

LOCTITE®

Fixmaster® Nordbak®

Epoxy Application Guide

Steel Putty

Superior Metal

Aluminum Putty

Wearing Compound

Pneu-Wear



FIXMASTER® & NORDBAK®

Epoxy Application Guide

Loctite® Epoxy Compounds have been developed to provide cost-effective solutions for numerous repair and maintenance applications.

Loctite® Epoxy Compounds offer proven maintenance solutions to the problems caused by wear, abrasion, chemical attack, erosion, vibration, corrosion, fatigue, and mechanical damage.

This manual is designed to assist maintenance personnel through many common everyday repairs. Not all repair procedures are listed. However, with the techniques shown here, combined with the versatility of Loctite® products and the ingenuity of the user, many hundreds more are possible. For application assistance or technical information in the United States, call 1-800-LOCTITE (1-800-562-8483). In Canada, call 1-800-263-5043.

Or visit us on the web at www.loctite.com

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MIXING

The following tips are designed to facilitate the process of working with Loctite® repair compounds under a variety of conditions.

Mixing. Thorough mixing of epoxies, in proper ratio, is critical to the performance of the material. Whenever possible, the complete container should be mixed at one time. If the material is to be mixed in separate batches, the user must be careful to adhere to the mix ratios which appear on the product label.



Epoxy is turned out onto a disposable surface to ensure proper mixing

The material is mixed by adding hardener to resin. The mixing process is complete when the product is free from streaks or other variances. Failure to thoroughly mix the material will cause soft spots or overall failure of the product. Mixing should take 3 to 5 minutes.

Large masses of epoxy (over one pound) can be mixed more easily by turning out the resin and hardener onto a clean, disposable surface. Mix and knead material with a putty knife or other flat tool until the product is thoroughly mixed. Do not fold material into the mix as this process can cause air entrapment that will weaken the cured product.

Cure. Epoxy compounds begin to cure, or harden, when the hardener is added to the resin. Epoxy cures by a chemical reaction that causes exotherming, or the process of giving off heat. There are some basic principles of working with epoxy compounds that every user should understand:

Cure times are mass dependent. The larger the mass that is mixed, the faster it will cure. If the mixed material cannot be applied during the working time specified on the product label, mix it in smaller batches.

Cure times are temperature dependent. The higher the temperature, the faster the product will cure. Ideal mixing temperature of epoxies is between 55°F and 80°F.

If the application is to occur at higher temperatures, the product should be stored at room temperature or slightly below to slow down the chemical reaction between resin and hardener.

At lower temperatures, the epoxy will cure very slowly or may fail to cure at all. To speed up the cure at low temperatures, store product at room temperature and heat parts to be repaired prior to application. The repaired area can also be heated with a heat gun upon completion of the application.

Most epoxies are skin and eye irritants, and many epoxy hardeners are corrosive. Always wear appropriate gloves and goggles or face shield during mixing and handling. Observe good industrial safety practices, and review product Material Safety Data Sheet (MSDS) prior to use for complete precautionary information.

SURFACE PREPARATION

The successful application of any Loctite® FIXMASTER® or NORDBAK® epoxy is largely dependent on correct surface preparation. For this reason, it is critical that all applications begin with a thorough preparation of the repair surface in keeping with the instructions in this section.

Surface conditions vary from application to application. This section is designed to prepare any substrate for use with all repair products in the Loctite® epoxy range.

GENERAL SURFACE PREPARATION

Ensure that the surface is dry and stop all liquid leakage. Remove all dirt, paint, rust, and other contaminants by abrasive blasting or other suitable mechanical techniques.

Degrease thoroughly using Loctite® ODC-Free Cleaner & Degreaser.

Provide a profile by abrasive blasting or other mechanical means.

To bond an epoxy to a badly degraded surface or to fill large voids, first tack weld wire mesh over the damaged area, then fill the prepared area with the epoxy.



The wire mesh reinforces the repair area and forms a mechanical backing for the epoxy.

To prevent epoxy from adhering to a surface, as when casting parts or in tooling applications, coat the surface with Loctite® Silicone Lubricant (Product No. 51360) or other release agent.

CLEANING THE SURFACE

Clean the surface with Loctite® ODC-Free Cleaner & Degreaser.

Areas immersed in oil must be cleaned repeatedly to draw the oil out of the surface. Use a heat gun to force oil out of the pores. Allow the surface to cool, then degrease again.

After cleaning, roughen the surface to produce a good profile. The following methods may be used, but in all cases the objective is to obtain an anchor profile of 0.003 to 0.005 inches (75 to 125 microns).

Abrasive blast using an angular grit such as aluminum oxide, silicon carbide, or Black Beauty 1240 medium grade. Round abrasive grit should *not* be used. High velocity water blasting with an abrasive medium is also recommended. (See figure 1)

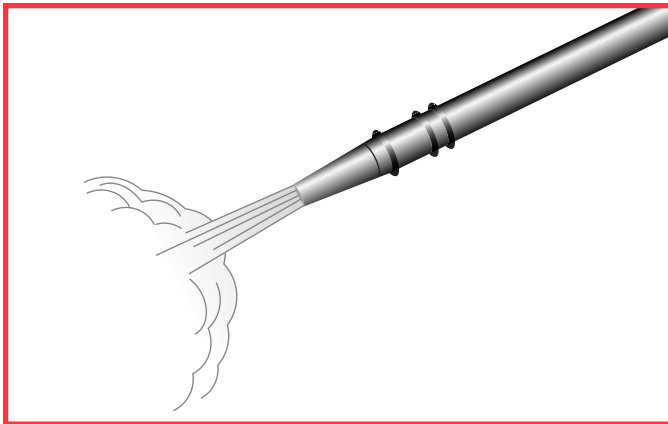


Figure 1. For best results, abrasive blast the application surface.

If grit blasting is not possible, roughen the surface using a coarse grinding wheel (60 grit or coarser) or a needle gun to achieve the desired profile. (See figure 2)

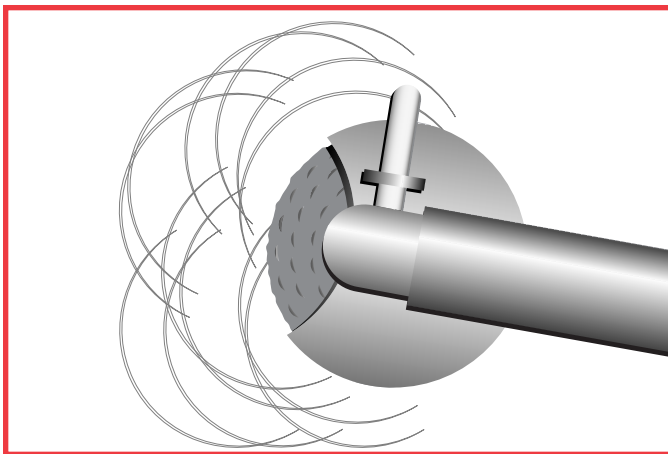


Figure 2. Coarse grinding of the surface is also recommended for surface preparation.

Using coarse sandpaper or a file is acceptable only if the first two methods cannot be utilized.

After roughening, the surface must again be thoroughly cleaned with Loctite® ODC-Free Cleaner & Degreaser.

Repairs should be made as soon as possible to avoid rusting.

WET SURFACES

Surface must be dry. Exceptions are when using Wet Surface Repair Epoxy, Underwater Repair Epoxy or Metal Magic Steel™. These products will cure in the presence of water.

Stop all leakage or seepage by:

- Turning off the water flow.
- Fitting a wooden peg or sheet metal screw.
- Stuffing with cork, wax, rags, or any other suitable material. (See figure 3)

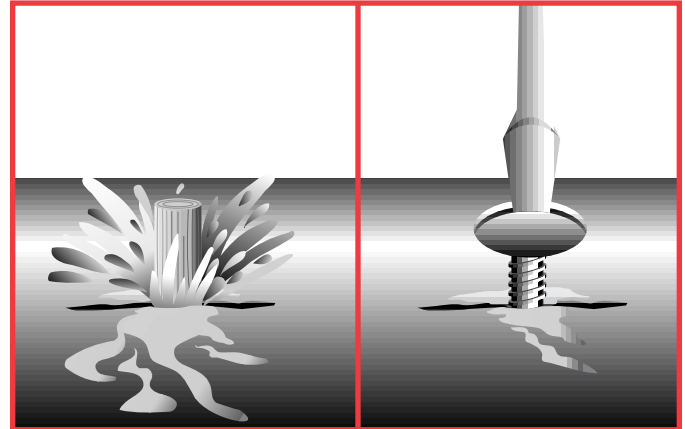


Figure 3. Stop leaks with a wooden plug or screw inserted in area of seepage.

