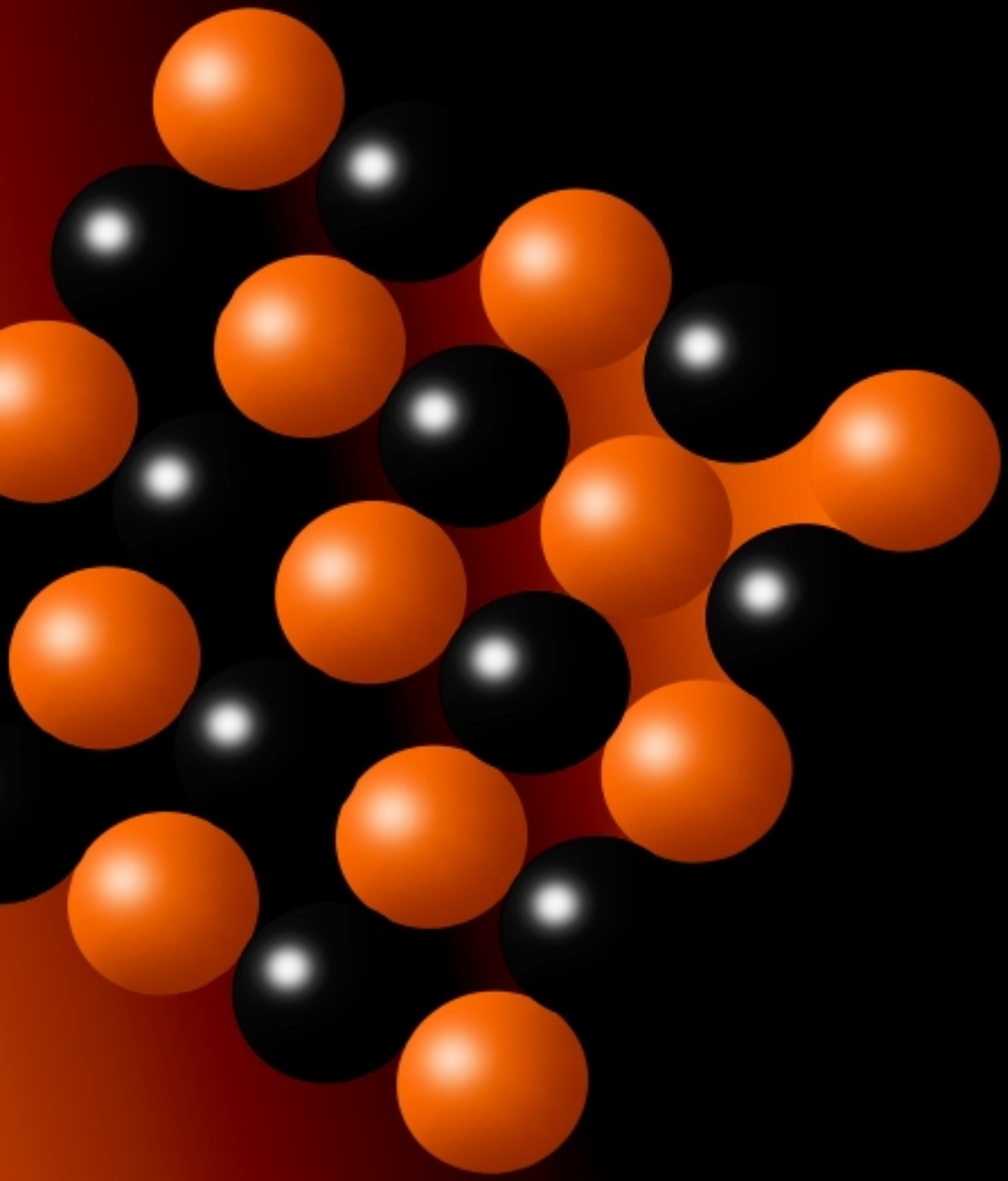
POST-VULCANIZATION BONDING GUIDE

CHEMLOK®
ADHESIVES



LORD

TABLE OF CONTENTS

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Cautionary Information
Before using this or any other Lord product, refer to the product Material Safety Data Sheet (MSDS) and label for safe use and handling instructions.

