# TABLE OF CONTENTS

General Overview ................................................................................................................. 3
Packaging ................................................................................................................................. 3
Substrate Preparation .................................................................................................................. 3
  Types of Surface Preparation ........................................................................................................... 3
  General Surface Preparation ........................................................................................................... 4
Preparation Methods for Various Substrates .................................................................................. 4
  Steel................................................................................................................................................. 4
  Stainless Steel ................................................................................................................................. 4
  Aluminum ........................................................................................................................................ 4
  Magnesium ..................................................................................................................................... 5
  Brass and Copper ............................................................................................................................ 5
  Zinc .................................................................................................................................................... 5
  Plated Metals .................................................................................................................................. 5
  Plastics .............................................................................................................................................. 5
  Miscellaneous Substrates ............................................................................................................... 5
Selecting a Preparation Method ...................................................................................................... 5
Maintenance of Surface Properties .................................................................................................. 6
Applying Chemlok Solvent-based Adhesives ...................................................................................... 7
  Preparing the Adhesive ....................................................................................................................... 7
  Applying the Adhesive ........................................................................................................................ 7
    Hand Brushing ................................................................................................................................. 7
    Dip Application ............................................................................................................................... 8
    Spray Application ............................................................................................................................ 9
    Spray Equipment .......................................................................................................................... 9
  Roll Coating .................................................................................................................................... 10
  Drying Processes ............................................................................................................................ 10
  Handling Coated Parts .................................................................................................................... 10
  Coated Parts Layover Stability ......................................................................................................... 11
  Proper Storage ............................................................................................................................... 11
Applying Chemlok Aqueous Adhesives ............................................................................................. 12
  Differences Between Solvent-based and Aqueous Adhesive Systems .................................................. 12
  Benefits of Aqueous Systems .......................................................................................................... 12
  Preparing the Adhesive ...................................................................................................................... 12
  Applying the Adhesive ....................................................................................................................... 12
    Spray Application ............................................................................................................................ 12
    Spray Equipment .......................................................................................................................... 13
  Dip Application .................................................................................................................................. 14
  Automatic Systems ......................................................................................................................... 15
    Brushing ......................................................................................................................................... 15
    Roll Coating .................................................................................................................................... 15
    Pad Painting ..................................................................................................................................... 15
  Accelerating Drying Time .................................................................................................................. 15
  Monitoring ....................................................................................................................................... 15
  Storage .............................................................................................................................................. 17
  Coated Parts Layover Stability ......................................................................................................... 17
Molding ........................................................................................................................................... 18
Post-Treatment ................................................................................................................................. 19
Troubleshooting .............................................................................................................................. 19
Safe Handling .................................................................................................................................. 20
Lord Applications Laboratory .......................................................................................................... 20
Service and Equipment Suppliers ................................................................................................... 21
It’s been more than 40 years since Chemlok® rubber-to-metal adhesives were first introduced. While much has changed during this time, one thing remains constant: the quality of Chemlok adhesives. Today — as from the beginning — the Chemlok family is recognized as the industry leader in rubber-to-metal adhesives. That’s why when manufacturers have a critical application that demands a proven rubber-to-metal adhesive, they look to Chemlok products.

Although a premium adhesive is the basis of a quality bond, it’s only the beginning; proper application is essential for maximum results. Whether you’re dipping or spraying, using solvent-based or aqueous Chemlok products, you’ll learn how to maximize efficiency and optimize results. This guide will also show you how to troubleshoot common bond problems, and find names and numbers of materials and equipment suppliers.

We recommend you read this entire booklet before using Chemlok adhesives; however, we realize that many of our customers have been using our products for years, and reading this guide from cover to cover isn’t necessary. Regardless, we hope this resource will become an indispensable part of your operation and a convenient, one-source solution to many of your bonding questions. Just think of it as an extension of Lord Corporation, and remember: When it’s critical, it’s Chemlok.

Packaging
Chemlok solvent-based and aqueous adhesive systems are available in several sizes to accommodate varying production requirements. Choose from one of these convenient packages:
• Quart containers
• 1-gallon pails
• 5-gallon pails
• 55-gallon, phenolic-lined metal drums with agitator paddles

Substrate Preparation
One of the most important steps to a quality bond is substrate preparation. To ensure optimum bond performance and long-term environmental resistance, substrates must be free of organic and inorganic contaminants. Organic materials, which can be removed by solvent or alkaline cleaning, include grease, dirt and oils. Common inorganic pollutants are rust, scale and oxide layers. These contaminants can be cleaned by abrasion or chemical processes, or a combination of both.

Types of Surface Preparation — There are a number of ways to prepare substrates for adhesive application; however, the methods can be broadly divided into mechanical and chemical. Regardless of which method you choose, the essentials of all good surface preparations include:
• Removal of all surface contaminants and decomposition products.
• Prevention of recontamination.
• Careful handling through all processing steps.

Mechanical preparation involves physically removing surface contamination and increasing surface area and substrate profile. These methods include:
• Blasting — Abrasive particles (sand, grit or metal oxides) are projected against the surface with a stream of air. Blasting is especially effective for removing inorganic contamination and other corrosion compounds found on metal. The character or quality of the treatment is affected by duration of the blast; shape and size of the blasting media; particle velocity; and the hardness, porosity and other properties of the substrate.
• Abrading — A wire brush or abrasive paper or pad is used to grind the surface. Care must be taken to prevent contamination of the abrasive material and to remove dust and particles after use.
• Machining — Cutting tools are used to “score” surfaces. If oils are completely removed, machining produces an excellent bonding surface. However, any oil left on the metal surface may cause poor adhesion.

Chemical processes, on the other hand, utilize organic and inorganic chemicals to dissolve, suspend or eliminate soils and surface contaminants. Preparations include:
• Vapor/solvent degreasing — The vapor of solvent or alkaline cleaning solution is utilized to eliminate organic contamination or oils. Because degreasing will not remove scale or corrosion, it’s best to use in conjunction with blasting for metal substrates.
• Anodizing — Aluminum oxides are electro-lytically deposited on bonding surfaces.
• Passivation
• Zinc phosphating
• Alkaline cleaning
• Chromate alodizing
• Chemical etching
• Pickling

General Surface Preparation — Whether you’re using Chemlok solvent-based or aqueous adhesive systems, the following three-step process is the preferred mechanical surface preparation technique:
1. Degreasing
2. Grit-blasting
3. Degreasing

While the above methods produce excellent surfaces for bonding most substrates, more elaborate chemical methods may be needed for certain substrates or for improved environmental resistance. Details on specific methods are described under the heading for the specific substrate.

Regardless of the system you choose, parts must remain clean when being removed from the cleaning tank. Water break tests (ASTM F22) should be performed regularly to check purification effectiveness.

Preparation Methods For Various Substrates — Although the general principles are the same for preparing all substrates, some materials require special attention. Below, we’ve outlined some of the nuances of preparing various surfaces for bonding.

Steel — Grit blasting (with steel or aluminum oxide) is widely used for preparing steel surfaces. It is especially effective for metals covered with rust, scale, oxide layers and other corrosion compounds. Steel preparation usually involves:
1. Vapor degreasing
2. Grit blasting (recommended grit size ranges from G-40 to G-70)
3. Solvent degreasing or alkaline cleaning with rust inhibitor in rinse

Chemical treatments for steel include iron phosphate or zinc phosphate conversion coatings. Micro-crystalline, calcium-modified zinc phosphates are preferred for solvent-based and aqueous adhesives.

When preparing steel with chemical methods, a calcium-modified, microcrystalline zinc phosphate (film weight of 125 to 450 mg/ft²) is recommended. Zinc phosphate treatment consists of:
1. Hot caustic clean
2. Water rinse
3. Phosphoric acid pickle
4. Water rinse
5. Zinc phosphate
6. Water rinse
7. Rust inhibiting rinse
8. Hot air dry

This type of surface treatment provides on-the-shelf corrosion protection of the uncoated part as well as improved under-bond corrosion protection.

For detailed information and names of representative suppliers, consult manufacturers of phosphating treatments and other chemical treatments.

Stainless Steel — Preparing stainless steel with mechanical methods includes:
1. Blasting with sand or aluminum oxide (Steel grit should not be used because it leaves ferrous deposits that can cause galvanic corrosion.)
2. One-hour layover maximum

Chemical treatment for the passivation of stainless steel involves the following:
1. Vapor degreasing and/or alkaline cleaning
2. Immersion for 15 to 20 minutes at 120°F to 135°F in a solution of nitric acid (20% to 25% by weight), sodium dechromate (2% to 4% by weight) and water (71% to 78% by weight)
3. Cold water rinse
4. 1-hour dry

Immersion times, solution concentrations and operating temperatures may be adjusted to suit conditions and alloys.