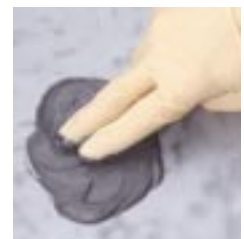
If the leak is caused by corrosion, the side wall may be weak. Open the hole to a point where the wall is close to its original thickness. Then plug the opening using a suitable material.

All surface condensation, wetness, or dampness must be wiped clean and dried off using a hot air gun or similar device.

Continue surface preparation in accordance with the preceding section on Surface Cleaning.

APPLICATION TIPS

- **For Maximum Bond**
Pre-coat the application surface by rubbing the mixed epoxy into the substrate. This technique, called "wetting out the surface," helps the epoxy repair material fill all the crevices in the application surface, creating a superior bond between the epoxy and substrate. The rest of the mixed epoxy can then be applied over the pre-coat to finish the application.
- **Pouring Liquid Epoxies**
Avoid air entrapment in cured epoxies by pouring close to the mold in a steady, even stream.



APPLICATION TIPS (cont.)

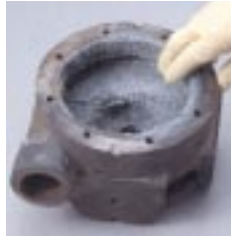
- **Eliminating Air Entrapment**

Use a heat gun (do not use an open flame) to pull air bubbles out of cast epoxy. Heat will cause bubbles to rise to the top of the epoxy and dissipate.



- **Creating a Smooth Finish**

Smooth out the uncured epoxy finish with a warm trowel for a smooth, glossy finish. A heat gun can also be used to create a smooth finish.



- **Wear Resistant Putty**

Ceramic fibers give this trowelable putty excellent wear and abrasion resistance. Provides a smooth, low-friction finish. Particularly suitable for repairing shafts and other low-friction surfaces.

- **Aluminum Putty**

Aluminum-filled epoxy rebuilds and repairs aluminum equipment, forming a non-rusting finish.

- **Stainless Steel Putty**

Stainless steel-filled epoxy forms a very hard, durable finish on damaged stainless steel surfaces.

- **Wet Surface Repair Putty**

This unique, trowelable epoxy can repair and rebuild wet, even underwater, surfaces. Bonds to wood, concrete, steel, iron, aluminum, brass, and some plastics.

FIXMASTER® EPOXIES

Filled epoxies repair, rebuild and restore damaged parts to get equipment back into service quickly.

Different fillers provide a range of performance characteristics, making FIXMASTER® epoxies suitable for specific applications. Putty, liquid and stick forms give you the flexibility to fix equipment throughout the plant.

PUTTIES

- **Steel Putty**

The workhorse of the FIXMASTER® line, this steel-filled product is used for making cost-saving repairs on metal parts all over the plant. Our most recommended, general-purpose epoxy.



- **Fast Set Steel Putty**

A fast-curing version of Steel Putty, this material reaches a functional cure in about 10 minutes. Use it wherever a fast, general-purpose epoxy is called for.

- **Superior Metal**

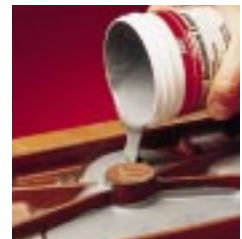
Ideal for surfaces subject to corrosion, abrasion and harsh environments. Ferro-silicon-filled epoxy has outstanding compressive strength and chemical resistance. Non-rusting.

LIQUIDS

- **Steel Liquid**

- **Aluminum Liquid**

These epoxies are similar in chemistry to putty types, however, liquid versions are self-leveling and can be poured or cast to form molds, tools or replacement parts. Also used to repair and rebuild difficult to reach areas.



STICK

- **Metal Magic Steel™**

No toolbox is complete without this convenient, fast-curing epoxy in stick form. Just cut off a section, knead and apply to leaking pipes or damaged equipment. Cures in 10 minutes. It's the ultimate in repair convenience. NSF approved to Standard 61.



- **Underwater Repair Epoxy**

This putty-like material works on both wet and dry surfaces and sets up and cures underwater. It is ideal for plumbing, irrigation and marine applications because it is unaffected by chlorinated or salt water. It is hand kneadable and fully cures in one hour.

NORDBAK® EPOXIES

Tackle the toughest industrial repair jobs with the #1 name in wearing compounds.

NORDBAK® epoxies utilize the superior wear properties of ceramic and the convenience of two-part epoxies. Available in trowelable and brushable formulations with special fillers for the toughest conditions, NORDBAK® products are designed to keep equipment like pumps, chutes and augers in tip-top operating condition. NORDBAK® epoxies are ideal for all those large-scale repairs that have to last.

PUTTIES WITH BEADS

- **Wearing Compound**

Large ceramic beads and fine silicon carbide in a high performance epoxy system protect against hard sliding abrasion.

- **Pneu-Wear**

This epoxy contains small ceramic beads and silicon carbide for maximum protection against pneumatic abrasion.

- **High Impact Wearing Compound**

A rubber-modified epoxy with better impact resistance than ceramic tile. For applications where both sliding abrasion and impact are present.

- **Combo Bead Wearing Compound**

Combines large and small ceramic beads and silicon carbide. Protects against hard sliding abrasion. Extends the life of material handling equipment.



HIGH TEMPERATURE FORMULAS

- **High Temperature Wearing Compound**

- **High Temperature Pneu-Wear**

Same great performance as standard curing versions, only these high temperature formulas can be used up to 450°F/232°C. Both must be post-cured for maximum temperature resistance and performance.



Both epoxies are also available, as a special order, in an Ultra High Temperature formula, good to 550°F/288°C with post-cure.

FAST SET FORMULAS

- **Fast Cure Wearing Compound**

- **Fast Cure Pneu-Wear**

These faster curing versions perform like standard wearing products while reducing equipment downtime. Now you can renew worn surfaces and put equipment back in service in as little as three hours.

BRUSH-ON FORMULAS

- **Brushable Ceramic**

Ultra-smooth and ceramic filled for a high gloss, low-friction coating. Protects against turbulence, abrasion and cavitation. Also works as a topcoat over Wearing Compound for surface rebuilding and lasting protection.



- **High Temperature Brushable Ceramic**

Performs like standard Brushable Ceramic while providing protection up to 550°F/288°C. Must be post-cured for maximum temperature resistance and performance.

SPECIAL FORMULAS

- **Chemical Resistant Coating**

This advanced formulation epoxy protects against extreme chemical attack and corrosion. Low viscosity means it can be applied by brush. Smooth, glossy, low-friction finish.

- **Castable Wearing Compound**

Pourable ceramic epoxy can be cast into any shape. Use it for making replacement parts, lining cyclone apexes and filling flat back elbows.

- **Ceramic Tile Adhesive**

Secure ceramic tiles to vertical, horizontal and overhead surfaces with this high-strength epoxy. Excellent shock and impact resistance make it an ideal grout.



PIPE AND DUCTING REPAIRS

Pipes are used for transporting all compositions of fluids, slurries, gases, and solids. Wear, corrosion, abrasion and chemical attack can lead to progressive damage to pipe walls, leading to eventual piping failure.

Industries such as coal-fired power plants, sewage treatment plants, pulp and paper processors, and aggregate sites are particularly vulnerable to pipe abrasion due to caustic and abrasive media carried in the piping system.

The areas of piping most subject to wear and damage are elbows, t-junctions, reduction fittings and weld spots in both seams and joints. Flange faces can also suffer erosion, preventing effective gasket sealing.

The problem of pipe damage can be as simple as a leaky pipe or as severe as a total plant shutdown, service contamination, or fire damage; but good plant maintenance depends on keeping equipment, such as piping systems, running smoothly and efficiently. The following information is intended to identify possible problem areas that can be successfully protected or repaired with Loctite® epoxies in order to reduce downtime and equipment failure.

Note: Before starting any pipe repair, the line pressure must be removed.

EXTERIOR REPAIR – FRACTURES AND PINHOLES

1. **To prepare the application**, plug the hole or fracture with FIXMASTER® Metal Magic Steel™, an epoxy in stick form that hardens in just 10 minutes. Or use a wooden dowel, putty or plasticine. If the wall thickness is insufficient to support a mechanical plug, use a rubber patch and an adhesive such as FIXMASTER® 4-Minute Epoxy.

Abrasive blast, grind, or file off all deposits, paint, rust, and millscale. The area must be prepared with an extension border of 3" (7, 6 cm) around the damaged area. Degrease the application area completely with Loctite® ODC-Free Cleaner & Degreaser.

2. **For repairs to large diameter pipes, weeping pipework, and high-pressure pipes**, use a half section of pipe with a slightly larger diameter than the pipe to be repaired. A curved aluminum or steel backing plate that extends 2" (5 cm) radially and axially beyond the damaged area will also work to reinforce the repair.

Abrade the inside and outside of the backing plate and degrease thoroughly with ODC-Free Cleaner & Degreaser.

