Water-Based Chemlok® Adhesive Systems

Application Guide

This guide is an attempt to highlight the factors, discipline and detail that should be followed to ensure the highest level of performance when using water-based Chemlok® products.

Differences Between Solvent-based and Water-based Adhesive Systems:

Water-based adhesives are formulated using a mixture of high molecular weight polymer emulsions, pigments and curatives in a water-based medium. Solvent-based adhesives consist of pigments and curatives with dissolved polymers in a solvent solution. While the chemical composition of solvent-based and water-based Chemlok systems is similar, handling requirements differ.

Packaging:

Chemlok water-based adhesive systems are available in several sizes to accommodate varying production requirements. Choose from one of these convenient packages:

- 1-gallon pails (3.8 L)
- 5-gallon cans (18.9 L)
- 55-gallon (208.2 L), phenolic-lined metal drums with agitator paddles.

Substrate Surface Preparation:

One of the most important factors influencing adhesion in the bonding process is surface preparation. To ensure optimum bond performance and long-term environmental resistance, substrates must be free of organic and inorganic contaminants. Organic materials include grease, dirt and oils which can be removed by solvent or alkaline cleaning. Common inorganic contaminants are rust, scale and oxide layers. These can be cleaned by either mechanical 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

Technology Differences

Solvent-Based	Water-Based
Solutions/dispersions	Emulsions
Not VOC-compliant	All VOC-compliant
18-28% TSC by weight	25-50% solids by weight
Dilution typically required	Dilution rarely needed
Diluents: MIBK, MEK, Xylene, Toluene	Diluents: Deionized (DI) water, distilled water
Film thickness control by viscosity measurement: Zahn or Ford cup	Film thickness control by density measurement: hydrometer
More forgiving of part contamination	

media; particle velocity; and the hardness, porosity and other substrate properties.

- Abrading – A wire brush or abrasive paper 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 – If cutting oils are completely removed, machining may provide an acceptable bonding surface. However, any oil/grease left on the metal surface will reduce adhesion. For optimum bond results, do not exceed an eight-hour layover period between machining and adhesive application.

Chemical processes, on the other hand, utilize organic and inorganic chemicals to dissolve, suspend or eliminate soils and surface contaminants. Preparation methods include:

- Vapor/solvent degreasing – The solvent vapor 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 electrolytically deposited on bonding surfaces.
- Passivation
- Zinc phosphating
- Alkaline cleaning
- Chromate alodizing
- Chemical etching

Special Note About Degreasers

Although chlorinated solvents like trichloroethylene and perchloroethylene are still used for degreasing, many companies have discontinued use due to environmental and health-related issues. As a result, many "environmentally preferred" alternatives have been developed, which produce surfaces clean enough for use with adhesive systems. Popular alternatives to chlorinated solvent degreasers include:

- *Water-based alkaline cleaning systems, which have been used with solvent-based and water-based adhesives.*
- *Environmentally preferred petroleum-based solvents.*

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** – Chemical conversion often provides enhanced environmental resistance compared to mechanical methods.
- **Government Regulations** – Waste disposal regulations may prohibit the use of chemical treatments in certain areas.

Maintaining Surface Conditions:

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 grits and abrasives remain clean and free of contaminants.
- Check the purity of rinse water and "drying" air frequently, ensuring minimal contamination.

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 60 seconds or more, it is considered essentially free from grease or oil.

General Surface Preparation:

The following three-step process is the preferred mechanical surface preparation technique.

1. Degreasing;
2. Grit-blasting; and
3. Degreasing.

The above methods produce excellent surfaces for bonding most substrates. Sometimes, more elaborate chemical methods may be needed for certain substrates or for improved environmental resistance. For more information, please contact your Parker LORD Representative. Details on each specific method mentioned above are described under the heading for the specific substrate.

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

Surface Preparation for Various Substrates:

Although the general principles are the same for preparing all substrates, some materials require special attention. Outlined below are guidelines for surface preparation of specific substrates:

Steel (Mechanical Preparation)

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 similar corrosion compounds.