Aluminum — The preferred mechanical method for preparing aluminum is blasting. This includes:
1. Blasting with sand or aluminum oxide (Steel grit should not be used because it leaves ferrous deposits that can cause galvanic corrosion.)
2. One-hour layover maximum

Chromate alodizing of aluminum also produces excellent bonds. This involves:
1. Vapor degrease and/or aqueous aluminum
2. Water rinse
3. Deoxidizer
4. Water rinse
5. Chromate conversion treatment
6. Water rinse
7. Warm air dry

Consult the manufacturers of the proprietary materials used in these processes for more information.

Aluminum surfaces may also be prepared by anodizing (electrolytic deposition of aluminum oxide). Although both sulfuric acid anodizing and chromic acid anodizing are effective when preparing aluminum, chromic acid anodizing should not be used when bonding silicone rubbers. Surfaces prepared with sulfuric acid anodizing must be unsealed and the adhesive applied within one hour.

Magnesium — Depending upon the required environmental resistance, preparation of magnesium surfaces varies. Blasting with sand or aluminum oxide provides a good bonding surface, but the bond will not resist environmental conditions well. For best results, use chemical methods such as chrome pickling or anodizing.

Brass and Copper — In addition to blasting with sand or aluminum oxide, brass and copper surfaces may be treated with chemical methods, including ammonium persulfate etching. The steps for this procedure are:
1. Vapor degrease and/or alkaline clean
2. Immersion for 1 to 2 minutes in a solution of ammonium persulfate (25% by weight) and water (75% by weight)
3. Water rinse
4. Dry

Zinc — Zinc surfaces are almost always prepared mechanically. However, be careful when bonding directly to zinc-plated, galvanized or electrogalvanized surfaces. Typically, hot dip-galvanized substrates can’t be adhered to, whereas electrogalvanized surfaces do accept bonds.

Plated Metals — Two unique problems are often encountered when preparing and bonding plated metals:
• Vigorous mechanical treatment may penetrate and destroy the plating.
• Plating-to-base adhesion may be inadequate.

Since the plating process produces a clean, bondable surface, freshly plated surfaces often do not require additional preparation. Keep in mind, however, that plating changes surface properties such as adhesion, porosity and surface stress of the metal deposit. Current density, composition of the plating bath (including brightener content) and temperature of the bath also affect the plated surface’s ability to be bonded.

When mechanical pretreatment is used, abrade the surface lightly. Fine grades of sand or abrasive paper will minimize penetration. The correct chemical treatment depends upon the type of metal which is deposited during the plating process.

If the plating does not adhere tightly to the base metal, the plating process itself should be investigated. Application of Chemlok 205 or 207 primer (0.1 to 0.2 mil) often improves adhesion to plated metals.

Plastics — Rubber can be bonded to many rigid plastics. To prepare plastic surfaces:
1. Clean with aqueous alkaline or a non-aggressive solvent
2. Lightly sand or abrade the surface (Avoid sanding vigorously; this creates excessive heat, which will melt the plastic, impede bonding and warp the substrate.)

Miscellaneous Substrates — The principles outlined in this bulletin can be adapted to the surface preparation of almost any rigid material for bonding. Again, the essentials of proper surface preparations include:
• Removal of all surface contaminants and decomposition products
• Prevention of recontamination
• Careful handling through all processing steps

Also remember that high surface profiles from mechanical blasting generally bond better than those with low surface profiles.

Selecting a Preparation Method — To determine which preparation method best suits your needs, consider:
• Economy — In large volumes, chemical treatments are generally less expensive than mechanical methods.
• Versatility — Mechanical preparation methods may be applicable to numerous metals, while chemical treatments may be metal-specific.
• Adaptability to Existing Equipment — Existing facilities may favor either mechanical or chemical processing.
• Adhesion Requirements — Adhesion requirements vary from product to product, and bond quality is affected by the particular application. Therefore, surface preparation will vary accordingly.
• Environmental Resistance Requirements — Chemical conversion often provides better environmental resistance than mechanical methods.
• Government Regulations — Waste disposal regulations may prohibit the use of chemical treatments in certain areas.

**Maintenance of Surface Properties** — Maintaining optimum surface cleanliness is essential until adhesive application is complete. To accomplish this:
• Apply the primer or adhesive immediately after the surface is prepared.
• Avoid exposure to dust, moisture, chemical fumes, mold release agents and other possible contaminants.
• Keep solvents and cleaning solutions free from contamination, and replace when necessary.
• Ensure abrasives remain clean and free of contaminants.
• Check the purity of rinse water and “drying” air frequently, ensuring minimal contamination.
• Prevent surface oxidation by applying a coat of primer or adhesive.

The “water break” test can be used to check for oil and grease removal. If a surface can support an unbroken film of deionized water for 20 seconds or more, it is considered essentially free from grease or oil.
Preparing the Adhesive

Temperature — Temperature affects the viscosity of Chemlok primers and covercoats. If stored cold, allow them to return to the usual working temperature before using. For drums, this may take as long as 48 hours.

Dilution — Regardless of dilution amounts, it is important — in all cases — that the appropriate diluent be added to the primer or adhesive while stirring. Depending upon the application, dilution of both the primer and covercoat may be required. Mixing guidelines are listed on product bulletins that come with each Chemlok product.

Pails, Single Gallons and Smaller Containers — Hand-stir in a “figure 8” motion with a wooden paint stick. For gallon containers, paint shakers may also be used with solvent-based adhesives. Fifteen minutes is usually sufficient.

Continue mixing until all settled material is removed from the bottom and the solution has a uniform appearance. Stir frequently during use.

To minimize solvent loss, replace the container lid when not in use. Solvent loss reduces ingredient solubility, and increases solids content and viscosity.

Caution: If used, electric mixers should have spark-proof motors.

Drums — Chemlok products are available in standard 55-gallon drums as well as 55-gallon units with built-in agitators. The standard drum has two openings (3/4-inch and 2-inch) in the drum head, while the agitator drum has a 2-inch side opening near the drum head outer edge. Regardless of type, all steel drums have protective interior coatings that have been tested for safe storage.

Most Chemlok products are available in agitator units, which have a double-blade agitator accessible through a bung in the center of the drum head. (See Figure 1) Initially, a steel hand crank may be used to loosen settled material. Then, the adhesive should be agitated at least three to four hours at 40 to 60 rpm prior to use; eight hours is recommended. For continuous agitation, a variable speed, air-driven motor is typically used.

Applying the Adhesive

Chemlok solvent-based adhesives may be applied by brushing, dipping, spraying or roll-coating. General recommendations are:

- Primer dry film thickness — 0.2 to 0.5 mil (.0002 to .0005 inch)
- Covercoat dry film thickness — 0.5 to 1.0 mil (.0005 to .001 inch)
- Post-vulcanization bonding — 0.8 to 1.3 mil (.0008 to .0013 inch)

Hand Brushing — Chemlok solvent-based adhesives are suitable for hand brushing straight from the can. When using this method, wear cloth gloves and work in a clean environment. Also make sure there are no dirty or greasy objects within reach.

When working from small, open containers, solvent evaporation may increase adhesive solids. This is particularly true with large brushes, which carry a substantial volume of...
adhesive in the brush body. This adhesive dries and, in some cases, becomes pasty.

If brush strokes become visible on painted parts, dilute the adhesive to the original viscosity. Brushing is easiest when the viscosity is correct.

Primers and covercoats usually dry in 30 to 60 minutes at 70°F. Higher temperatures and/or increased air circulation will accelerate drying time.

**Dip Application** — Hand-dipping Chemlok adhesives is recommended when only a small number of parts need to be coated or when factory conditions prohibit mechanical units. To avoid excess coating, sags and drips, withdraw parts from the adhesive slowly. Also be sure to control the viscosity and agitate the adhesive frequently.

**Mechanical Dipping** — There are two primary mechanical dipping applications: conveyor equipment and dip tanks.

Conventional conveyor equipment is classified as either monorail or bar conveyor systems. The monorail system is a single-chain unit; the bar conveyor is a double-chain assembly with bars running horizontally between the chains. Selection of a conveyor unit depends on the size and number of parts to be dipped.

For best results, arrange the conveyor’s dipping section so parts are withdrawn at an angle rather than straight up and down. By removing the parts at an angle, the conveyor’s forward motion provides a gradual vertical lift, which allows excess fluid to drain evenly from parts.

When using dip tanks, the adhesive should be agitated continuously, ensuring a good top-to-bottom turnover. The constant motion prevents skinning and sweeps air bubbles to the side. Circulating pumps or submerged impeller agitators are very effective. Because of the filler content, diaphragm pumps, if used, should be dual-diaphragm models.

Tank depth should only accommodate the largest part to be dipped. Additional depth only increases the volume of the tank and lessens the likelihood of adhesive turnover. Also, the tank bottom should be slanted so that immersion depth of the parts and the tank depth both decrease as parts move up and out at an angle.