3. **For large, low pressure pipes** (diameter > 3" or 7.6 cm and pressure less than 100 psi or 0.70 mpa), prepare the pipe as above. Inspect the damaged area to see if the fracture or crack is under stress. If so, relieve by drilling the ends and "V"-ing out the crack.

Apply the epoxy to the prepared area forcing the product into the crack. Also apply epoxy to the inside radius of the backing plate. Press the backing plate firmly over the repair area. (See figures 4 & 5) Force out any air, and remove excess epoxy. Use ties, clamps, or wire to hold the repair firmly in place. After the epoxy has cured, the clamps may be removed and the patch coated with more product for reinforcement of the repair. (See figure 6)

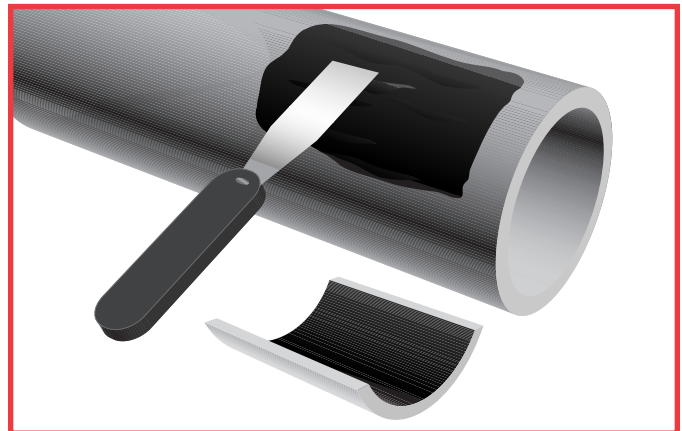


Figure 4. Force epoxy into the damaged area.

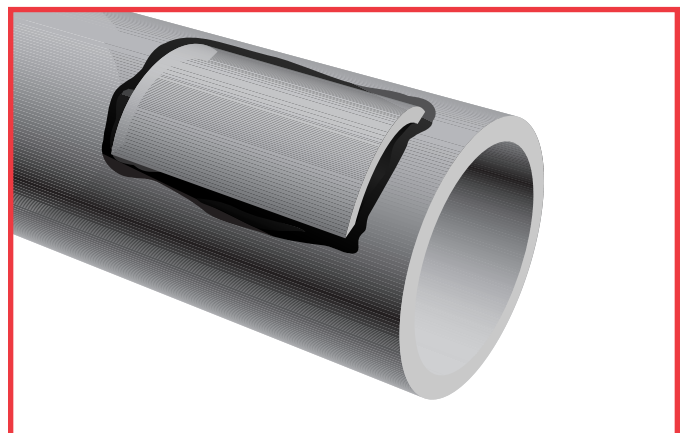


Figure 5. Press backing plate over the damaged repair area.

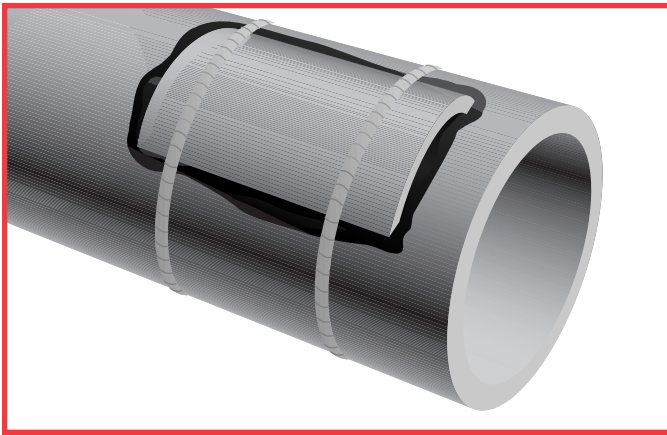


Figure 6. Reinforce repair area by tying or clamping the repair until the epoxy is cured.

4. For high-pressure pipes (> 100 psi or 0.70 mpa) prepare the pipe as above. For small diameter pipes, wrap the repair firmly with reinforcing mesh impregnated with epoxy. Before the epoxy hardens, over-coat and shape the repair with a final application of epoxy. (See figure 7)

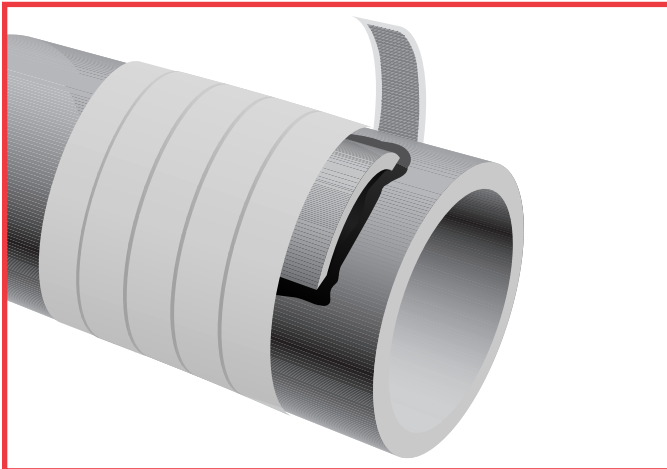


Figure 7. Wrap the repair area with reinforcing mesh when repairing small pipes.

For large diameter pipes, once patched, clamp into position using steel clamps 2" (5 cm) apart. Do not remove the clamps. (See figure 8)

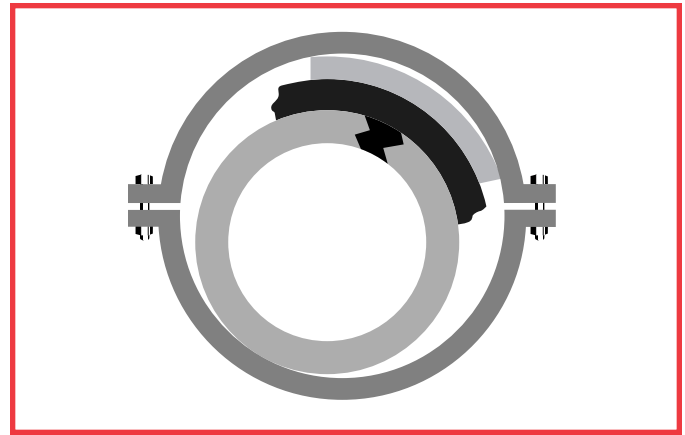


Figure 8. Use steel clamps to reinforce repairs to large diameter pipes.

5. For low pressure, small diameter pipes (< 100 psi or 0.70 mpa and < 3" or 7.6 cm diameter). Prepare as in Step 1 above. Apply 1/8" or 3 mm layer of epoxy, working it well into the anchor pattern and into the hole. Wrap reinforcement mesh treated with repair compound at least twice around the pipe. Remove excess product. As epoxy starts to cure, over-coat the repair with a final application of epoxy.

INTERNAL REPAIR

Internal repair of pipes, elbows, and fittings is sometimes possible and necessary. This procedure should include exterior patching according to Step 3 above.

1. To prepare the surface, flush the interior of the pipe liberally with high-pressure water, if available. Abrasive blast to achieve .003 - .005" (75 - 125 microns) profile. Blast inside and outside, as well as the backing plate, for the exterior patching.
Degrease thoroughly.
2. Exterior patching must be done prior to internal lining. If backing plate is not suitable, tack weld a heavy metal mesh and apply 1/8 to 1/4" (3 - 6 mm) of epoxy.
3. Coat the interior by applying a series of thin coats of epoxy pressed into the abraded profile. Continue to build up the original profile. As the epoxy begins to cure, apply a 1/4" (6 mm) over-coat of epoxy to the repair area.

Do not coat the ends of sectioned pipe.

CAUTION: PRESSURIZED LINES SHOULD BE REPLACED WHEN TIME AND MANPOWER PERMITS.

METAL SURFACE REPAIRS

The following procedures are developed for surface repairs that call for filling or rebuilding a damaged metal surface. Damage caused by metal fatigue or stress cracks should be replaced.

Loctite® Repair Epoxies are recommended for making surface repairs to restore the integrity of cracked or damaged metal. In general, epoxies are not recommended for heavy load bearing applications or for making structural repairs; however, experience has shown that successful temporary or emergency repairs can be made to seriously damaged equipment using skillful and imaginative techniques.

Non-stress cracking problems are common to pump casings, bearing housings, valve bodies, tanks and gearboxes.

Note: When the equipment to be repaired may have contained flammable or explosive material, proper safeguards must be taken to clean the area thoroughly to remove all flammable material. If in doubt, contact a Loctite representative.