Steel preparation usually involves:

1. Degrease – The initial alkaline cleaning is used to remove soils such as greases and oils. This is done to prevent grit contamination during the subsequent blasting step. Scale or corrosion will not be removed.
2. Grit Blast – Blasting consists of impinging abrasive particles against the metal surface with an air stream that is free of oil and water. Grit size most commonly used is G-40. Use of grit is preferred over the use of shot since grit produces a rough, open surface, while shot peens the surface and sometimes causes occlusion with loose particles.
3. Alkaline Cleaning – The second alkaline cleaning step will ensure that abrasive dust and any contaminants that may be present in the blasting media are removed.

Consult the manufacturers of blasting equipment, abrasive media and alkaline cleaning units for specific information concerning equipment for this process. The names of representative qualified suppliers will be furnished on request.

Steel (Chemical Preparation)

Chemical treatments for steel typically include iron phosphate or zinc phosphate conversion coatings.

For rubber-to-metal bonding applications, calcium-modified, microcrystalline zinc phosphate (film weight of 125-450 mg/ft^2) 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. Cold water rinse
7. Hot water 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 (Mechanical Preparation)

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 between blasting and adhesive application.

Stainless Steel (Chemical Preparation)

Chemical treatment for the passivation of stainless steel involves the following:

1. Vapor degrease and/or alkaline clean
2. Immersion for 15 to 20 minutes at 49- 57°C (120-135°F) in a solution of nitric acid (20-25% by weight), sodium dichromate (2-4% by weight) and deionized water (71-78% by weight).
3. Cold water rinse
4. Dry and apply adhesive within 30 days.

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. Two-hour layover maximum between blasting and adhesive application.

Chromate alodizing of aluminum also produces excellent bonds. This involves:

1. Solvent degrease or aqueous clean
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).

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 provide outstanding environmental resistance. For best results, use chemical methods such as chromic pickling or anodizing. The chrome-pickle process consists of:

1. Vapor degrease and/or alkaline clean
2. Cold water rinse
3. Chrome-pickle
4. Cold water rinse
5. Hot water rinse

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. This method involves:

1. Solvent degrease and/or alkaline clean
2. Immersion for 1 to 3 minutes at room temperature in a solution of ammonium persulfate (25% by weight) and water (75% by weight).
3. Water rinse at room temperature
4. Dry and apply adhesive as soon as possible.

In addition to ammonium persulfate etching, there are a number of commercially available etchants. Consult the manufacturers of these specific products for product selection and processing information.

Lead

Mechanical methods are used almost exclusively with lead and are usually satisfactory. If the lead surface is freshly abraded and an oxide film has not had time to form, surface preparation may not be required.

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 not be adhered to, whereas some electrogalvanized surfaces may be bondable.

Plated Metals

Two unique problems are often encountered when preparing and bonding plated metals:

- Vigorous mechanical treatment may penetrate and destroy the plating.
- Adhesion of the plating to the base metal 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 bondability of the plated surface.

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.

Plastics

Rubber can be adhesive 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. Check dimensional tolerances after surface roughening.

A rough surface can be molded into the plastic by using a mold that has been textured. Use only internal plastic mold releases. Further details concerning the proper treatments of many engineered plastics are available on request.

Miscellaneous Substrates

The principles outlined in this document 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 [as high as 50.8-76.2 micron (2-3 mil)] from mechanical blasting generally bond better than those with low surface profiles [less than 12.7 micron (0.5 mil)].

Preparing the Adhesive:

Like solvent-based products, most water-based products must be agitated before use to ensure consistent performance.

- Agitation should be done by hand, or by motor-driven or air-powered stir paddles at 20-30 rpm or less. Do not use high-shear agitation as vigorous agitation causes bubbles which interfere with film-forming characteristics.
- Chemlok water-based adhesives should NEVER be mixed on a paint shaker.
- 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.
- 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.
- Take care to avoid contaminating the adhesive during agitation.

Despite high non-volatile content (solids), the viscosity of water-based adhesive systems is typically low. Consequently, monitoring application parameters with conventional methods is difficult.