To facilitate adhesive changing and minimize down-time, tanks should be mobile. If parts are to be partially dipped or if the conveyor’s low point is not adjustable, provisions will be needed for raising or lowering the tank. A drip pan behind the dip tank is also recommended. If excess droplets from the parts have not hardened, they may be returned to the tank. However, if the material has solidified, it should be discarded. Other suggestions include:

- Equipment made of carbon steel
- Large piping to ensure low-pressure operation
- Solvent-resistant packing or a mechanical seal in all pumps
- Method for agitating contents of the tank

Chemlok adhesives may be agitated or pumped continuously over indefinite periods without damage. However, over-mixing can cause solvent loss.

**Depth of Immersion** — As a general rule, avoid immersing parts deeper than absolutely necessary. This minimizes adhesive build-up. For parts that require only partial coating, adjust the conveyor line height or immersion tank level to suit your needs.

It’s also important to clean part-hanging hooks prior to use. And when a variety of parts will be processed by the same dipping equipment, various hook sizes may be needed.

**Design of Metal Parts** — To ensure successful dipping, a metal contour or hole should be designed in the part’s upper body for securing it to a conveyor hook. The part should hang so drainage is toward a point where the adhesive tear will not interfere with the molding process. Air entrapment can be avoided by changing positions on the conveyor hook. Protruding stud heads that have been welded or swaged into flat plates frequently trap air where the weld is not completely filled. If the stud is at a high stress point, the small void can be the first spot of bond failure. Hand touch-up of critical points may be needed to prevent solvent entrapment.

**Perforated Metals** — When parts with small perforations are dipped, adhesive is frequently trapped in the holes, causing webbing or sagging. You may need to “touch up” these areas with a paint brush. Withdrawing parts slowly from the dip tank helps prevent these problems.
Precautions With Threaded Parts — Soft, rubber caps or thimbles for externally threaded studs, or a cork for tapped holes, are often used to protect threads from adhesive coating. Unfortunately, these protective devices are not always effective. **Do not dip if it is important to the function of the part that threads be clean.**

Withdrawing Parts From the Adhesive — Removing metal parts slowly from the adhesive is critical to dipping success. If removed too quickly, an excessive amount of adhesive may cling to the part. This excess adhesive drains slowly and unevenly, forming tears, sags and fat edges. Collectively, these imperfections reduce aesthetics, prolong drying time and, ultimately, affect the overall molding operation.

For optimum results, remove parts slowly and evenly. This allows uniform adhesive drainage, helping eliminate bond defects. A vertical withdrawal rate of 3 feet per minute is usually satisfactory.

Dip/Spin Coating — Dip/spin coating may be used on small parts, but appearances are not as uniform as dipping. Despite reduced aesthetics, this method is satisfactory for many applications, including rubber-encapsulated inserts.

When dip/spin coating, place parts in a dip/spin barrel, dip in the appropriate primer, then spin in the drum at a high rpm until excess primer is removed. Coated parts can then be dumped onto a screen or open conveyor to dry at room temperature or in warm, dry, circulating air. The same procedures can be used when applying the adhesive covercoat.

Spray Application — Spray application of adhesives is particularly applicable when coating one side or certain areas of a part. When spraying, however, it is important that the adhesive reach the substrate wet. If drying occurs before reaching the metal, adhesion will be poor.

Hand-held guns may be used for small runs, while conveyorized or automated units are effective for large production operations. To reduce overspray, electrostatic units can be employed. And for small, intricate parts, an air brush may be used. Regardless of size, properly adjusted equipment ensures delivery of uniform films — without sags and tears.

During hand-spray operations, parts are often assembled on racks that incorporate masks wherever needed. If the application requires overall coating, parts can be rotated in front of the spray gun. Chain-on-edge conveyors can be programmed to automatically rotate metals as they pass the guns.

Spray Equipment — Many manufacturers make paint guns that are also suitable for applying Chemlok adhesives. The preferred system includes:

- Gun tips and air caps suited for job-specific volume and spray pattern
- Adjustable air pressure on the liquid supply tank
- Controllable atomizing air pressure on the gun or air source
- Screen (usually 100 mesh) in the liquid line
- Filters and moisture traps in air lines

Removal of oil and water is critical to preventing contamination. Therefore, the entire spray system should be easy to dismantle and clean. If settling of diluted adhesive in a flow-restricted areas becomes a problem — particularly in an automatic airless spray system where adhesive flows the majority of the time — it may be necessary to install plumbing which switches to a clean-out solvent every eight hours.

When spraying Chemlok adhesives, it is also important to continuously agitate the supply tank. Liquid lines (preferably 3/8-inch or less diameter hoses) should be short to provide rapid flow rate and prevent dead spots where settling can occur.

Electrostatic Spray Equipment — A number of devices may be used for electrostatic spray applications, including electrostatic and conventional electrostatic air hand guns, and spinning disc and mini-bell electrostatic applicators. (The controls and adjustments on electrostatic and conventional electrostatic guns are similar except for the necessity of a remote power-pack.)

When using these applicators, a small amount of MEK, or other polar solvent such as diacetone alcohol or cyclohexanone, may be needed to increase covercoat polarity. Slow-evaporating aromatic solvents may also be added to primers to improve the spray’s wrap quality.

Do not, however, exceed 15% ketone by volume when diluting a topcoat that will be
sprayed over an uncured primer. This eliminates the chance of re-solvating the primer.

Because of the high dilution typically used with primers and adhesives, both must be continuously agitated. Also, hose and piping lengths should be minimized, and precautions should be taken against adhesive settling in the lines during extended shut-downs.

Coverage — Estimating coverage of sprayed adhesives is difficult, as the quantity used depends largely upon the amount of overspray. In many cases, it may be as much as 50%. With electrostatic spraying, however, transfer efficiency may be as high as 75%; thus, a much higher coverage rate can be expected.

Controlling Atomizing Air Pressure — Maintaining atomizing air pressure is important to successful spray application. If the pressure is too high, adhesive droplets may disperse and dry before reaching the metal, leaving a dry, dusty appearance. Threads of material will also be seen floating in the spray booth. You can control the problem by reducing atomization pressure, further dilution or by using a higher boiling solvent.

Controlling Premature Drying — Spray-coated parts dry much more quickly than dipped parts, as partial drying occurs during atomization. To properly wet the metal, the adhesive must be fluid when it reaches the substrate. If multiple guns are used, ensure each is applying a wet coat. Do not apply a dry coat with the first gun then cover it with a wet coat.

Roll Coating — Roll coating may be used to coat cylindrical or flat objects. Shafts and pipes can be coated by holding them momentarily between two rotating felt rolls that have been dipped in adhesive. A mohair fabric paint roller can be used to coat large, flat surfaces. However, short nap rollers are preferred.

Reverse Roll Coating — Reverse roll coating is used to apply Chemlok solvent-based products to coil steel, coil aluminum or coil stainless. If you do not have two coating units that can run in tandem, the primer must be covercoated at a later time.

When reverse roll coating, pump the primer (or adhesive) from a drum into a coating pan. A pick-up roll then transfers the adhesive to an applicator roll that the coil metal passes over at a line speed of 100 to 150 feet per minute. Adjust the primer or adhesive flow rate so it overflows the coating pan into a slanted trough, which then returns the material to the drum. This system ensures constant agitation.

Drying Processes

All Chemlok solvent-based adhesives can be dried at room temperature (30 to 45 minutes at 75°F is sufficient). If faster drying is necessary, use a circulating air dryer at 150°F to 200°F. Be sure there is adequate air circulation, though, because the fastest drying occurs when the solvent is removed and begins diffusing through the surface. Air may be recirculated, provided there is enough bleed-off to prevent excessive solvent build-up.

With closed systems, care must be taken to prevent explosive solvent build-ups. For this reason, conveyored dryers with open ends and crosswise air circulation are most often used. Gas-fired ovens may also be used — if they are designed properly. It’s also important to purge solvent vapors and unburned gas before restarting gas ovens.

Other effective dryers include steam coils and infrared heat lamps. When using heat lamps, however, temperature of the substrate surface must not exceed 250°F, and should be interlocked to shut off if the line stops.

Handling Coated Parts

After drying, unload coated metal parts directly from the conveyor into tote baskets. They may be handled while warm without danger of scuffing; however, be aware of any sharp points and corners.

Coated areas that will receive high levels of stress should be protected or retouched if damaged. Removing adhesive from these areas may cause premature bond failure.

Both clean metal parts and coated materials should be kept free of contamination. Because fingerprints can adversely affect adhesion, gloves are highly recommended. Thin, white, cotton gloves are satisfactory, as they show soil easily, are economical enough to be discarded when necessary, and are thin and porous enough to be comfortable.
Coated Parts Layover Stability

Mold as soon as possible, but store all coated parts properly to ensure maximum layover. Typically, this entails sealing rubber-treated metals in a plastic bag and storing the package in a cardboard box. These precautions ensure parts are not exposed to UV light.