1. To **prepare the surface** of the damaged metal, refer to *Surface Preparation* in this manual.
2. **Drill holes** 1/8" (3 mm) larger than the crack at either end of the crack. Use detecting dye if necessary to determine the actual area of the crack. If the crack is over 5" (12.5 cm) long, drill multiple holes along the length of the crack. (See figure 9)

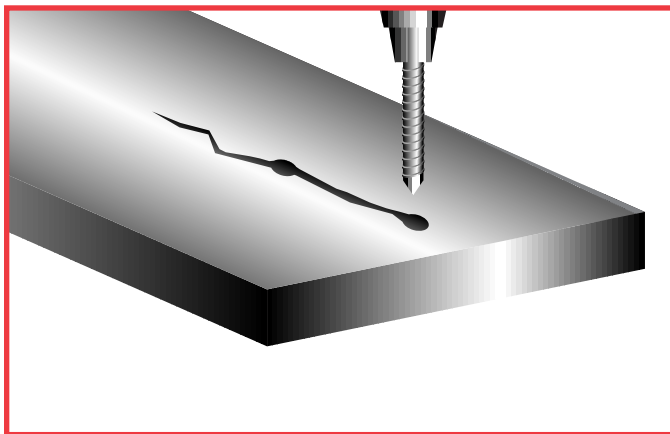


Figure 9. Drill holes at either end of the crack.

3. To **create a better bond**, drill or edge grind the cracked area with an abrasive wheel to "V" out the cracked area. After the area has been opened up, clean the area of any residue using Loctite® ODC-Free Cleaner & Degreaser. (See figure 10)

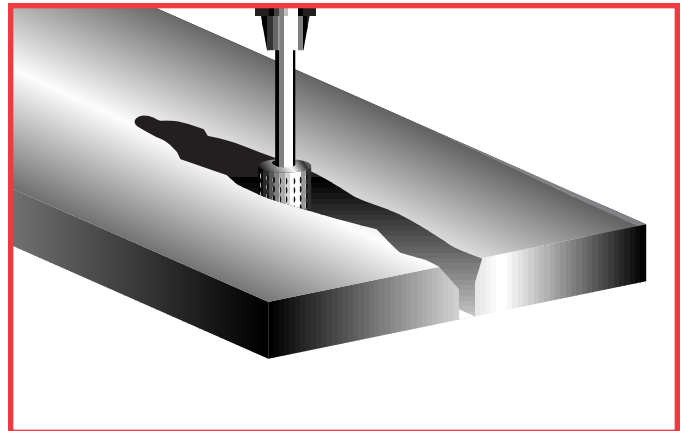


Figure 10. Grind out the repair area for maximum adhesion.

4. **Apply the epoxy** with a putty knife, forcing the epoxy material into the crack. Fill the "V" thoroughly, and overlap approximately 1" on each side of the application area. (See figure 11)

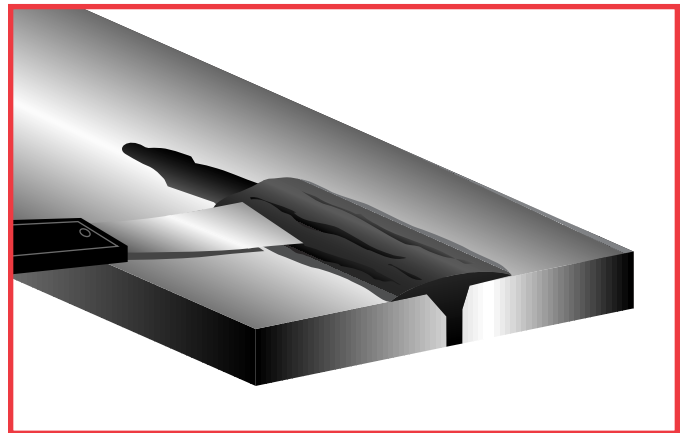


Figure 11. Fill the repair area with epoxy.

- Using reinforcing mesh, such as fiberglass or wire screening, lay a strip of the reinforcement material over the application and imbed the tape into the epoxy. (See figure 12)

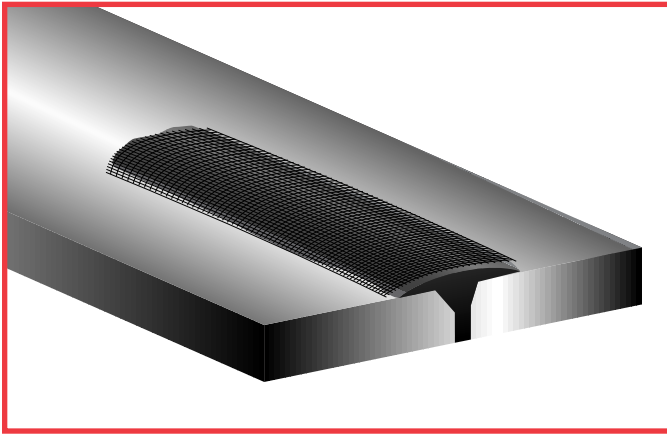


Figure 12. Reinforce the repair by applying tape over the epoxy.

- Apply another 1/16" to 1/4" (1.5 – 6 mm) of epoxy over the reinforced mesh and smooth out the epoxy. To prevent lifting of the repair, be sure to feather the edges in keeping with the contour of the repaired equipment. (See figure 13)

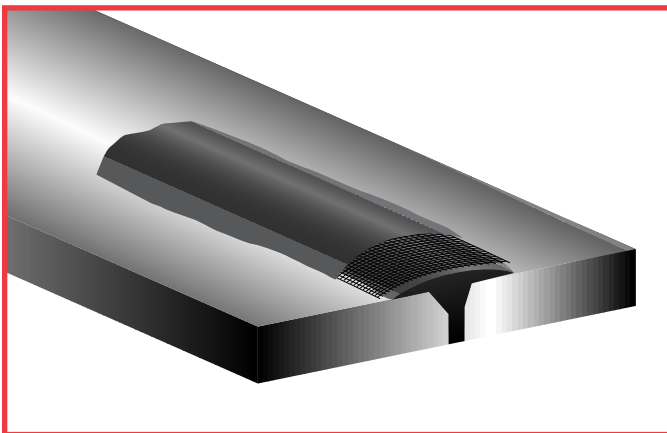


Figure 13. Over-coat the epoxy/tape application with another coating of epoxy.

- To speed the cure, heat the repair area with a heat gun or heat lamp. Never expose epoxy to an open flame.

SHAFT REPAIRS

Loctite® epoxies can often be used to repair damaged or scored shafts. In some cases, however, the repair may not provide long-term service and should not be made.

Repairs *are not* recommended to the following shafts:

- Any repair on an area subject to frictional heat such as on a shaft worn by mechanical packing.
- The worn area under a bearing, bushing or mechanical seal that exceeds its width.
- Shafts under 1/2" (13 mm).

THE SHAFT

Since the area to be repaired needs to be machined, the standard preparation procedures are not used. (See figure 14)

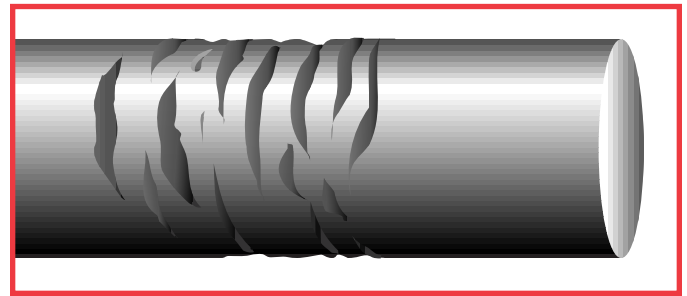


Figure 14.

Undercut the worn area according to the following guidelines:

Shaft Diameter	Desired Undercut
1/2 to 1" (13 – 25 mm)	1/16" (1.5 mm)
1 to 3" (25 – 75 mm)	1/8" (3 mm)

- Using a lathe, undercut to the desired depth. If the shaft is already worn to the recommended depth, go to the next step.

Dovetail the ends of the worn area to lock the application into place and to serve as a guide when repairing. (See figure 15)

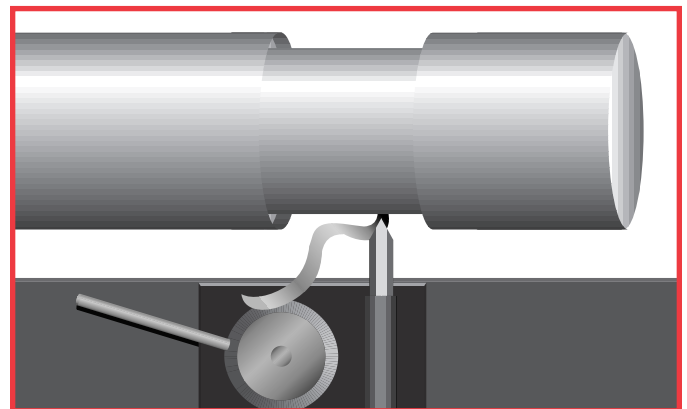


Figure 15. Dovetailing provides mechanical lock for epoxy.

SHAFT REPAIRS (cont.)