Adhesive Handling

Solvent-Based	Water-Based
Store at 1-38˚C (30-100˚F)	Do not freeze
Agitate at 40 to 60 rpm initially	Do not shake
Decrease agitation to 20 to 30 rpm	Agitate at 20 to 30 rpm
Ground drum with grounding straps	No grounding straps required

Adhesive Preparation

Container		Solvent-Based	Water-Based	Mixing Time
1 gallon	(3.8 L)	Hand stir and paint shake	Hand stir and air-driven mixer	20-30 minutes
5 gallon	(18.9 L)	Hand stir and air-driven mixer	Hand stir and air-driven mixer	45-60 minutes
55 gallon	(208.2 L)	Hand crank and air-driven mixer	Hand crank and air-driven mixer	8 hours

For example, dilution from 10-100% causes little change in Zahn cup viscosity. Because density is a linear relationship between the non-volatile content and the amount of diluents, product density is the best way to monitor water-based adhesive systems and control film thickness. Specific gravity can be measured with a hydrometer.

Water-based and Solvent Hybrid Systems:

Water-based primers and adhesives can be utilized with solvent-based primers and adhesives to create hybrid adhesive systems. These water-based and solvent hybrid systems can consist of water-based primers and solvent adhesives as well as solvent-based primers and water-based adhesives. Application methods used by existing water-based and solvent-based systems can also be used with hybrid systems. In the case of using an water-based primer and solvent adhesive, lower preheat temperatures can be utilized.

Applying the Adhesive:

Most Chemlok water-based primers and adhesives are recommended for spray application, although some systems can be dipped. Brushing, roll coating or pad painting techniques can also potentially be used, however, they are not recommended for several reasons:

- Surfactants in water-based 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.

Spray Application

When applying water-based Chemlok primers and adhesives, many different spray application methods are available but the typical flow should follow the flow chart recommendations listed in Figure 1.

Water-based adhesives should always be sprayed on preheated metals [55-75°C (131-167°F)]. Film thickness and uniformity are more easily controlled and dry films are cosmetically superior. Spray application also accelerates drying because the atomization of water-based systems increases the surface area where evaporation can occur. Higher substrate temperatures have also been shown to increase transfer efficiency and product performance.

When using existing chain-on-edge equipment, you must have a preheat cycle prior to primer or one-coat application. As discussed earlier, the preheat ensures improved adhesive application and performance. Refer to Figure 2 for sample of chain-on-edge design.

If you have stainless steel guns and pressure pots, you can also use them to apply water-based adhesives, however, all solvent-based materials must be removed. Lines should be flushed first with solvent (Methyl Ethyl Ketone [MEK] is recommended), and 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. If possible, **it is preferred to replace the fluid lines completely to eliminate contamination concerns.**

Water-based Chemlok products can and will settle. Spray equipment (guns and fluid delivery lines) should be flushed clean when not in use. Frequency of line cleaning will need to be established based on operating parameters.

Preheat/Drying

Dry time, dry film flexibility and the dilution/viscosity relationship of water-based adhesive systems differ from solvent-based systems. Water evaporates more slowly and water-based adhesives may require more drying time. Preheating the metal causes water-based adhesives to dry from the metal surface outward, preventing surface skin-over and water entrapment and is the recommended application choice.

Spray Guns

Primers – A wide variety of spray guns can be used to apply water-based Chemlok primers. Given the lower dry film thickness requirements of the primers [5.1-10.2 micron (0.2-0.4 mil)] relative to the adhesives, you may need to dilute primers 10% with deionized water. **Do not use tap water.**

Adhesives – Adhesives, covercoats and one-coats are usually sprayed unreduced.

Gun Details –

- Use gun fluid nozzles ranging from 0.6-1.0 mm (0.023-0.042 inch) for primers.
- Use gun fluid nozzles ranging from 0.6-1.3 mm (0.023-0.055 inch) for adhesives.