Proper Storage

Temperature variations encountered during shipping and storage typically do not affect the performance of Chemlok solvent-based primers and adhesives. However, freezing temperatures may increase viscosity, and some products may gel. All products should be warmed to room temperature before using. Refer to product literature for additional information.

Summer storage and shipping temperatures, on the other hand, may exceed safe limits for Chemlok products. Shipping and storage temperatures of 40°F to 90°F are recommended, and temperatures greater than 100°F should be avoided. Also, avoid storing Chemlok products near heating units and in upper racks of non-air conditioned warehouses. Cool and well-ventilated storage areas are ideal and should be used whenever possible. Special handling and storage precautions, when necessary, will be clearly marked on drums.
Differences Between Solvent-based and Aqueous Adhesive Systems

Aqueous products are made from a mixture of high molecular weight polymer emulsions, pigments and curatives in a water-based medium; solvent-based adhesives, on the other hand, consist of pigments and curatives with dissolved polymers in a solvent solution.

Although the chemical make-up of Chemlok solvent-based and aqueous systems is similar, handling requirements differ.

**Preparing the Adhesive**

Like solvent-based products, most aqueous primers and covercoats must be agitated before use to ensure consistent performance. Use slow, controlled stirring by hand, or by motor-driven or air-powered stir paddles at 30 rpm or less, rather than high-shear agitation; vigorous agitation causes bubbles which interfere with the adhesive’s film-forming characteristics. Also avoid contaminating the adhesive during agitation.

Gallon-size or smaller containers may be hand-mixed with a paint stick. Mechanical agitation may also be used, but solid materials should first be loosened from the container bottom. **Chemlok aqueous adhesives should never be mixed on a paint shaker — even for a short period.**

Mix 5-gallon pails mechanically, using stainless steel agitator paddles. Drums are equipped with built-in, single-blade agitators, and air motors can easily be attached. Single-station drum agitators are available, as well as multi-drum configurations. Consult the suppliers’ list for more information on these systems.

**Applying the Adhesive**

Chemlok aqueous primers and adhesives can be applied by spraying or dipping. In some cases, brushing, roll coating or pad painting techniques are used; however, they are not recommended for several reasons:

- **Surfactants in aqueous systems produce foam during brush application.**
- The low viscosity of the products can cause adhesive pooling. (In areas where there is pooling, the dried film will be thick and lack chip resistance.)
- **Controlling dry film thickness and uniformity is difficult.**

Whenever possible, aqueous adhesives should be sprayed. Film thickness and uniformity are more easily controlled and dry films are cosmetically superior. Spray application also accelerates drying because the atomization of aqueous systems increases the surface area where evaporation can occur.

**Spray Application** — When spray-applying Chemlok aqueous primers, one pass is usually sufficient to achieve appropriate dry film thickness. This is particularly true when the primers are finely atomized. In most cases, conventional air guns produce the finest adhesive droplet size.

**Benefits of Aqueous Systems**

The most obvious benefit of Chemlok aqueous adhesives is protection of the environment. In fact, meeting and complying with environmental regulations like the Clean Air Act of 1990 has been a major impetus in the development of more environmentally sound products. Directly related to environmental benefits is increased workplace safety. Because solvents are not present in aqueous adhesives, workers aren’t exposed to fumes. This, in turn, eliminates potential fire hazards associated with flammable solvents.
For automatic systems, consider the part size and configuration when selecting a system. Gun position, number of guns, and whether or not reciprocating guns are installed all affect aqueous primer and covercoat thickness. Choose a system that will provide uniform film thickness and complete coverage.

If you have stainless steel spray guns and pressure pots that were used to apply solvent-based products, you can also use them to apply aqueous systems. However, all solvent-based materials must be removed from the equipment. Lines should be flushed first with solvent — MEK is recommended — then with water, until water exiting the system runs clean. Never allow MEK to stand in lines for more than a few minutes. If you plan to use solvent-based systems with the equipment again, reverse the process.

When using chain-on-edge equipment, you may need to make adjustments to accommodate a preheat cycle before applying the primer or one-coat. However, it may be possible to change the point where parts are loaded rather than adding new equipment to the line. If you consider such a change, consult a Lord Technical Service Representative for additional help.

### Spray Equipment —
A wide variety of spray guns can be used to apply Chemlok aqueous adhesives. Given the lower dry film thickness requirements of the primers (0.2 to 0.4 mils) relative to the covercoats, you may need to dilute primers 10% to 30% with deionized water, particularly when using HVLP (high-volume, low-pressure) equipment. Covercoats and one-coats, however, can usually be sprayed full strength.

Use gun tips ranging from 0.030 to 0.042 inches for primers and 0.042 to 0.055 inches for adhesives. When using conventional air-atomized guns, atomization pressures range from 20 to 50 psi, while pressures for HVLP guns typically range from 2 to 7 pounds. For both manual and automatic spray lines, 50 mesh in-line fluid filters are recommended.

Spray equipment options include:

**Electrostatic Spray Units** — Most Chemlok aqueous adhesive systems can be sprayed with electrostatic spray units, and portable electrostatic air atomizing equipment can be used to apply many Chemlok aqueous systems. Occasionally, dilution of 10% to 30% is required to atomize materials adequately and maintain correct film thickness. Typical equipment and settings are shown in Figure 2.

**Air Turbine Spray Systems** — Air turbine spray units are low-pressure systems designed to reduce overspray. Advantages of turbine systems include material savings of approximately 30% to 65%, improved film build and faster drying.

Operating in the 2 to 5 psi range, turbines deliver a constant, high volume head of heated air to the gun. Once atomized, the turbine produces an invisible cone of warm air that helps project particles to the metal surface. (Because most of the atomized particles are held within the cone, even distribution is produced within the fan range.) The warm air of the turbine also aids in drying.

The equipment shown in Figure 3 has been tested by Lord Corporation and found satisfactory for applying Chemlok aqueous adhesives. Depending upon the product and application, dilution may be necessary.

### Conventional Air-Atomized Units —
Conventional air-atomized systems typically provide excellent, uniform dry films with all Chemlok aqueous systems. (See Figure 4) However, the atomizing pressure (usually 20 to 40 pounds) should be monitored closely. If too much pressure is applied, the adhesive will...
disperse, possibly causing dry spray. Also, the turbulence created by the high pressure will likely create significant overspray. To control dry spray, reduce the atomizing pressure or move the gun closer to the metal insert. Other Spray Systems — Information is also available by request for recommendations on HVLP (high-volume, low-pressure) systems. Air-assisted and airless spray techniques are not recommended for application of Chemlok aqueous adhesive systems.

Dip Application — Dipping is acceptable for aqueous adhesives. In most dip applications, aqueous adhesives can be used full strength.

To achieve desired film thickness and maintain uniformity, it may be necessary to dilute primers 10% to 30% and covercoats 5% to 10%. Even then, film thickness may show variations from top to bottom. Since inserts are generally completely coated when dip-applying adhesive, be aware that problems with demolding or mold fouling can occur where coated metal comes in direct contact with the metal mold. (See Figure 5)

Follow these steps when converting dip tanks to an aqueous system:
1. Dismantle and clean all plumbing and hardware.
2. Blast the tank and fluid passages, and apply a protective epoxy coating.
3. Replace hoses, tubes and fittings with rubber, plastic or stainless steel components.
4. Clean stainless steel or plastic tanks, rinse with methyl ethyl ketone, then with water.

Aqueous adhesives should be well-mixed prior to charging the dip tank. To pump adhesive from the pail or drum to the dip tank, use a double-diaphragm pump constructed of stainless or plastic with Teflon diaphragms. The adhesive should be filtered through a 150- to 200-micron GAF bag filter installed in line with the pump.

While in the dip tank, continuously agitate the adhesive, and monitor the density with a hydrometer at least once each shift or when extra material is added. Before adding material, however, the adhesive should be pre-diluted to the appropriate density. Also monitor the tank level to ensure material completely covers the metal inserts being dipped. (Some dip tanks use an overflow and sump to maintain constant fluid level.)

Dry film thickness will vary on most dipped inserts, with the thinnest areas at the top and the heaviest areas at the bottom and around drainage areas. What’s more, dipping pre-heated metals inserts may cause variations from top to bottom, making dry film thickness more difficult to control.

To control dry film thickness, adjust the withdrawal angle and rates. Typical withdrawal angles should be 10 to 35 degrees from horizontal. Higher or lower angles may cause uneven or heavy films.

While withdrawal angles are important, withdrawal rates of aqueous systems (vertical inches per minute) have the biggest effect on surface appearance and tear drop at the part bottom. Withdrawal rates should range from 2 to 18 vertical inches per minute. If faster than 18 vertical inches per minute, foam may form.

Position parts to drip to one corner for best results. And for heavy metal inserts, use an air knife to remove or minimize drip at the part bottom. If used, position the knife so the drip is removed before it begins to skin over.