- 2. Finish undercutting** by machining a rough cut surface or gramophone pattern, the larger the shaft diameter, the deeper the threads. Degrease thoroughly. (See figure 16)

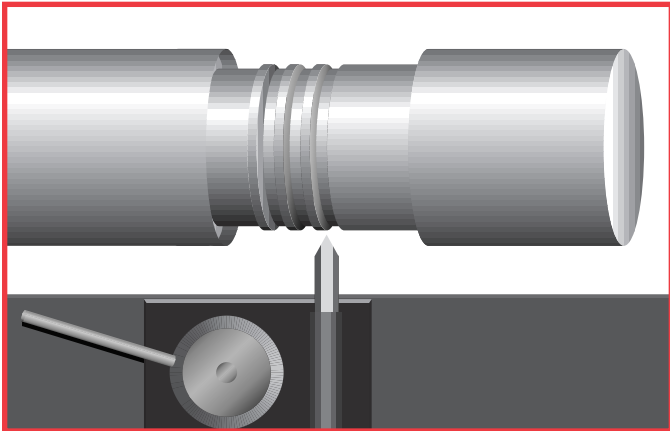


Figure 16. Roughen shaft for better adhesion.

- 3. Apply** a very thin layer of the recommended repair epoxy and force into the bottom of the threads. Turn the shaft at a very low speed and continue to apply more material by using a tool, such as a putty knife, that can be bent. (See figure 17)

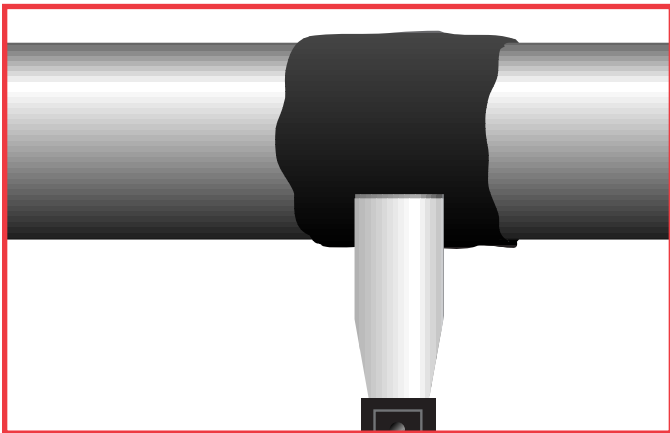


Figure 17. Fill the repair area with epoxy.

Allow the product to cure for the required period at 70°F (20°C) or higher. Apply dry heat to the area, if necessary, to speed up the cure.

- 4. Machine the repair** to the required dimensions using the guidelines below. (See figure 18)

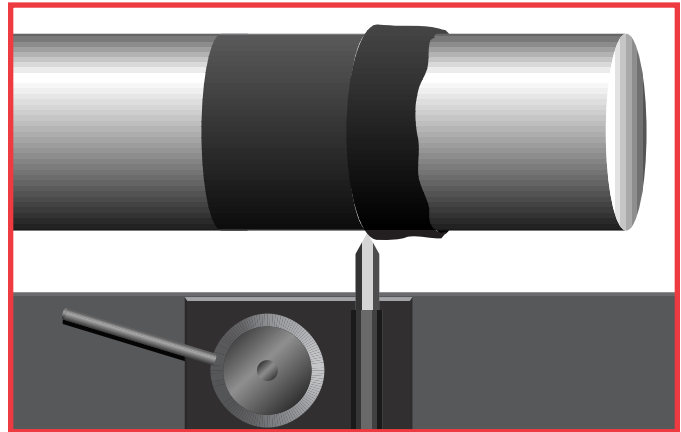


Figure 18. Machine the epoxy to the original dimensions of the shaft.

Lathe Speed:	150 ft./min.	46 m/min.
Feed Rate:	Roughing	.025 in./rev 0.64 mm/rev
	Finishing	.010 in./rev 0.25 mm/rev

Top Rake:	3°
Side Clearance:	3°
Front Clearance:	3°

Comments: Cut dry; use carbide or high speed steel bits. If polishing is required, use only wet 400 to 600 grit emery paper. (See figure 19)

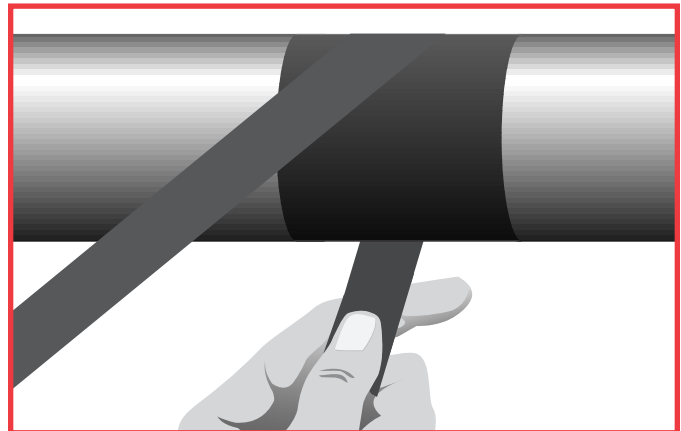


Figure 19. If necessary, polish repair with emery paper.

KEYWAYS

A keyway becomes worn through constant pressure from starting and stopping.

1. **To prepare the surface**, follow the *Surface Preparation* section.

Roughen the surface with a file or rotary cutting/grinding tool and degrease again. (See figure 20)

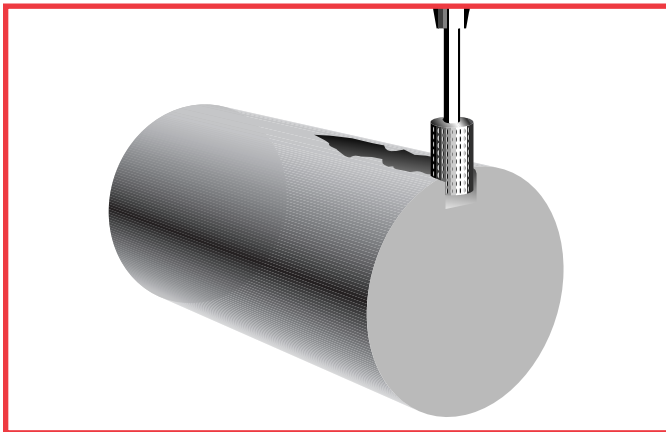


Figure 20. Roughen the damaged surface.

2. **Apply** a thin layer of Loctite® Silicone Lubricant release agent to the key and to any area where you do not want the product to stick. (See figure 21)

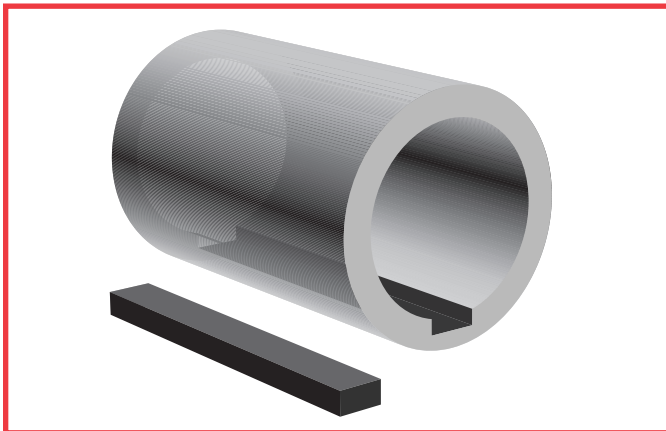


Figure 21. Coat with release agent.

3. **Apply the recommended epoxy** using a spatula or putty knife. Use a thin coat on the bottom and a thicker layer on the side walls to ensure the key will not be raised and also to ensure a close tolerance fit. (See figure 22)

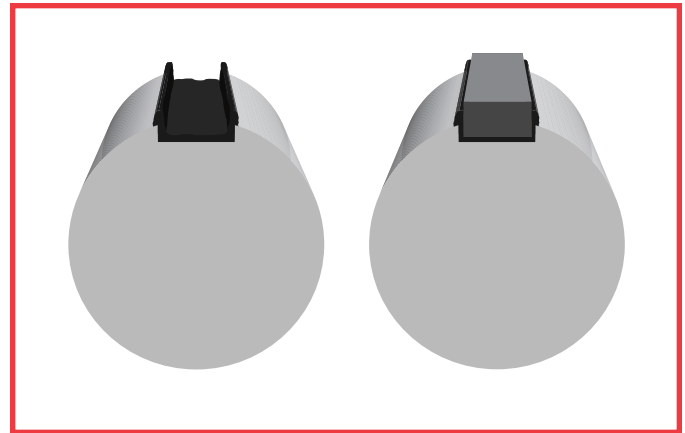


Figure 22. Fill keyway with epoxy and install coated key.

