, ceramic, non-asbestos-organic, semi-metallic and asbestos formulations of brake pads, drum linings, train blocks, clutches and industrial friction materials.

Please talk to a Cardolite sales representative for a complete overview of these products, including application details and test data, and to learn about tailored made materials.

Brown Friction Particles

Brown friction particles are available in many particle sizes and are mainly used in disc and drum brake applications. Standard brown particles help stabilize friction coefficient in the 150°C and 300°C temperature range. They are a great choice to help control wear and surface hardness in normal duty applications.

Black Friction Particles

Black particles, also available in many sizes, generally find use in high performance and heavy duty applications. In these applications, where high temperatures are reached by high energy stops, black friction particles help to dissipate heat across the surface to avoid hot spotting that lead into fade. They also contribute to wear reduction and help to control the overall surface hardness. These particles are mainly being used in heavy duty brake pads and linings, train blocks and clutches. Other friction material applications having intermediate to higher thermal conductivity may find black friction particles beneficial.

Specialty Friction Particles

A range of specialty friction particles is available for high demanding applications or very specific end-uses. These specialty particles have been developed to offer compounders a solution to meet today’s high friction material requirements.

The selection charts that follow can be used to choose the appropriate friction particle for different application requirements.



Brown Friction Particle Selection Chart

Product	Acetone Extract (%)	Ash (%)	Volatile loss @ 370°C, %	Size (Mesh)	Applications/Comments
NX-2004-20	≤ 4	≤ 3	≤ 35	20	Standard brown particle for all normal duty disc pad and drum lining applications.
NX-2020-30	≤ 4	≤ 3	≤ 35	30	
NX-1820	≤ 6	≤ 3	≤ 35	30	
NC-104-40	≤ 8	≤ 3	≤ 35	40	
NX-2004-40	≤ 5	≤ 3	≤ 35	40	
NX-5207	≤ 6	≤ 3	≤ 35	100	Fine brown particle with improved heat resistance for disc pad, drum lining and clutch applications.

Black Friction Particle Selection Chart

Product	Acetone Extract (%)	Ash (%)	Volatile loss @ 370°C, %	Size (Mesh)	Applications/Comments
NC-108	≤ 10	≤ 3	≤ 30	30	Black particle with medium to higher heat resistance and improved hardness for disc pad and drum lining applications.
NX-5319	≤ 7	3 - 7	≤ 30	40	
NX-5208	≤ 10	≤ 3	≤ 30	100	Fine black particle with improved heat resistance for disc pad, drum lining and clutch applications.

Specialty Friction Particle Selection Chart

Product	Acetone Extract (%)	Ash (%)	Volatile loss @ 370°C, %	Size (Mesh)	Applications/Comments
NX-1034-20	≤ 4	≤ 1.5	≤ 30	20	Unique, high purity, yellow particle providing excellent wear reduction.
NX-1035	≤ 5	7 - 10	≤ 25	60	Inorganic modified brown particle providing superior heat resistance at elevated (>400°C) temperatures.
NX-1045	≤ 5	3 - 6	≤ 25	60	
NX-5311	≤ 4	≤ 10	≤ 30	60	Neutral pH black particle providing excellent anti-corrosion properties.
NX-5319-2	≤ 2	≤ 2	≤ 30	40	High furfural black particle providing increased pad hardness.
NX-1500	1 - 3.4	≤ 5	≤ 25	60	Higher heat resistant black particle for high-end disc pad and clutch applications.

Binder Resins & Intermediates



CNSL resins are used as a binder for friction products such as brake pads, linings and blocks. Together with hexamine as cross-linking agent, they provide a heat curable thermosetting system that offers the desirable characteristics of impact resistance, flexibility and thermal stability. Cardolite offers a wide range of liquid binder resins, including high and low viscosities, solvent-free, solvent cut and elastomer modified grades.

Please talk to a Cardolite sales representative for a complete overview of these products, including application details and test data, and to learn about tailored made materials.

Solvent free CNSL Liquid Resins

Solvent free CNSL liquid binder resins are mainly used in asbestos and non-asbestos rolled linings, heavy duty and railway blocks. Hexamine addition of 8-9 wt% of the resin is recommended for cure. Solvent free resins are a great choice in situations where organic solvents are restricted. Mild heating to 50°C will reduce viscosity somewhat and aid resin wetting of formulation ingredients.