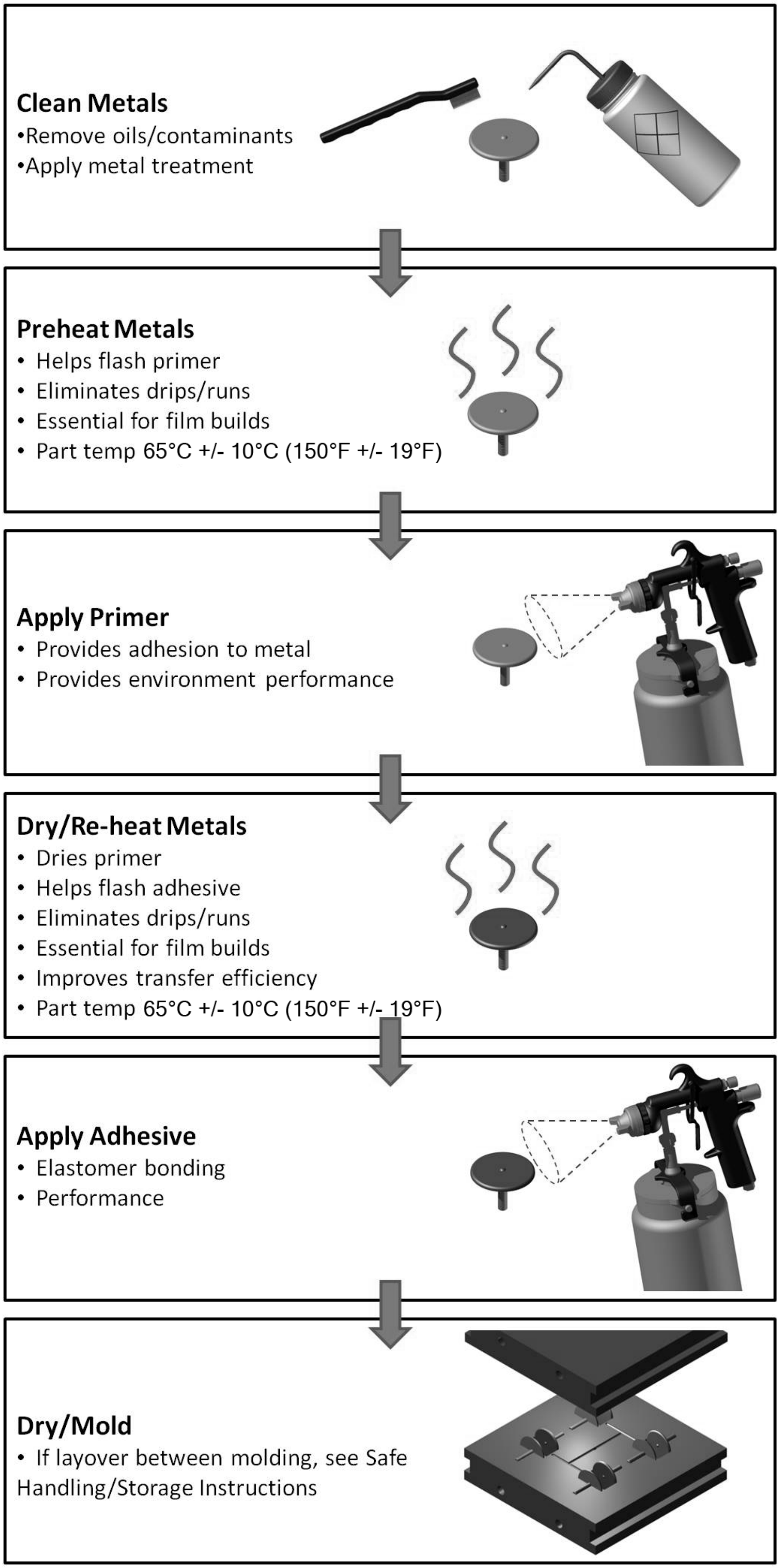

Figure 1. Spray application of water-based Chemlok systems

- These are recommendations and gun selection ultimately depends on the type of system being sprayed as well throughput considerations.
- **Fluid viscosity and flow rates are important criteria when selecting a spray gun system.**

HVLP Spray Systems (High Volume, Low Pressure) – This spray gun uses a higher volume (HV) of air and propels the adhesive at lower air pressure (LP). The result is a higher proportion of material reaching the target surface with reduced overspray, materials consumption, and air pollution. A regulator to reduce the air pressure is typically required and recommended for this type of equipment.

Conventional Air-Atomized Units – Conventional air-atomized systems typically provide excellent, uniform dry films with all Chemlok water-based systems. However, the atomizing pressure (usually 2.1-3.1 bar; 30-45 psi) 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 and reduced transfer efficiency. To control dry spray, reduce the atomizing pressure or move the gun closer to the metal insert.