4. **Scrape** away excess epoxy from the side of the keyway. (See figure 23)

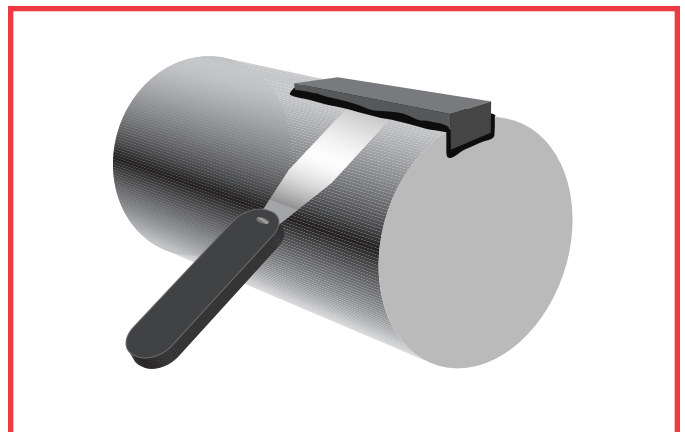


Figure 23. Immediately scrape excess epoxy away from repair area.

5. **Immediately reposition** the shaft on the hub to properly align the key, shaft and hub. Leave assembled. (See figure 24)

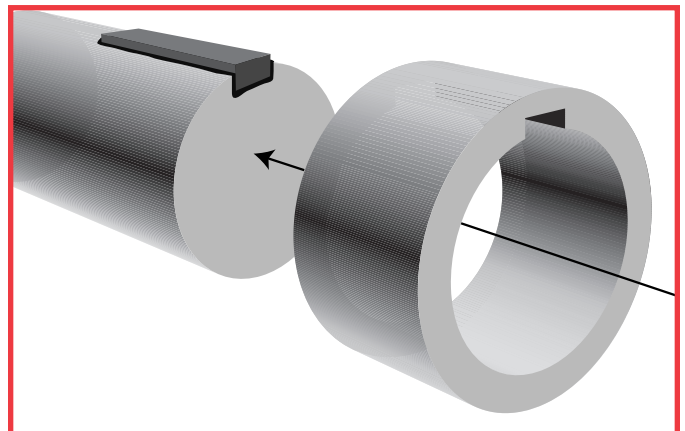


Figure 24. Immediately align key, shaft and hub.

SPLINES

1. **Remove the spline** shaft from the socket and chamfer the edges of the sockets to a 45° angle using a file. (See figure 25)

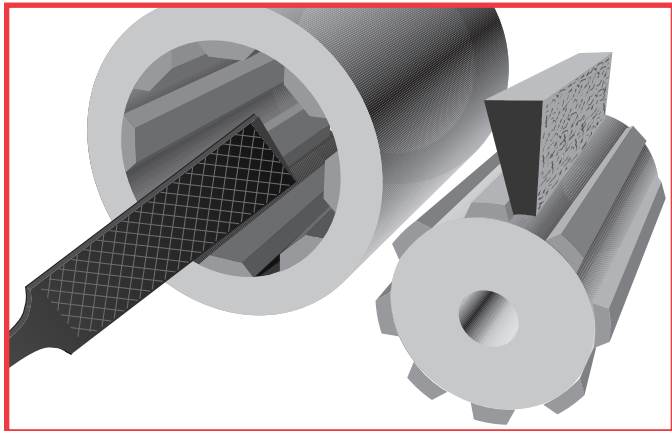


Figure 25. File the socket to a 45° angle.

2. **To prepare the application surface**, degrease the surface thoroughly.

Check the spline shaft for evenness and remove any high spots or rough areas by filing or sanding.

Degrease again.

3. **Apply** a thin layer of Loctite® Silicone Lubricant release agent to the spline shaft, ensuring that the entire surface is coated.
4. **Mix and apply** the recommended repair compound to the spline shaft. Do not apply product into the socket. Immediately push the spline shaft into the socket and remove excess material. (See figure 26)

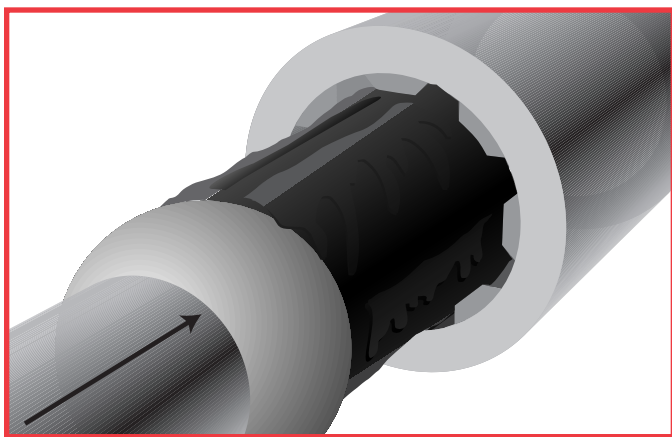


Figure 26. Install coated spline into shaft and remove excess epoxy.

Allow the epoxy to cure according to the application instructions before putting the equipment back into service.

If it will be necessary to dismantle the assembly in the future, mark the position of the spline and socket in order to be able to reposition the assembly in exactly the same position. (See figure 27)

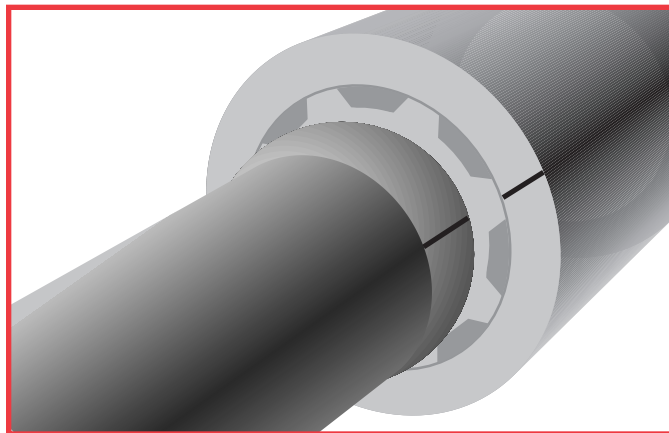


Figure 27. Mark the position of the spline in the socket for future assembly.

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and/or product availability,
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or visit us on the web at**

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HEAT EXCHANGER AND CONDENSER REPAIRS

Tubes in a heat exchanger are subject to severe galvanic corrosion since the tubes and the tube sheet are not of the same metal. The corrosion process is accelerated by the presence of hot, wet conditions and, if left unattended, the tube plate will corrode and eventually fail. The following is an easy and effective way to rebuild and extend the life of a tube plate in a heat exchanger using Loctite® Epoxies that are designed to fight bi-metallic corrosion.

- 1. Install stoppers.** Remove the end plates and baffles, and insert rubber stoppers into the end of the tubes. The stoppers should protrude no more than 1/8" (3 mm). This clearance will allow for a 1/8" coating of epoxy, as illustrated. (See figure 31)

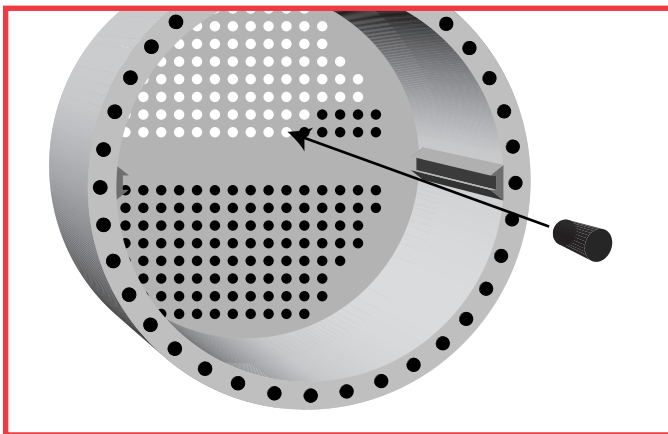


Figure 31. Install stoppers flush with the ends of the tubes.

The best way to install stoppers is to push each one snug. If the tube is not flush with the tube plate due to wear or design, install the stopper to be flush with the end of the tube. (See figure 32)

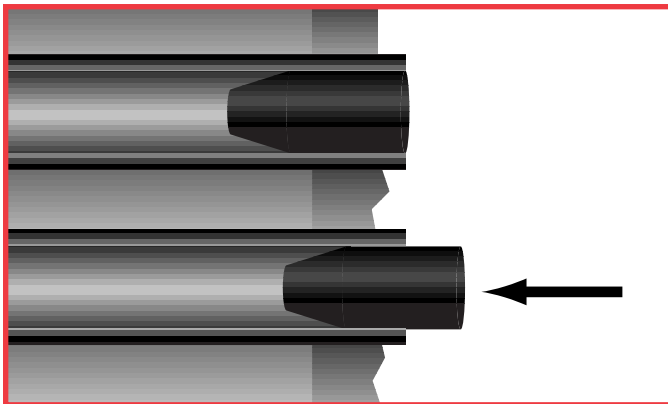


Figure 32. Install stoppers flush with the end of the tube when the tube extends beyond the sheet.