For additional information, contact us at:

Lord Corporation
Chemical Products Division
2000 West Grandview Blvd.
P.O. Box 10038
Erie, PA 16514-0038
1-800-CHEMLOK, extension 3365
FAX: 814/864-3452
www.chemlok.com

INTRODUCTION

For many years, Post-Vulcanization (PV) bonding has successfully bonded cured rubber to metal. PV bonding can be used for prototype and production parts. This method provides greater product and mold design freedom and reduced tooling, production time and labor costs.

Many of the Chemlok® adhesives used for vulcanization bonding are also used for post-vulcanization bonding of diene elastomers. The Chemlok primer/cover-coat, one-coat solvent or aqueous adhesive may be applied to the rubber, cleaned metal or both, then placed under compression and cured at elevated temperatures.

Place the pre-shaped, cured rubber onto the metal under compression using a fixture. The time, temperature and pressure for adhesive cure are selected to yield a well-bonded assembly. Rubber-to-metal products that are PV bonded have bonds as strong as those made by regular vulcanization bonding.

Other techniques for post-vulcanization bonding use various types of reactive adhesives that are different from the Chemlok vulcanization formulations. Some of these, most notably the ultra-fast cyanoacrylate ester adhesives, do not require exposure to elevated cure temperatures. Other classes, two-part epoxy or two-part polyurethane formulas, will cure slowly at ambient temperature. These two-part adhesives require heat in order to speed up the production process.

Structural Strength and Reliability

PV bonding with Lord adhesives offers exceptional reliability and performance. This method provides high-quality, rubber-tearing bonds over a wide range of elastomers. It also provides excellent high-temperature and environmental resistance comparable to vulcanization bonding.

Adhesive Selection

Lord PV bonding adhesives are divided into three groups:

- Conventional Chemlok Adhesives
- Epoxy and Urethane Structural Adhesives
- Cyanoacrylate Adhesives

CONVENTIONAL CHEMLOK ADHESIVES

This technique is used where good contact is available between rubber and metal (5% to 35% rubber pre-compression) and elevated temperature cures are possible.

Metal Preparation — Use mechanical or chemical methods typically used for vulcanization bonding. Mechanical preparation of ferrous substrates is accomplished by degreasing with an alkaline cleaner and blasting with G40 to G70 steel grit media. Apply the Chemlok primer within 8 hours. Chemical conversion coatings such as iron or calcium modified zinc phosphate applied at up to 450 mg./sq. ft. are effective surface treatments. For more information, please consult the "Preparation of Substrates for Bonding" guide (Lord Technical Bulletin 7101).

Rubber Compounding/Preparation — PV bonding is applicable to cured NR, SBR, NBR, CR, BR, IIR and EPDM elastomers. Moderate-to-high sulfur cures are more easily bonded than low or non-sulfur compounds. Do not use wax type antiozonants or levels of other compounding ingredients that will bloom. Phthalate plasticizers can be used, but only at very low levels.

EFFECT OF SURFACE TREATMENT* (lbs.)

TREATMENT	NATURAL RUBBER	SBR	NEOPRENE
TCE Wipe	650	260	747
Hot Alkaline/Rinse	941	902	965
Abrasion	1362	1141	985
Chlorination	808	1000	1006

*Test method ASTM D429 (Method D), Chemlok 205/234B, Vapor degreased, grit blasted, vapor degreased steel, Cure cycle 45 min at 300°F in forced air oven, 8% rubber compression.

ADHESIVE SELECTION

ELASTOMER	CHEMLOK ONE-COAT SYSTEM	CHEMLOK TWO-COAT SYSTEM
Natural	252X, 8560S/D	205/234B, 8007/8560S/D
SBR	252X, 8560S/D	205/234B, 8007/8560S/D
Neoprene	252X, 8560S/D	205/234B, 8007/8560S/D
Butyl	252X, 8560S/D	205/238, 8007/8560S/D
EPDM	252X, 8560S/D	205/238, 8007/8560S/D

Avoid silicone containing mold releases by using semi-permanent type mold releases that transfer minimally to the molded rubber surface. Cleaning or abrasion of the rubber surface is generally not necessary if the rubber is post bonded within a couple of days after molding. If cleaning is desired to remove dirt, dust or bloom, use one of the following steps:

- Wipe or briefly immerse in a chlorinated solvent.
- Tumble in an alkaline cleaning bath; follow with a warm water rinse.
- Treat with Chemlok 7701 or 7707 solvent-based chlorinated solution.