The tank and conveyor should be constructed so that excess adhesive drips back into the tank. Do not, however, allow dried adhesive to re-enter the tank because it will not redissolve. Foil or a disposable cover for the drip board can be used to facilitate clean-up and avoid build-up.

If possible, use a forced-air heat source when drying inserts on a dip line. The drying chamber should be ventilated to remove any accumulation of water vapor and volatile material. Oven temperatures should also be adjusted to achieve a peak metal temperature no higher than 130°F (54°C) for primer films; otherwise, metal inserts will be too hot as they enter the dip tank.

At temperatures between 110°F to 130°F, (43°C to 54°C), the adhesive film on most metal inserts can be dried within 70 seconds.

While in the dip tank, continuously agitate the adhesive, and monitor the density with a hydrometer at least once each shift or when extra material is added. Before adding material, however, the adhesive should be pre-diluted to the appropriate density. Also monitor the tank level to ensure material completely covers the metal inserts being dipped. (Some dip tanks use an overflow and sump to maintain constant fluid level.)

Dry film thickness will vary on most dipped inserts, with the thinnest areas at the top and the heaviest areas at the bottom and around drainage areas. What’s more, dipping pre-heated metals inserts may cause variations from top to bottom, making dry film thickness more difficult to control.

To control dry film thickness, adjust the withdrawal angle and rates. Typical withdrawal angles should be 10 to 35 degrees from horizontal. Higher or lower angles may cause uneven or heavy films.

While withdrawal angles are important, withdrawal rates of aqueous systems (vertical inches per minute) have the biggest effect on surface appearance and tear drop at the part bottom. Withdrawal rates should range from 2 to 18 vertical inches per minute. If faster than 18 vertical inches per minute, foam may form.

Position parts to drip to one corner for best results. And for heavy metal inserts, use an air knife to remove or minimize drip at the part bottom. If used, position the knife so the drip is removed before it begins to skin over.

The tank and conveyor should be constructed so that excess adhesive drips back into the tank. Do not, however, allow dried adhesive to re-enter the tank because it will not redissolve. Foil or a disposable cover for the drip board can be used to facilitate clean-up and avoid build-up.

If possible, use a forced-air heat source when drying inserts on a dip line. The drying chamber should be ventilated to remove any accumulation of water vapor and volatile material. Oven temperatures should also be adjusted to achieve a peak metal temperature no higher than 130°F (54°C) for primer films; otherwise, metal inserts will be too hot as they enter the dip tank.

At temperatures between 110°F to 130°F, (43°C to 54°C), the adhesive film on most metal inserts can be dried within 70 seconds.
(See Figures 6 - 8) Drying temperatures of 150°F to 200°F (65°C to 93°C) are acceptable for one-coat products. Before removing, inserts should be cooled to at least 110°F (43°C) to minimize chips in the film and avoid sticking.

When not in use, the dip tank should be covered to prevent contamination and water loss. To avoid hard settling, maintain agitation during down times. Also completely redisperse any settled solids before reuse, and remove any inserts that have fallen into the tank.

**Automatic Systems** — Monorail systems are often used for large parts that must undergo more than one process. However, output is relatively low and the labor per piece is high. Monorail systems also require large capital investments and a significant amount of floor space.

When only adhesive application is necessary, bar conveyors may be used. These systems are effective for small parts, requiring less floor space and providing more labor efficiency than monorail systems. Automatic unloading is sometimes used.

**Brushing** — Brush application of Chemlok aqueous adhesives is not recommended. But, if it is necessary, use either a 100% natural fiber bristle brush or a foam brush. Apply the adhesive in one direction with short brush strokes while keeping the wet film uniform and free of surface voids. Also, avoid rebrushing the wet film and flooding the metal with adhesive.

Brush-apply primers full strength at a wet film thickness of less than 1 mil. Aqueous covercoats should be applied at 2 to 3 mils wet for proper dry film thickness in a single pass. Even when using aqueous covercoats at full strength, achieving an adequate dry film thickness in a single application may be difficult without experiencing runs and sags. For best recoating results, allow the first coat to dry thoroughly, then apply a second coat. (Avoid recoating if possible.)

**Roll Coating** — As with brushing, roll coating Chemlok aqueous adhesives is not recommended. However — if necessary — use short nap rolls and a recommended defoamer; long nap and foam rolls cause surface foaming.

As with brush application, avoid recoating and work in one direction only. Primers and covercoats alike should be used full strength. Defoamer recommendations are available upon request.

**Pad Painting** — Due to foam formation, achieving cosmetically acceptable dry film with a foam pad applicator is difficult. If it is necessary to apply aqueous adhesives with this type of applicator, work in one direction and avoid recoating the wet film.

**Dry film cosmetics for all application methods described above can be improved by preheating the metal surface to 140°F.**

Additional cautionary information:

Whatever application method is used, make sure Chemlok aqueous adhesives do not come in contact with mild steel surfaces, including gate valves on drums, pressure pots and fluid feed lines. Only plastic or stainless steel is acceptable.

Dried films should also be removed regularly from equipment and paint booths. Like dried films of solvent-based Chemlok adhesives, the residue from Chemlok aqueous systems is combustible. Avoid exposing dried films to sparks, open flames or excessive heat. See the guide to safe handling of Chemlok adhesives.

**Accelerating Drying Time**

Dry time, dry film flexibility and the dilution/viscosity relationship of aqueous adhesive systems differ from solvent-based systems. Because water evaporates more slowly than solvents, aqueous adhesives may require more drying time. However, adjustments can be made to minimize or eliminate these differences.

To reduce drying time, preheat metals (120°F to 140°F; 49°C to 60°C) with an infrared heat lamp, forced air convection oven or electric oven before applying the primer. Preheating metal inserts causes aqueous adhesives to dry from the metal surface outward, preventing surface skin-over and water entrapment.

Often, preheating eliminates the need for further oven drying. Larger metal inserts may retain enough heat to make an additional preheat prior to covercoat application unnecessary. However, metal inserts can be reheated with no adverse effect on primer performance.
**Chemlok 8560D**  
Initial Solids Content = 45%

<table>
<thead>
<tr>
<th>Mix Ratio*</th>
<th>Specific Gravity</th>
<th>#2 Zahn Cup (seconds)</th>
<th>#3 Zahn Cup (seconds)</th>
<th>Brookfield Viscosity (cps)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Strength</td>
<td>1.286</td>
<td>30</td>
<td>13</td>
<td>225</td>
</tr>
<tr>
<td>90/10</td>
<td>1.194</td>
<td>19</td>
<td>10</td>
<td>85</td>
</tr>
<tr>
<td>80/20</td>
<td>1.172</td>
<td>16</td>
<td>9</td>
<td>35</td>
</tr>
<tr>
<td>70/30</td>
<td>1.142</td>
<td>15</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>60/40</td>
<td>1.120</td>
<td>14</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>50/50</td>
<td>1.000</td>
<td>14</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

*A #2 spindle @ 30 rpm was used for the full-strength, 90/10 and 80/20 dilutions; all other measurements were obtained using a #1 spindle @ 30 rpm.

**Chemlok 8560S**  
Initial Solids Content = 40%

<table>
<thead>
<tr>
<th>Mix Ratio*</th>
<th>Specific Gravity</th>
<th>#2 Zahn Cup (seconds)</th>
<th>#3 Zahn Cup (seconds)</th>
<th>Brookfield Viscosity (cps)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Strength</td>
<td>1.186</td>
<td>18</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>90/10</td>
<td>1.152</td>
<td>15</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>80/20</td>
<td>1.144</td>
<td>14</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>70/30</td>
<td>1.121</td>
<td>14</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>60/40</td>
<td>1.100</td>
<td>14</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>50/50</td>
<td>1.081</td>
<td>14</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

*A #2 spindle @ 30 rpm was used for the full-strength, 90/10 and 80/20 dilutions; all other measurements were obtained using a #1 spindle @ 30 rpm.

**Chemlok 8007**  
Initial Solids Content = 32.9%

<table>
<thead>
<tr>
<th>Dilution Ratio*</th>
<th>Hydrometer</th>
<th>#2 Zahn Cup (seconds)</th>
<th>#1 Zahn Cup (seconds)</th>
<th>Brookfield Viscosity (cps)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Strength</td>
<td>1.150</td>
<td>18</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>90/10</td>
<td>1.136</td>
<td>16</td>
<td>34</td>
<td>35</td>
</tr>
<tr>
<td>80/20</td>
<td>1.120</td>
<td>15</td>
<td>32</td>
<td>15</td>
</tr>
<tr>
<td>70/30</td>
<td>1.100</td>
<td>14</td>
<td>29</td>
<td>10</td>
</tr>
<tr>
<td>60/40</td>
<td>1.086</td>
<td>14</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>50/50</td>
<td>1.068</td>
<td>13</td>
<td>27</td>
<td>5</td>
</tr>
</tbody>
</table>

*A #2 spindle @ 30 rpm was used for the full-strength, 90/10 and 80/20 dilutions; all other measurements were recorded using a #1 spindle @ 30 rpm.