- 2. Surface preparation.** Once the stoppers are installed, abrasive blast the entire faceplate. After blasting, blow out the debris from the sheet using clean air. Degrease thoroughly with Loctite® ODC-Free Cleaner & Degreaser. For best results, steam clean the application surface after blasting and degreasing. Prepare the baffle plates and end covers as the tube sheet itself. (See figure 33)

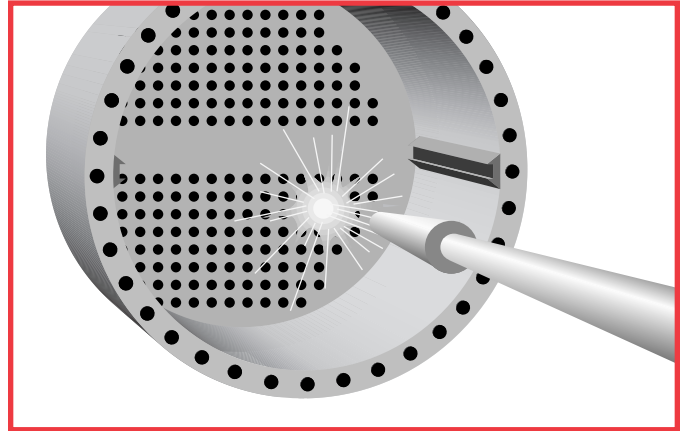


Figure 33. Sandblast the tube sheet once stoppers are installed.

- 3. Apply Loctite® Brushable Ceramic** in two coats. After the first coat, wait 1-3 hours and recoat again. The two-coat system helps fill any voids missed after the first coat. (See figure 34)

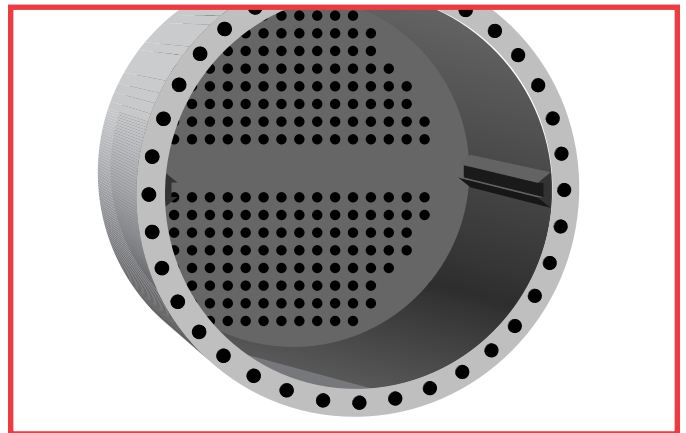


Figure 34. Apply two coats of epoxy to the tube sheet.

HEAT EXCHANGER AND CONDENSER REPAIRS (cont.)

- To build up** depressions where there is a greater than 1/8" (3 mm) distance from the tube sheet, first coat the sheet with Brushable Ceramic to help "wet out" the surface and act as an excellent prime coat for the next step. (See figure 35)

Next, trowel on Loctite® Wear Resistant Putty to the tube plate surface at the desired thickness. Build up the thickness of the face plate to be flush with the tubes themselves. Then apply a topcoat of Brushable Ceramic. (See figure 36)

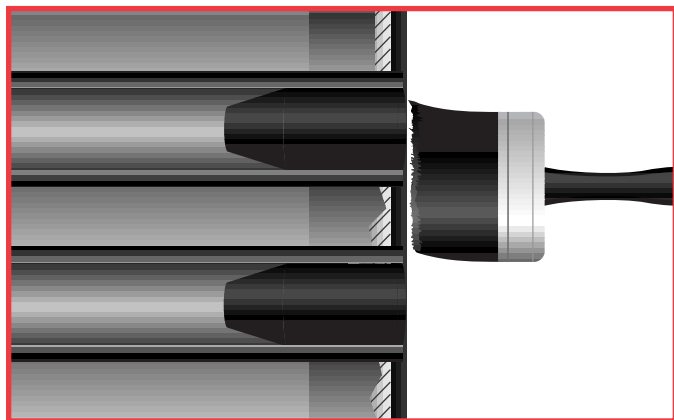


Figure 35. Brush apply epoxy to "wet out" surface.

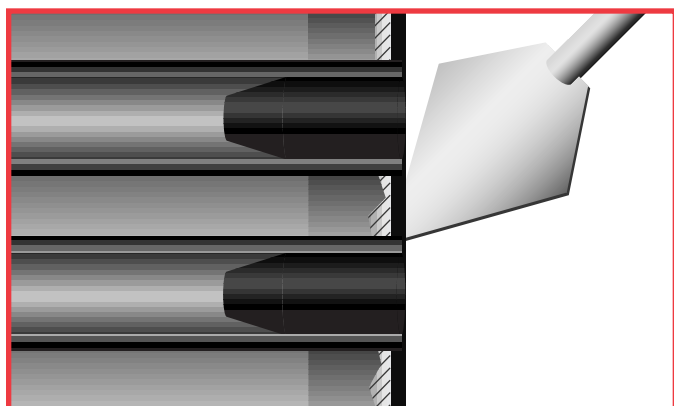


Figure 36. Build up damaged surface with epoxy putty.

- Coat** the inlet areas, baffle plate inserts, and the end covers. Be sure not to apply any epoxy material to the baffle plate holder tracks, otherwise, it may be difficult to reassemble the plates after all the coatings have been applied, as illustrated in the next column. (See figure 37)

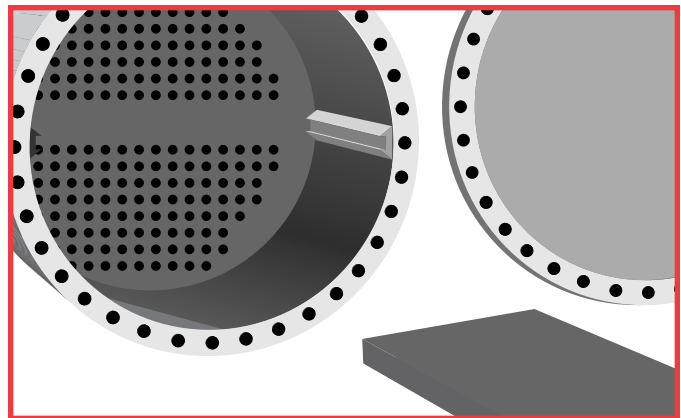


Figure 37. Coat inlet areas, baffle plate inserts and end covers for complete protection of equipment.

- Wait** at least 18 hours after the coating has been applied before taking out the stoppers. Then take a packing puller or large pliers and pull out all the rubber stoppers. (See figure 38)

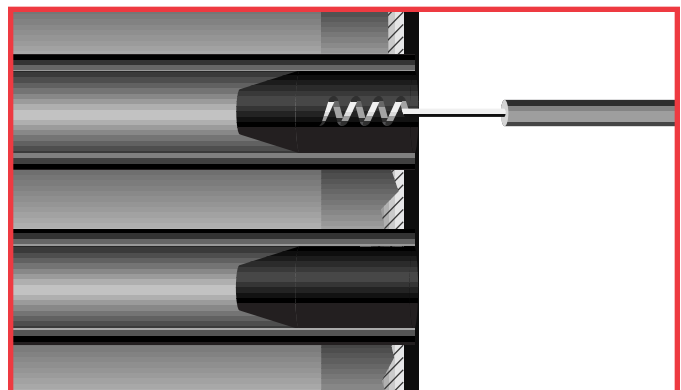


Figure 38. Remove stoppers with a packing puller.

- To provide a clean finish** in the tubes, allowing an easy flow of liquid, smooth the opening of the tubes to remove excess epoxy. Use a conical grinding bit for best results. (See figure 39)

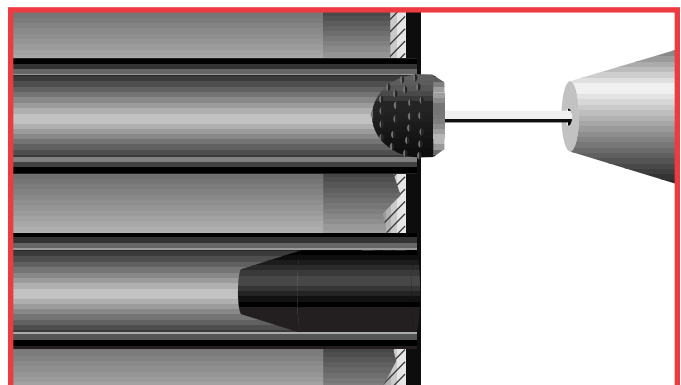


Figure 39. Smooth ends of tubes by grinding.