Other Spray Systems – **Air-assisted and airless spray techniques are not recommended for application of Chemlok water-based adhesive systems.**

Spray Pattern

- A single uniform application is typically more desirable than multiple layers and/or coats.
- Avoid flooding the part and build the desired film thickness gradually over the available application processing time.

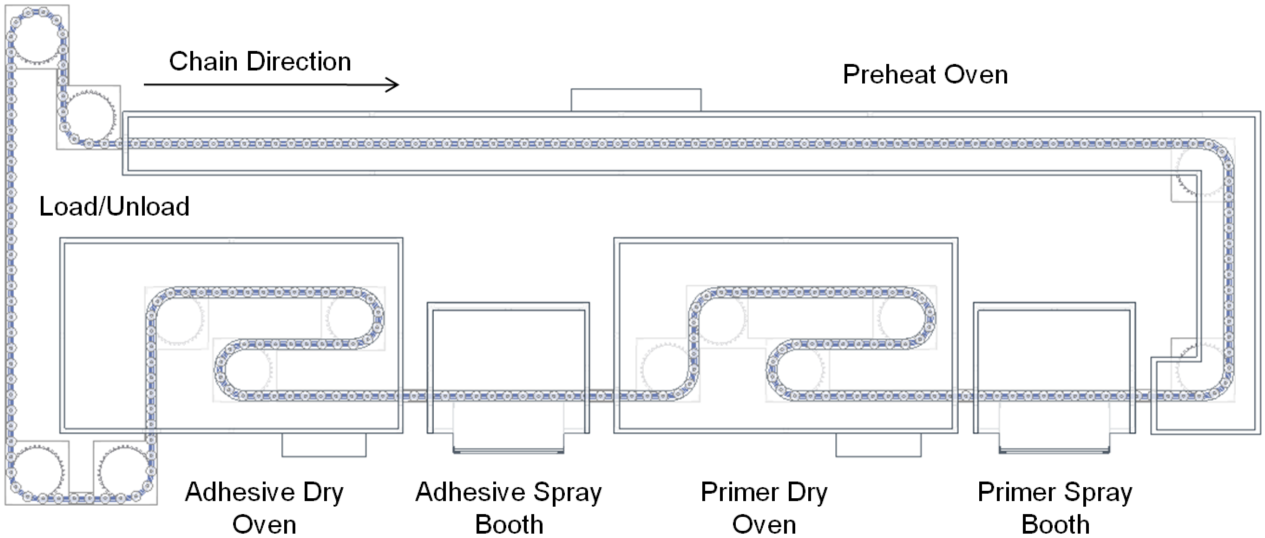

Figure 2. Sample chain-on-edge design for water-based Chemlok systems (for reference only)

- Depending on the application and the amount of control needed with regards to fluid delivery, a fluid regulator can be utilized to maintain and deliver a constant low pressure. There are a number of systems available from spring regulated to air regulated that can be utilized.
- Please refer to the applicable technical data sheet for recommended dry film requirements for both primers and adhesives.

Material Delivery Options

As previously described, water-based Chemlok systems differ from solvent-based Chemlok systems and action must be taken to avoid processing complications.

- Some existing solvent-based delivery systems may not be suitable for handling water-based Chemlok materials.
- Local fluid delivery options (pressure pots) is the preferred method for applying water-based Chemlok primers and adhesives. Central delivery systems are potentially possible but should be discussed with a Parker LORD Application Engineering Representative before processing.
- Avoid stagnant product in the fluid lines; water-based Chemlok materials will settle and can create a number of undesirable issues such as clogged lines.

Local Delivery Option (Pressure Pots) – Figure 3 illustrates the use of pressure pots.

- This set up utilizes a single spray gun; multiple gun options can also work by adding fluids, atomization air and trigger lines.
- This system incorporates a secondary pressure pot and 3-way valve filled deionized water as a method to flush the fluid lines and spray gun(s). An inline fluid regulator may also be utilized with a local delivery system to deliver and maintain a consistent, low pressure fluid feed to the spray equipment.

Line Maintenance

- Whichever application method is selected, make sure water-based Chemlok 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 water-based Chemlok systems is combustible. Avoid exposing dried films to sparks, open flames or excessive heat.