**Chemlok 8210**  
Initial Solids Content = 27.5%

<table>
<thead>
<tr>
<th>Dilution Ratio*</th>
<th>Hydrometer</th>
<th>#2 Zahn Cup (seconds)</th>
<th>#1 Zahn Cup (seconds)</th>
<th>Brookfield Viscosity (cps)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Strength</td>
<td>1.110</td>
<td>22</td>
<td>54</td>
<td>250</td>
</tr>
<tr>
<td>90/10</td>
<td>1.096</td>
<td>18</td>
<td>41</td>
<td>150</td>
</tr>
<tr>
<td>80/20</td>
<td>1.080</td>
<td>17</td>
<td>36</td>
<td>90</td>
</tr>
<tr>
<td>70/30</td>
<td>1.066</td>
<td>15</td>
<td>32</td>
<td>40</td>
</tr>
<tr>
<td>60/40</td>
<td>1.056</td>
<td>14</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>50/50</td>
<td>1.048</td>
<td>14</td>
<td>29</td>
<td>15</td>
</tr>
</tbody>
</table>

*A #2 spindle @ 30 rpm was used for the full-strength, 90/10 and 80/20 dilutions; all other measurements were recorded using a #1 spindle @ 30 rpm.

**Chemlok 8560D**  
#2 Zahn Cup Viscosity as a Function of Temperature

<table>
<thead>
<tr>
<th>Dilution Ratio*</th>
<th>35°F (12°C)</th>
<th>45°F (7°C)</th>
<th>55°F (13°C)</th>
<th>65°F (18°C)</th>
<th>75°F (24°C)</th>
<th>100°F (38°C)</th>
<th>125°F (52°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Strength</td>
<td>39.8</td>
<td>38.5</td>
<td>29.5</td>
<td>27.8</td>
<td>27.3</td>
<td>26.7</td>
<td>Gelled</td>
</tr>
<tr>
<td>90/10</td>
<td>21</td>
<td>20.7</td>
<td>20</td>
<td>19.7</td>
<td>19.6</td>
<td>19</td>
<td>18.8</td>
</tr>
<tr>
<td>80/20</td>
<td>18</td>
<td>17.5</td>
<td>16.4</td>
<td>15.5</td>
<td>15.3</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>70/30</td>
<td>15.7</td>
<td>15.4</td>
<td>15</td>
<td>14.6</td>
<td>14.5</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>60/40</td>
<td>14.5</td>
<td>14.5</td>
<td>14</td>
<td>14</td>
<td>13.8</td>
<td>13.5</td>
<td>13.5</td>
</tr>
<tr>
<td>50/50</td>
<td>14</td>
<td>14</td>
<td>13.5</td>
<td>13.5</td>
<td>13.5</td>
<td>13.4</td>
<td>13.4</td>
</tr>
</tbody>
</table>

*Dilution Ratio — part adhesive/part deionized water by weight; solids content of full strength adhesive = 45%.
If a metal preheat is impractical, the aqueous adhesive film may be dried either under ambient conditions or by running the inserts through a drying oven (120°F to 22°F; 49°C to 104°C). To accelerate drying time, raise the oven temperature, increase air flow or increase oven dwell time. (See Figures 6-8) Of these methods, increasing air flow is most effective.

Monitoring

Despite high non-volatile content (solids), the viscosity of aqueous adhesive systems is typically low. Consequently, monitoring application parameters with conventional methods is difficult. For example, dilution from 10% to 100% causes little change in Zahn cup viscosity.

Because density is a linear relationship between the non-volatile content and the amount of diluent, product density is the best way to monitor aqueous adhesive systems and control film thickness. Specific gravity can be measured with a hydrometer. (See Figures 9-18)

Storage

Aqueous adhesive systems should be stored in dry areas at temperatures between 70°F to 80°F (21°C to 27°C) at all times. If stored in subfreezing temperatures (32°F, 0°C), water crystals will form, and materials will coagulate and eventually freeze solid.

Extended exposure to temperatures above 100°F (38°C) should also be avoided, as this affects the adhesive's inherent stability; short-term storage (less than one week) in high temperatures, however, has little effect on viscosity or adhesive performance. (See Figures 19-23)

Coated Parts Layover Stability

Parts coated with Chemlok aqueous adhesives have shorter layovers than solvent-based systems; therefore, they should be molded within two to three weeks after coating. During layover periods, protect metal inserts from excessive heat, humidity, dust, contamination and light.
One of the most important steps in the manufacturing process is molding. During this phase, the adhesive-coated metals and rubber are placed in the mold cavity, and — under proper conditions of time, temperature and pressure — the bonded assembly is formed.

Controlling each step in the molding process is critical to bond success. Major variations in any step will cause bond failures. Minor alterations — though not detrimental individually — can collectively result in poor or marginal adhesion and above-average scrap rates.

For ideal bonding, maintain maximum mold pressure with minimum elastomer viscosity. This pressure/viscosity ratio, typically obtained with the specified time and temperature conditions, ensures peak wetting at the adhesive-elastomer interface. It also optimizes physical properties of the elastomer being cured.

Other considerations include:
- **Molding pressure.** Optimum adhesion requires adequate pressure and intimate contact of elastomer and adhesive during vulcanization and cure. Molds that are too tight or leaky will hinder bond quality.
- **Temperature.** Dramatic temperature variations from cavity to cavity may cause bond failure, lack of cure, or overcure on some parts. Mold temperature should be checked periodically — particularly within the individual cavities. Tempilsticks®, or selective melting-point wax pencils, are excellent for spot-checking mold cavities. Thermocouples can also be used, but they must be calibrated regularly.
- **Mold design.** When designing the mold, provisions should be made to facilitate substrate loading as well as removal of the vulcanized part. Also avoid mold parting lines in critical bond areas. Also avoid placing sprue holes near adhesive-coated metals. Close proximity during mold filling can cause sweeping or wiping of the adhesive from the metal surface.

![FIGURE 17](image17.png)

**Chemlok 8210**

Dry Film Thickness versus Hydrometer Reading

<table>
<thead>
<tr>
<th>Dilution</th>
<th>Specific Gravity</th>
<th>DFT on ZPS (mils)</th>
<th>DFT on GBS (mils)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Strength</td>
<td>1.110</td>
<td>0.68</td>
<td>0.78</td>
</tr>
<tr>
<td>90/10</td>
<td>1.093</td>
<td>0.49</td>
<td>0.50</td>
</tr>
<tr>
<td>80/20</td>
<td>1.080</td>
<td>0.37</td>
<td>0.40</td>
</tr>
<tr>
<td>70/30</td>
<td>1.066</td>
<td>0.19</td>
<td>0.24</td>
</tr>
<tr>
<td>60/40</td>
<td>1.056</td>
<td>0.15</td>
<td>0.16</td>
</tr>
<tr>
<td>50/50</td>
<td>1.048</td>
<td>0.10</td>
<td>0.10</td>
</tr>
</tbody>
</table>

![FIGURE 18](image18.png)

**Chemlok 8007**

Dry Film Thickness versus Hydrometer Reading

<table>
<thead>
<tr>
<th>Dilution</th>
<th>Specific Gravity</th>
<th>DFT on ZPS (mils)</th>
<th>DFT on GBS (mils)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Strength</td>
<td>1.150</td>
<td>0.31</td>
<td>0.33</td>
</tr>
<tr>
<td>90/10</td>
<td>1.128</td>
<td>0.13</td>
<td>0.20</td>
</tr>
<tr>
<td>80/20</td>
<td>1.114</td>
<td>0.11</td>
<td>0.12</td>
</tr>
<tr>
<td>70/30</td>
<td>1.098</td>
<td>0.09</td>
<td>0.06</td>
</tr>
<tr>
<td>60/40</td>
<td>1.088</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>50/50</td>
<td>1.068</td>
<td>0.04</td>
<td>0.03</td>
</tr>
</tbody>
</table>
**POST-TREATMENT**

Following part bonding, additional treatments are usually required. However, exercise caution throughout the process, especially during the following situations:

- When deflashing parts with dry ice or nitrogen. If temperatures in the tumbler remain too low for an extended period, there may be a failure between the adhesive and elastomer.
- When cleaning with a wire brush, grinding or machining. These procedures may cause bond problems by generating too much heat.
- When electroplating. If current densities are too high, the bond will be highly stressed during plating. Also, the adhesive must resist the plating bath.
- When painting parts. Bonds may fail if the adhesive does not resist solvents in the paint.

**TROUBLESHOOTING**

The American Society for Testing and Materials (ASTM) standard on adhesives provides detailed symptoms for bond failures. When used, these descriptions allow complete and accurate problem assessment as well as quick solutions. (For this discussion, the terms “elastomer” and “adhesive” should be interpreted as “rubber” and “cement” respectively.)