Solvent based CNSL Liquid Resins

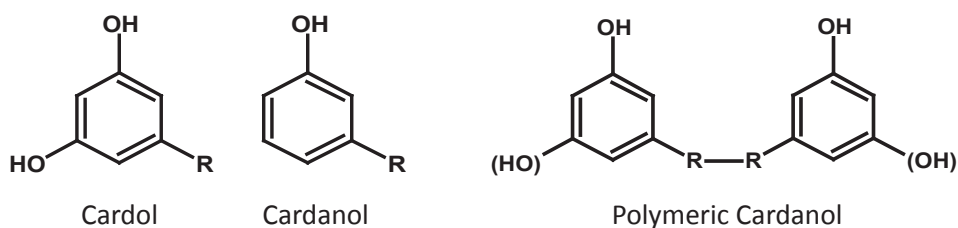
CNSL liquid binder resins containing solvent makes the resin easy to use, but the solvent must be removed after the mixing/rolling process. Hexamine is used to cure these resins and 7-9 wt% of the resin solids content is recommended.

CNSL elastomer modified liquid binder resins are primarily used in flexible asbestos free rolled segments. A single solvent or solvent blend is used to reduce the viscosity for easier mixing. Because of the rubber modification these resins are also highly useful in applications where some softening or reduced rigidity is desired. To cure these types of resins, hexamine should be added at 6-7 wt% of the resin solids content. The elastomer part may be cured with 1.5 wt% sulfur and 2.1 wt% zinc oxide on a resin solids basis.

Intermediates

Cardolite intermediates are C15 alkyl phenols, a mixture of C15 alkyl phenols, or dimer/trimer of C15 alkyl phenols. The primary use of these chemicals is as a substitute for phenol streams to improve flexibility and water sensitivity. As a modified phenolic resin, they can be used in a variety of applications such as composites, friction binder resins, foundry resins, wood adhesives, laminates and abrasives, processing oil for rubber, or any other application where phenolic resin is being used. A Cardolite sales representative can provide more technical details about these products and provide assistance when using them in specific applications.

The selection charts that follow can be used to choose the appropriate binder resin or intermediate for different application requirements.



Solvent Free Binder Resin Selection Chart

Product	Solids (%)	Viscosity, cps @ 25°C	Gel Time, @ 82°C (min)	Lbs/Gal (Kg/L) (Typical)	Applications/Comments
NC-370	> 98	25,000 - 80,000 at 50°C	20 - 45	8.3 (1.00)	Solvent free, high viscosity cashew resin. Excellent for wet mix processing. Provides superior strength in heavy duty applications.
NX-2056	> 99	90,000 - 130,000	30 - 50	N/A	
NC-371	> 99	15,000 - 40,000	25 - 35	N/A	Solvent free cashew resin with good processing viscosity for all friction material applications providing high strength and temperature resistance.
NX-4778	> 98	40,000 - 51,000	40 - 55	N/A	

Solvent based Binder Resin Selection Chart

Product	Solids (%)	Viscosity, cps @ 25°C	Gel Time, @ 82°C (min)	Lbs/Gal (kg/l) (Typical)	Solvent	Applications/Comments
NC-311	80	22,000 - 29,000	15 - 35	7.95 (0.96)	Mineral Spirits	Good processing viscosity for rolled drum linings.
NC-326	80	13,500 - 23,500	12 - 24	7.95 (0.96)	Aliphatic Solvent	A blend containing high and low molecular weights providing exceptional strength for high-end NAO formulations.
NC-338	90	20,000 - 35,000	20 - 45	7.99 (0.96)	Mineral Spirits	
NC-370E80	80	800 - 2,000	10 - 25	8.25 (0.99)	Ethanol Blend	Ethanol blend providing very low processing viscosity.
NC-342X	80	12,000 - 20,000	8 - 20	7.58 (0.91)	Aliphatic Solvent Blend	Elastomer modified binder resin that provides excellent processing viscosity, high temperature resistance, and good flexibility.
GX-1706	60	200 - 400	N/A	7.95 (0.96)	Mixed solvents	A CNSL based liquid binder/wetting agent/dust suppressor.

Intermediate Selection Chart

Product	Solids (%)	Viscosity, cps	Specific Gravity @ 25°C	Applications/Comments
NC-603	100	≤ 600	0.943 - 0.968	Cashew nutshell liquid
NC-700	100	45 - 75	0.925 - 0.945	Minimum 87% cardanol for phenolic resin synthesis and modification, or areas where a unique modified phenolic is desired.
NX-4670	100	≤ 20,000	1.0	An alkylated phenol mixture of ~40% cardanol, ~20% cardol, and ~40% polymeric cardanol. Used as an intermediate or modifier.
NX-2026	100	≤ 60	0.92 - 0.94	Low viscosity resin suitable for use as dedusting and wetting agent.



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