Adhesive Selection — A variety of Chemlok solvent and aqueous adhesives are effective for post-vulcanization bonding. The selection of adhesive depends on the type of elastomer and the design of the part.

Adhesive Mixing/Application — Chemlok solvent and aqueous primers and/or adhesives must be well agitated prior to and during use to ensure homogeneous mixing of all ingredients. If the adhesives are to be diluted prior to application, use the proper diluent specified in the product bulletin.

Use dip, spray, brush or roll application methods. A total film thickness of 1.0 to 2.0 mils is recommended for single-coat systems, and 0.2 to 0.4 mils of primer and 0.8 to 1.5 mils of cover-coat for two-coat systems.

Dry the adhesive 10 minutes at 150°F (65°C) in a forced drying oven, or 2 hours at room temperature minimum before post-bonding the assembly.

Handle coated inserts with clean gloves to avoid fingerprints, dirt, grease, oil and other contaminants.

Assembly — Assembly lubricants may be necessary depending on the molded assembly configuration. Naphthenic assembly oils such as CoChem M, O and R types (Clark Oil and Chemical Co.) and Sunthene RPO (Sun Oil Co.) historically have performed best. Do not immerse the rubber or coated Chemlok parts for more than 4 hours. Once the parts have been assembled, allow a minimum of 4 hours at ambient temperature for the oil to absorb into the rubber assembly prior to bonding. Maintain a minimum of 5% rubber compression during cure.

ADHESION VERSES COMPRESSION

% COMPRESSION	ADHESION (LBS.)
0	170
2	470
4	670
6	720
8	740
10	750

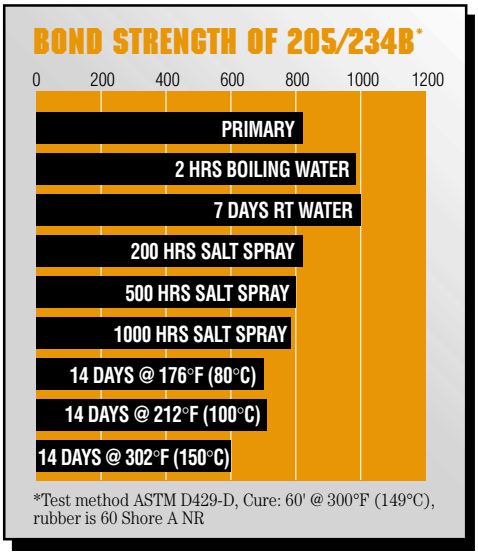
*ASTM D429 Method D, CH205/234B, Vapor degreased/grit blasted/vapor degreased steel, Cure Cycle 45' @ 300°F in forced air oven, NR compound.

Adhesive Cure — Cure conditions can vary depending on the size and configuration of the part and the number of parts being cured at one time. Forced air ovens, autoclaves and low-frequency induction heating have been used. Typical cure cycles are:

- Forced air oven: 30 to 60 minutes at 280°F to 300°F (138°C to 149°C)
- Autoclave cures: 15 to 30 minutes at 280°F to 315°F (138°C to 157°C)
- Induction cure: peak metal temperature at 390°F to 420°F (199°C to 216°C) in less than 30 seconds.

Post-Curing Processes — Post curing processes such as machining, plating, chemical conversion coating, painting, etc. can be performed. Avoid processes that generate excessive heat or exposure to deleterious environments.

Performance — Bonded assemblies have excellent environmental resistance as illustrated below.



*Test method ASTM D429-D, Cure: 60' @ 300°F (149°C), rubber is 60 Shore A NR

EPOXY AND URETHANE STRUCTURAL ADHESIVES

Lord epoxy and urethane structural bonding adhesives offer several advantages such as filling gaps between the rubber and metal and curing at room temperature. They are also environmentally compliant in the fact that some contain no VOCs.

Metal Preparation — The requirements are the same as for conventional Chemlok PV bonding.

Rubber Compounding/Preparation — PV bonding using epoxy and urethane adhesives is applicable to NR, SBR, NBR, CR, BR, IIR and EPDM elastomers. Moderate-to-high sulfur cures are bonded more easily than low- or non-sulfur compounds. Do not use levels of wax-type antiozonants or other compounding ingredients that will bloom. Phthalate plasticizers should only be used at very low levels. Avoid silicone containing mold releases, and instead, use semi-permanent type mold releases that transfer minimally to the molded rubber surface. For optimum performance, treat the rubber with Chemlok 7701 or 7707 solvent-based chlorinated solution. Apply these solutions by dip, spray or wipe methods. Allow solvents to flash at least 10 minutes before bonding.