Covering nearly 80% of all bond failures, the four basic ASTM designations are:

- **RC: Failure at the rubber-cement interface**
- **CM: Failure at the metal-primer interface**
- **CP: Failure at the cover cement-primer interface**
- **R: Failure in the rubber**

**Rubber-Cement (RC) Failures**

Separations between rubber and cement are usually characterized by a hard, glossy surface with little or no visible rubber. Common causes of RC failures include:

- Adhesive precuring; low molding pressure or temperature; inadequate cure; and migration of plasticizers, oils and other incompatible compounding ingredients. Insufficient cement thickness on the metal surface can also cause RC failure.

**Cement-Metal and Primer-Metal (CM) Failures**

A clean separation between metal and primer or adhesive indicates that no adhesion has occurred. Often, oil, dirt, dust or other contaminants inhibit bonding. In some cases, environmental factors cause under-bond separation. When adhesive solvents evaporate too quickly, ultra-fast drying (cobwebbing) may occur. This dry spray prevents the primer or adhesive from wetting and adhering to the metal surface. Another problem is sweeping, when flow of the elastomer stock during bonding causes adhesive-metal displacement.

**Cement-Primer (CP) Failure**

Separation at the primer-cover cement interface is easily detected if the primer cement and cover cement are different colors. These failures are invariably due to contamination of the primer, plasticizer migration from the adhesive, or inadequate primer/covercoat mixing or drying.

**Rubber (R) Failures**

Rubber failures are separated into the following categories:

- **SR (Spotty Rubber)** — Often caused by pre-bond surface contaminants, this failure appears like splattered rubber on the metal surface. SR breaks are also caused by ultra-fast adhesive drying as it leaves the spray nozzle (cobwebbing).
- **TR (Thin Rubber)** — Thin rubber failures are marked by even, but very light rubber residue on the metal surface. These imperfections usually occur with butyl or rubber stocks that are highly oil-extended. When oils migrate to the RC interface, they create a bond layer that is part adhesive, part oil and part rubber, which easily fails when the part is stressed.
- **HR (Heavy Rubber)** — A thick or heavy layer of rubber remaining on the metal surface indicates an excellent bond. The stock fails because it is stressed beyond its cohesive strength.
- **SB (Stock Break)** — With stock breaks, the elastomer appears as if it was folded back on itself, then broken off. The break is jagged and at a sharp angle to the metal surface.

Although there are four primary bond failures, keep in mind that rubber-cement, cement-metal and rubber failures are often found in combination.

For more information on elastomer bonding and troubleshooting, refer to the comprehensive Chemlok guide DS10-2040C.
SAFE HANDLING

Proper handling of Chemlok adhesives is essential for safe and effective application. Although many of the flammability and health concerns can be avoided by using Chemlok aqueous systems, we recommend these procedures be followed when using any Chemlok product:

- Ventilate application and storage areas.
- Avoid use around ignition sources.
- Wear protective clothing.
- Clean application and processing equipment regularly.
- Dispose of waste according to federal, state and local regulations.
- Read labels, MSDS and product bulletins before use.

Guidelines for safe handling can be found in the brochure “Chemlok Adhesives — A Guide to Handling and Application,” (SI 3018).

LORD APPLICATIONS LABORATORY

As an extension of our product development efforts, Lord Corporation has invested in an aqueous adhesives applications laboratory. By simulating customers’ applications, we can provide detailed technical support and more thoroughly evaluate optimum application characteristics of new products. Up to 1,000 pieces can be coated on the current equipment, which can support the following processes:

Alkaline Cleaning — Small batches (15 gallons) of customer inserts can be cleaned with high-turbulence alkaline detergents. Testing of new cleaning methods and materials is also possible with this equipment.

Hand Spray — The application lab is equipped with various spray equipment, including conventional guns, HVLP hand spray guns and an electrostatic hand spray gun. Batch preheating and post-heating are also available.

Chain-On-Edge — To help customers determine production needs, a full-size Binks 1.5-pitch chain-on-edge spray line is available for coating parts. Parts can be preheated and dried in a 13-foot, gas-fired oven. In a 5-foot spray booth, Chemlok aqueous adhesives are applied by automatic spray guns supplied by pressure pots or fluid pumps with high- and low-pressure recirculation.

Dip Tank — A dual-conveyorized, 19-gallon dip tank with variable withdrawal angles and rates can process parts up to 12 inches long and 8 inches wide. It features stainless steel construction with a double-diaphragm pump overflow and recirculation.
SERVICE AND EQUIPMENT SUPPLIERS

Coaters of Chemlok® Adhesives
Allied Coating
95 Woodhaven Lane
Troy, OH 45373
Greg Flanary
(937) 335-1170
BT Industries
228 Buckeye Blvd.
Port Clinton, OH 43452
Terry White
(419) 738-9840
Hitech Industrial Coatings
1874 Englewood Avenue
Akron, OH 44321-1095
Jerry Rzeppa
(810) 759-3559
Heritage Industrial Finishing
1874 Englewood Avenue
Akron, OH 44321-1095
Patty Clark
(216) 798-9840
Ken-Koat, Inc.
1605 Riverfork Drive East
Huntington, IN 46750
Jim Berger
(219) 356-4192
Midwest Technical Coatings
101 S. Dye Mill Road
Troy, OH 45373
Tom Bowers
(513) 339-2409
Performance Product Painting, Inc.
63 Omni Circle
P. O. Box 1165
Auburn, ME 04211-1165
Paul LaVoie or Dave Sullivan
(207) 783-4222
Sun Manufacturing
107 Industrial Road
Williamstown, KY 41097
Joe Williams or Dave Mobley
(606) 824-5004
Tiodize, Inc.
28966 Wall Street
Wixom, MI 48335
Earnestine Smith
(513) 339-8445

Metal Cleaning Equipment
American Metal Wash
360 Euclid Avenue
Canonsburg, PA 15317
(412) 746-4203
Bowden Industries
1004 Oster Drive NW
Huntsville, AL 35816
(800) 553-3660
CAE Ransohoff Company
4933 Provident Drive
Cincinnati, OH 45246
(800) 248-9274
DOW Advanced Cleaning Systems Company
2020 Dow Center
Midland, MI 48674
(800) 436-9227
Finishing Equipment
3640 Kennebec Drive
St. Paul, MN 55122
(612) 452-1860
Mirachem Corporation
1045 South Edward Drive
Tempe, AZ 85281
(800) 847-3527
Novamax Technologies
12801 Newburgh Road
Liconia, MI 48150
(800) 942-4383
Proco Inc.
14790 St. Augustine Road
Jacksonville, FL 32258
(904) 886-0200
Syntech Products Corporation
530 East Woodruff Avenue
Toledo, OH 43624
(419) 241-1215
The Mart Corporation
2450 Adie Road
Maryland Heights, MO 63043
(800) 543-6278

Phosphating and Plating Chemicals
Man-Gill Chemical Inc.
29000 St. Clair Avenue
Cleveland, OH 44117
(800) 627-6422
Parker-Amchem
32100 Stephenson Highway
Madison Heights, MI 48071
(800) 222-2600
McGeon-Rohco
50 Public Square #1250
Cleveland, OH 44113
(216) 441-4900
Texaco Corporation
2801 Highland Avenue
Cincinnati, OH 45212
(513) 731-3400
Novamax Technologies
12801 Newburgh Road
Livonia, MI 48150
(313) 464-4555

Mixers
55-Gallon Drum Mixers
Binks Manufacturing Co.
9201 West Belmont Avenue
Franklin Park, IL 60131-2887
(708) 671-3000
Models #31-114 and #31-134
Dedoes Industries
91 Roberts Road
Ossineke, MI 49766
(517) 471-5413

Multi-Head Mixers
5-Gallon Pail Mixers
Binks Manufacturing Co.
9201 West Belmont Avenue
Franklin Park, IL 60131-2887
(708) 671-3000
“Quick-Mixer” Model #149-873
Chemineer
P. O. Box 1123
Dayton, OH 45401
(513) 454-3200
Models LTG-2X and LTD-2X
DeVilbiss Ransburg
1724 Indian Wood Circle, Suite F
Maumee, OH 43537
(419) 891-8200
Model 8Q-5000
Indco
P. O. Box 589
New Albany IN 47150
(800) 942-4383
Model 815
DeVilbiss Ransburg
1724 Indian Wood Circle, Suite F
Maumee, OH 43537
(419) 891-8200
QMS Series Models
Lightnin
221 Rochester Street
Avon, NY 14414
(716) 226-6136
Series 30 Air Drive Model
“Jiffy” Mixer Blades For Aqueous Adhesives
Indco
P. O. Box 589
New Albany IN 47150
(800) 942-4383
Spray Equipment
Accuspray
P. O. Box 381252
Cleveland, OH 44139-1525
(216) 439-1200
Binks Manufacturing Co.
9201 West Belmont Avenue
Franklin Park, IL 60131-2887
(708) 671-3000
DeVilbiss Ransburg
1724 Indian Wood Circle
Maumee, OH 43537
(419) 891-8200
Graco Inc.
4650 Olson Memorial Highway
Minneapolis, MN 55422
(612) 623-6000