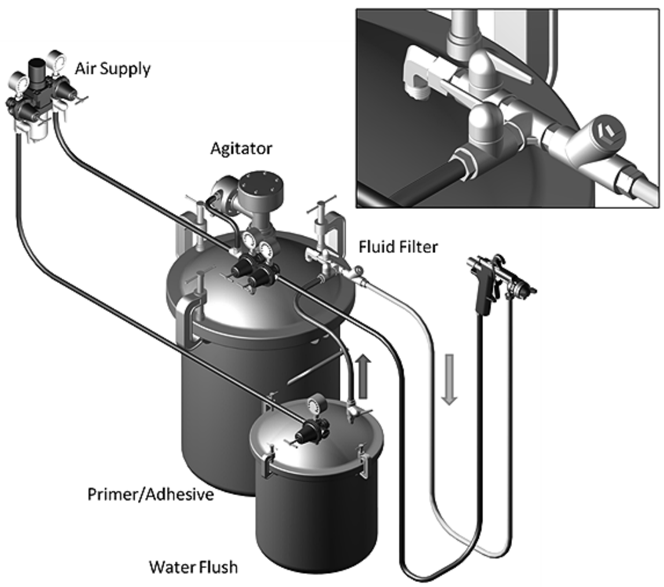

Figure 3. Local delivery option, single gun with pressure pot

Dip Application

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 primer 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. Diaphragm pumps, if used, should be dual diaphragm models.

Tank depth should only accommodate the largest part to be dipped. Additional depth increases the volume of the tank and reduces the rate of primer 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 (refer to Figure 4).

Mobile dip tank will be easier to clean and maintain and will help minimize any down time. 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 stainless steel
- Large piping to ensure low-pressure operation
- Method for agitating contents of the tank