ADHESIVE SELECTION

ADHESIVE	TYPE	COLOR	VISCOSITY	COMMENTS
320/310 Black	Epoxy	Black	Paste	Black, filled, high-temperature resistant
305-1/305-2	Epoxy	Blue	Syrup	Low viscosity, longer open time/slower cure
Lord 7650	Urethane	Clear	Syrup	Single component, moisture cure, tacky
Lord 7660	Urethane	Clear	Syrup	Increased tackiness compared to 7560

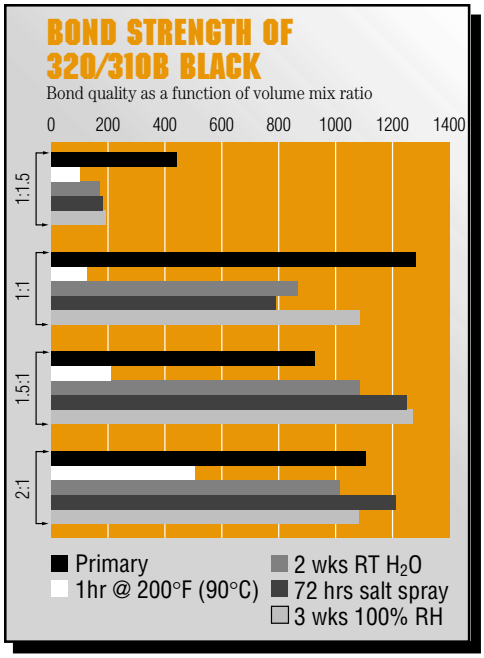
Refer to individual product bulletins for more specific information.

Adhesive Mixing/Application — These adhesives are available in a variety of containers. Two-component adhesives are available in a variety of cartridges to be used with manual or pneumatic dispensing guns employing disposable static mixer nozzles. Hand mixing of product may provide acceptable results on prototypes if air entrapment is minimized. Containers of 5 gallons or larger may be used with mix/meter/dispense equipment. Do not return unused mixed adhesive to the original container. See your Lord Sales Representative, Technical Service or Customer Service Representative for additional details.

Assembly/Cure/Disassembly — Apply adhesive to the metal and/or rubber. Assemble and fixture in a single motion. Apply 0.5 to 1 psi to obtain intimate contact between the bonding surfaces. An adhesive thickness of 5 to 10 mils (.005 to .010") is required to obtain optimum adhesion. Maintain contact during the entire curing step. Cure of the bonded assembly to handling strength, which will allow removal from the bonding fixture, requires a maximum of 24 hours at room temperature or 15 minutes at 200°F (93°C). Large assemblies may require longer cure times or higher temperatures. Refer to the individual product bulletins for the above products to obtain specific mix ratios, open times and cure times.

Post-Assembly Processes — Post-assembly processes such as machining, plating, chemical conversion coating, painting, etc. may be performed. Avoid processes that generate excessive heat or exposure to deleterious environments.

Performance — Bonded assemblies have excellent environmental resistance as illustrated below.



CYANOACRYLATE ADHESIVES

The primary advantage of Lord cyanoacrylate adhesives (CA) is their rapid cure rate at room temperature.

Metal Preparation — The requirements are the same as for conventional Chemlok PV bonding.

Rubber Compounding/Preparation — Post-vulcanization bonding with cyanoacrylates is applicable to NR, SBR, NBR, CR, BR, IIR and EPDM elastomers. Moderate-to-high sulfur cures are more easily bonded than low or non-sulfur compounds. Do not use levels of wax type antiozonants or other compounding ingredients that will bloom. Phthalate plasticisors must be used only at very low levels. Avoid silicone containing mold releases by using semi-permanent type mold releases that transfer minimally to the molded rubber surface. The rubber may need to be solvent or alkaline cleaned to remove loose particles, oil, dirt, bloom, etc. **DO NOT** treat the rubber with Chemlok 7701 or 7707 or other chlorination treatments. Acidic surfaces interfere with the performance of cyanoacrylate adhesives.