Phosphating and Plating Chemicals
Man-Gill Chemical Inc.
29000 St. Clair Avenue
Cleveland, OH 44117
(800) 627-6422
Parker-Amchem
32100 Stephenson Highway
Madison Heights, MI 48071
(800) 222-2600
McGeon-Rohco
50 Public Square #1250
Cleveland, OH 44113
(216) 441-4900
Texaco Corporation
2801 Highland Avenue
Cincinnati, OH 45212
(513) 731-3400
Novamax Technologies
12801 Newburgh Road
Livonia, MI 48150
(313) 464-4555

Mixers
55-Gallon Drum Mixers
Binks Manufacturing Co.
9201 West Belmont Avenue
Franklin Park, IL 60131-2887
(708) 671-3000
Models #31-114 and #31-134
Dedoes Industries
91 Roberts Road
Ossineke, MI 49766
(517) 471-5413

Multi-Head Mixers
5-Gallon Pail Mixers
Binks Manufacturing Co.
9201 West Belmont Avenue
Franklin Park, IL 60131-2887
(708) 671-3000
“Quick-Mixer” Model #149-873
Chemineer
P. O. Box 1123
Dayton, OH 45401
(513) 454-3200
Models LTG-2X and LTD-2X
DeVilbiss Ransburg
1724 Indian Wood Circle, Suite F
Maumee, OH 43537
(419) 891-8200
Model 8Q-5000
Indco
P. O. Box 589
New Albany IN 47150
(800) 942-4383
Model 815
DeVilbiss Ransburg
1724 Indian Wood Circle, Suite F
Maumee, OH 43537
(419) 891-8200
QMS Series Models
Lightnin
221 Rochester Street
Avon, NY 14414
(716) 226-6136
Series 30 Air Drive Model
“Jiffy” Mixer Blades For Aqueous Adhesives
Indco
P. O. Box 589
New Albany IN 47150
(800) 942-4383

Spray Equipment
Accuspray
P. O. Box 381252
Cleveland, OH 44139-1525
(216) 439-1200
Binks Manufacturing Co.
9201 West Belmont Avenue
Franklin Park, IL 60131-2887
(708) 671-3000
DeVilbiss Ransburg
1724 Indian Wood Circle
Maumee, OH 43537
(419) 891-8200
Graco Inc.
4650 Olson Memorial Highway
Minneapolis, MN 55422
(612) 623-6000
Infrared Heaters
Black Body/BBC Industries
1524 Fenspark Drive
Fenton, MO 63026
Phone: (314) 343-5600
(800) 654-4205
FAX: (314) 343-3952
Fostoria Industries
1200 North Main Street
Fostoria, OH 44830
Phone: (419) 435-9201
FAX: (419) 435-0842
Glenro
39 McBride Avenue
Paterson, NJ 07501
Phone: (314) 343-5600
(800) 654-4205
FAX: (314) 343-3952
Heatrex
Moisertown Road
Meadville, PA 16335
Phone: (814) 724-1800
(800) 394-6589
FAX: (814) 333-6580
Innovative Industries
P.O. Drawer 41205
Cleveland, OH 44141
Phone: (216) 468-2601
(800) 843-7647
FAX: (216) 468-2602
OAL Associates
16744 West Bernardo Drive
San Diego, CA 92127
Phone: (619) 451-1799
FAX: (619) 451-2799
Heatrex
Moisertown Road
Meadville, PA 16335
Phone: (814) 724-1800
(800) 394-6589
FAX: (814) 333-6580
Research Inc.
P.O. Drawer 24064
Minneapolis, MN 55424
Phone: (612) 829-7481
FAX: (612) 941-3628
Spectrum Infrared
244 East 131st Street
Cleveland, OH 44108
Phone: (216) 451-7481
FAX: (216) 941-3628
Thermation
12307 Nicollet Avenue
Burnsville, MN 55337
Phone: (952) 939-4566
FAX: (651) 905-4966
Web Systems (WSI)
1354 Linden Drive
Boulder, CO 80304
Phone: (303) 440-4868
(800) 786-4860
FAX: (303) 442-8078

Induction Heaters
Ameritherm
39 Main Street
Scotstville, NY 14546
(716) 889-9000
Radio Frequency Co.
152 Dover Road
Millis, MA 12054
(617) 762-4900
Ross Production Systems
20780 Parker Street
Farmington Hills, MI 48336
(810) 476-2882
True Tube Industries
506 N. Warren Avenue
Brocton, MA 02405
(508) 584-4500

Dry Film Thickness (DFT) Testing Equipment Manufacturers
Manufacturers:
Automation USA
P.O. Box 563
Westminster, MD 21158
(800) 678-4370
CMI International
2301 Arthur Avenue
Elk Grove Village, IL 60007
DeFelsko Corporation
802 Proctor Avenue
Ogdensburg, NY 13669
Eclomter Inc.
1893 Rochester Industrial Drive
Elk Grove Village, IL 60007

Distributors
Erichson Instruments, Inc.
1340 East Home Avenue
Akron, OH 44310
(800) 626-7697
FAX: (800) 942-9742
Electromatic Equipment Co.
602 Oakland Avenue
Cedarhurst, NY 11516
(800) 645-4330
Electro-Physik USA
778 West Algonquin Road
Arlington Heights, IL 60005
(800) 927-8623
Fischer Technology, Inc.
750 Marshall Phelps Road
Windsor, CT 06095
(800) 243-8417
UPA Technology, Inc.
Instruments
Terminal Drive
Plainview, NY 11803
(516) 349-8300
Paul N. Gardner Company
316 N. E. First Street
Pompano Beach, FL 33060
(800) 762-2478

Fluid Filters
Binks Manufacturing Co.
9201 West Belmont Avenue
Franklin Park, IL 60131-2887
(708) 671-3000
3/8” NPS (f) x 1/4” NPT (m):
Part # 101-1245
50 Mesh Filter Assembly
Part #38-2089
Replacement Screens
DeVilbiss Ransburg
1724 Indian Wood Circle, Suite F
Maumee, OH 43537
(419) 891-8200
3/8” NPS (f) x 3/8” NPT (m):
Part #SSM-5507
Gun-Mounted Assembly
Part #SSM-5511
50 Mesh Filter Screens
Graco Inc.
4050 Olson Memorial Highway
Minneapolis, MN 55422
(612) 629-0000

Water Deionizers
Culligan
1 Culligan Parkway
Northbrook, IL 60062
(800) 451-2400
Graver Water Division
2720 U. S. Highway 22
Union, NJ 07083
(908) 964-2400
Osmonics
5449 Clearwater Drive
Minnetonka, MN 55343
(800) 848-1750
Strippable Spray Booth Coatings
Binks Manufacturing
9201 West Belmoy Avenue
Franklin Park, IL 60131-2887
(708) 671-3000
#791 Peelable Booth Coating
Chemco Manufacturing
3175 MacArthur Blvd.
Northbrook, IL 60062
(800) 323-0431
Booth Coat #27-5860

Induction Heaters
Ameritherm
39 Main Street
Scotstville, NY 14546
(716) 889-9000
Radio Frequency Co.
152 Dover Road
Millis, MA 12054
(617) 762-4900
Ross Production Systems
20780 Parker Street
Farmington Hills, MI 48336
(810) 476-2882
Vacuum Tube Industries
506 N. Warren Avenue
Brocton, MA 02405
(508) 584-4500

Dry Film Thickness (DFT) Testing Equipment Manufacturers
Manufacturers:
Automation USA
P.O. Box 563
Westminster, MD 21158
(800) 678-4370
CMI International
2301 Arthur Avenue
Elk Grove Village, IL 60007
DeFelsko Corporation
802 Proctor Avenue
Ogdensburg, NY 13669
Eclomter Inc.
1893 Rochester Industrial Drive
Elk Grove Village, IL 60007

Distributors
Erichson Instruments, Inc.
1340 East Home Avenue
Akron, OH 44310
(800) 626-7697
FAX: (800) 942-9742
Electromatic Equipment Co.
602 Oakland Avenue
Cedarhurst, NY 11516
(800) 645-4330
Electro-Physik USA
778 West Algonquin Road
Arlington Heights, IL 60005
(800) 927-8623
Fischer Technology, Inc.
750 Marshall Phelps Road
Windsor, CT 06095
(800) 243-8417
UPA Technology, Inc.
Instruments
Terminal Drive
Plainview, NY 11803
(516) 349-8300
Paul N. Gardner Company
316 N. E. First Street
Pompano Beach, FL 33060
(800) 762-2478
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 0ZJ
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

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.