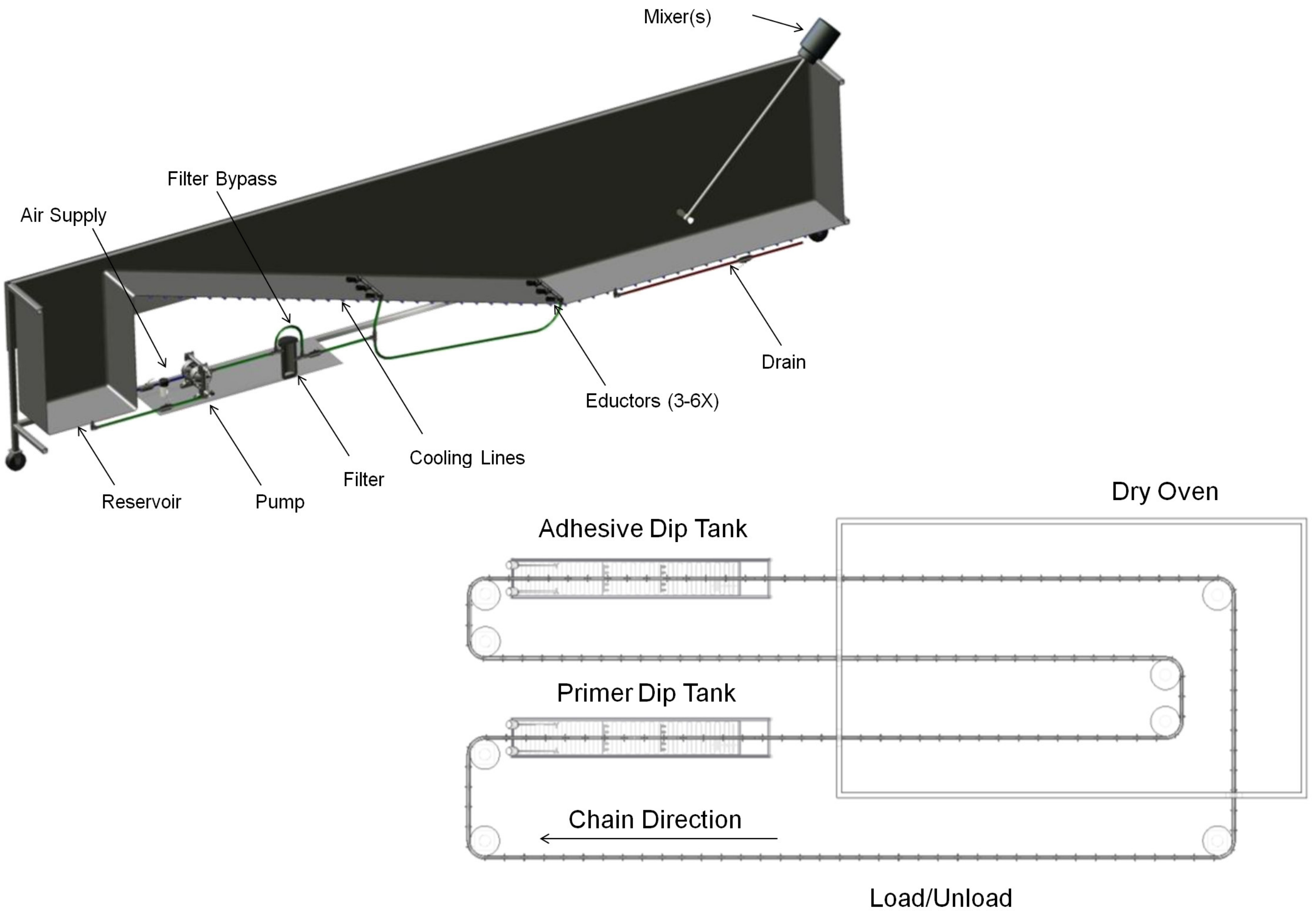

Figure 4. Section view of dip tank design

Handling Coated Parts:

- Cover parts for long-term storage: Cardboard Kraft paper (untreated) or plastic sheets (do not seal plastic bags tightly).
- Use clean cotton gloves to handle parts.
- Keep from sunlight and UV light.
- Do not store parts near press areas.
- Avoid silicone mold release agents.

Coated Parts Layover Stability:

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

Storage:

Water-based adhesive systems should be stored in dry areas at temperatures between 21-27°C (70-80°F). If stored in subfreezing temperatures (0°C; 32°F), water crystals will form, materials will coagulate and eventually freeze solid. Extended exposure to temperatures above 38°C (100°F) should be avoided, as this impacts product stability.

Molding Considerations:

One of the most important steps in the manufacturing process is molding. During this phase, the adhesive-coated metals and elastomer 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:

- **Adhesive Dry Film Thickness (DFT)** – One of the most important factors in environmental performance. Low and high DFT films can result in poor performance. Refer to the applicable technical data sheet for recommended DFT.
- **Molding Pressure** – Optimum adhesion requires adequate pressure and intimate contact of elastomer and adhesive during vulcanization and cure. Molds that are either too tight or are too loose will hinder bond quality.
- **Temperature** – Dramatic temperature variations from cavity to cavity may cause bond failure, lack of cure, or overcure conditions. 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. Avoid mold parting lines in critical bond areas and 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.

Troubleshooting:

ASTM International provides a set of detailed symptom descriptions for bond failures. These descriptions allow complete and accurate problem assessment as well as quick solutions. (In this document, the terms “elastomer” and “adhesive” should be interpreted as “rubber” and “cement”, respectively.)

The four basic ASTM International designations are:

- **RC** – failure at the rubber-cement interface.
- **CM** – failure at the cover cement-metal interface; or at the primer-metal interface.
- **CP** – failure at the cover cement-primer interface.
- **R** – failure in the rubber.

Rubber-Cement (RC) Failures

Separation between rubber and cement is usually characterized by a hard, glossy surface on the metal with little or no visible rubber.

Common causes of RC failure include: precuring of the adhesive or rubber before the rubber comes in contact with the adhesive; inadequate cement film thickness; low molding pressure or temperature; inadequate cure; and migration of plasticizers, oils and other incompatible compounding ingredients.

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 of the adhesive as it leaves the spray nozzle (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 displacement of the adhesive from the metal.

Cement-Primer (CP) Failure

Separation at the cover cement-primer 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 elastomer, or inadequate primer/adhesive 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. This weak layer 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.

Safe Handling:

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

- Ventilate application and storage areas.
- Avoid use around ignition sources.
- Utilize clean, dry sources of compressed air to avoid contamination.
- Wear protective clothing.
- Clean application and processing equipment regularly.
- Dispose of waste according to federal, state and local regulations.
- Read labels, SDS and data sheets before use.

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