Adhesive Selection — Several Lord cyanoacrylate products are available depending on viscosity needed. The higher viscosity products are better suited for more porous substrates.

Adhesive Application — The adhesive is ready to use as received. Apply a small bead of adhesive to the bond area. This may be done directly from smaller containers or by using automatic dispensing equipment with 500-gram containers. Wear plastic gloves to make sure that the adhesive does not get on your skin.

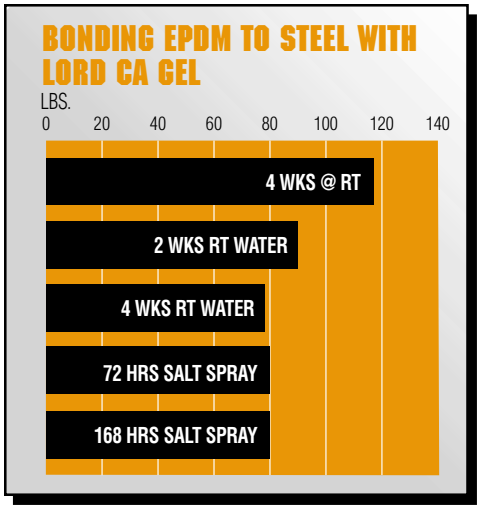
ADHESIVE SELECTION

PRODUCT	APPEARANCE	TYPICAL VISCOSITY (cps)	CURE TIME (sec)
Lord 8300	Clear	20	12
Lord 8400	Clear	210	23
Lord CA Gel	Clear	Thixotropic	12-15

Assembly — Since these products have very rapid cure rates, it is important to accurately mate the bonding assembly and maintain positioning by hand. Use pressure of up to 0.5 psi. until an initial set is achieved. Cyanoacrylate adhesives require a very thin adhesive thickness of 2 to 4 mils. These adhesives are not designed for gap filling.

Post-Assembly Processes — PV assembly processes such as machining, plating, chemical conversion coating, painting, etc. should be evaluated for compatibility with the adhesive prior to implementation. Avoid processes that generate excessive heat or exposure to deleterious environments.

Performance — Bonded assemblies have good environmental resistance as illustrated below.



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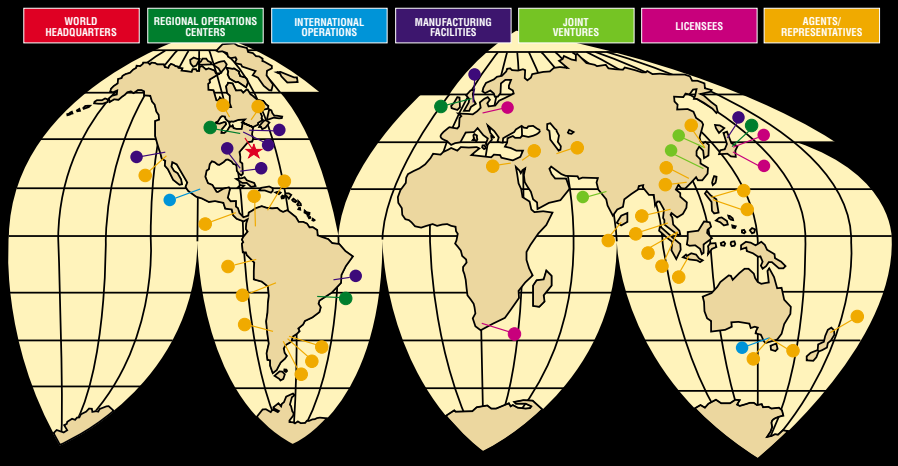

Lord Corporation (North America)
2000 W. Grandview Blvd.
P.O. Box 10038
Erie, PA, USA 16514-0038
1-800-CHEMLOK

Lord Corporation (Europe) Ltd.
Stretford Motorway Estate
Barton Dock Road
Stretford, Manchester
England M32 0ZH
44 (161) 865-8048

Lord Industrial Ltda.
Via Anhanguera, KM. 63,5
Distrito Industrial
13.200 Jundiai, Sao Paulo
Brazil
55 (11) 7392-7755

Lord Far East, Inc. (Japan)
2F, Yoyogi Center Building
57-1, Yoyogi 1-Chome
Shibuya-ku, Tokyo
Japan 151
81 (3) 3378-9011

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A Division of Lord Corporation

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