Note: Be sure not to coat machined surfaces that are gasket areas.

PUMP REPAIRS

Pump castings, impellers and volutes wear due to corrosion, erosion, cavitation, and mechanical damage. All these forms of damage can be effectively and economically repaired with Loctite® epoxies. The two main areas subject to wear are the volute and the impeller.

REPAIRING VOLUTES

1. **To prepare the surface**, remove all rust, old paint, and other debris from the area to be repaired. For best results, abrasive blast large areas or, use a needle gun or grinder. Prepare the area at least 1/2" (12 mm) greater than the repair area on all sides.

Where the equipment has been pumping salt solutions, abrasive blast all areas to be treated and leave for 24 hours, after which time the entire area should be given a brush blast to remove all salts which may have sweated to the surface.

Sandblast to sound metal and clean with Loctite® ODC-Free Cleaner & Degreaser.

2. **Build up the gouges** and worn areas on the inside of the body by applying a smooth coating of epoxy. To avoid air entrapment, use a suitably shaped thin plastic or metal applicator to apply a thin coat of product to all faces of the cavities. (See figure 40)

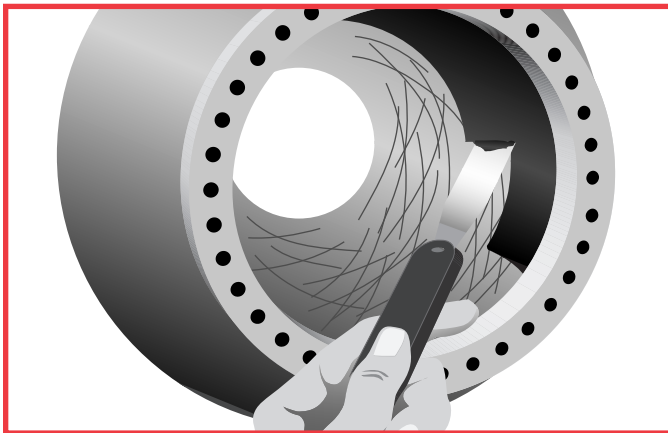


Figure 40. Epoxy putty is used to rebuild worn areas of volute.

3. **To fill the cavities**, press epoxy into the repair area. Use the applicator to smooth and shape the repair area to the original contour. Alternatively, the epoxy can be used to build up the repair area slightly larger than the required contour. After the epoxy has cured, it can be ground down to the original contour using a combination of grinding wheel and sanding disc attachments.
4. **Top coat** the entire volute area with Brushable Ceramic Epoxy to increase pump efficiency. (See figure 41)

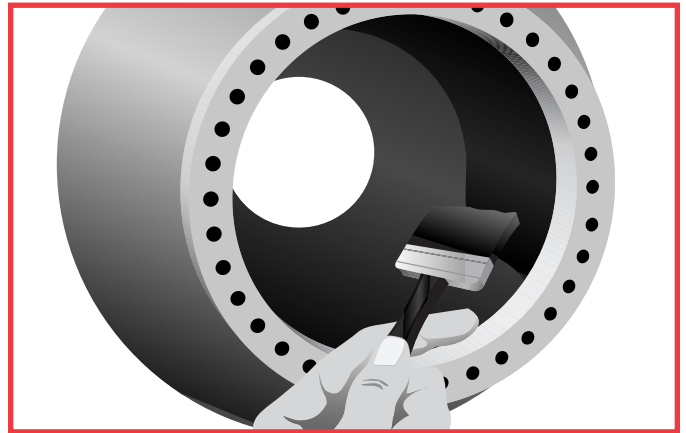


Figure 41. Brushable Ceramic applied over the epoxy putty repair provides a low friction finish that extends the operating life and efficiency of the pump.

For Material Safety Data Sheets (MSDS) or for Technical Data Sheets (TDS), Call 1-800-LOCTITE (1-800-562-8483) or visit us on the web at

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PUMP REPAIRS (cont.)

REBUILDING IMPELLERS

1. **Prepare the surface** as in **step 1** on previous page. To aid in penetration of the epoxy into cavities, warm the impeller to 120-140°F (50-60°C) before applying product.
2. **For severely eroded blades**, tack weld expanded metal from the edge to be rebuilt to the existing metal surface. (See figure 42)

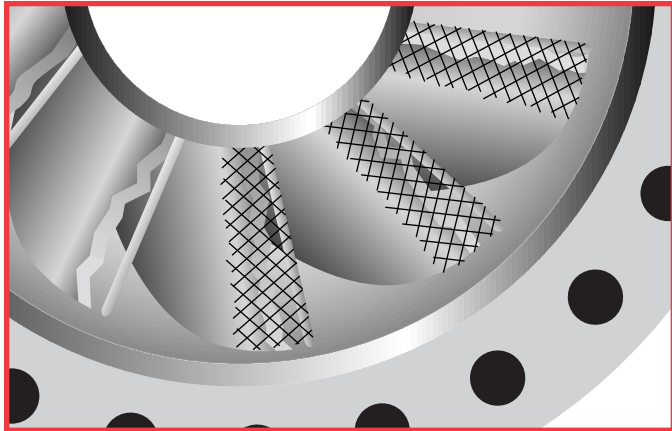


Figure 42. Expanded metal, used over damaged blades, rebuilds and reinforces the repair area.

3. **Apply epoxy** over the expanded metal, forcing the epoxy through the mesh, being careful to avoid air entrapment. Smooth the finish with a thin plastic or metal applicator. (See figure 43)

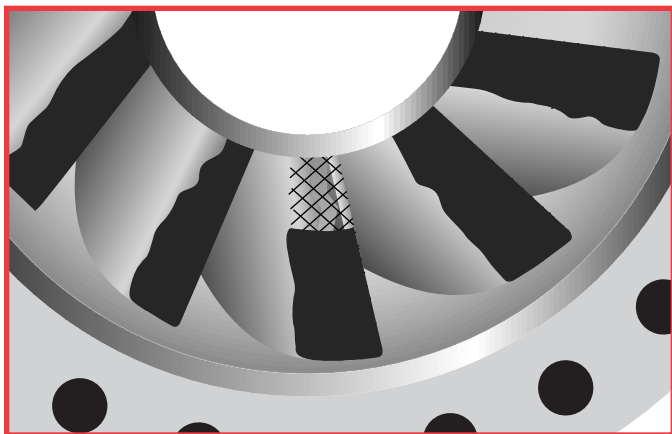


Figure 43. Coat expanded metal with epoxy and smooth out finish.

4. **To finish the repair**, brush apply a 15-20 mil coating of Brushable Ceramic to entire impeller area, filling in porous spots in the casting. Once the first coat has cured, apply a second coat of Brushable Ceramic. (See figure 44)

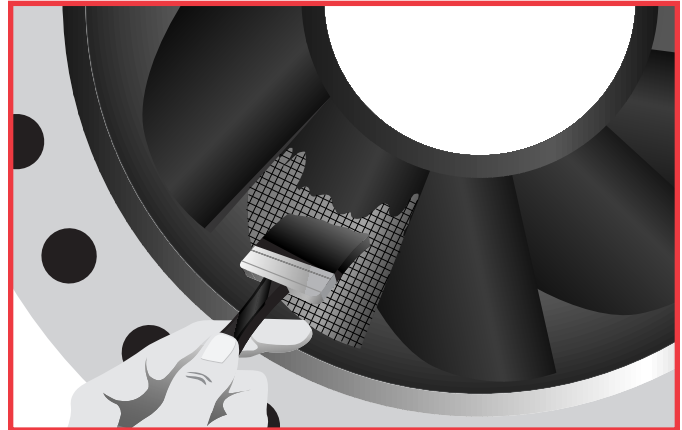


Figure 44. Two coats of Brushable Ceramic seal the metal and provide a low friction surface.

Note: After full cure, balance impeller before returning to service.

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FIXMASTER® EPOXIES

Problem: Gap between ceramic tile and flange lips

Equipment: Discharge flange face of cyclone

Solution: FIXMASTER® Wear Resistant Putty



FIXMASTER® Wear Resistant Putty fills the gap between liner and flange, created when new ceramic tiles were installed. Wear Resistant Putty is troweled into the gap and either "wet finished" (see Application Tips on page 4) or machined to exact tolerances.

Problem: Leaking flange

Equipment: Flange face on a chemical pump

Solution: FIXMASTER® Aluminum Putty



Flange faces, eroded by chemical exposure, were previously repaired by welding and machining. FIXMASTER® Aluminum Putty repairs aluminum faces at a lower cost and with far less downtime than conventional methods.

Problem: Severely damaged pipe

Equipment: Slurry transport pipe

Solution: FIXMASTER® Metal Magic Steel™



Damage to this pipe was so severe that expanded mesh is welded over the opening to provide reinforcement for the epoxy application. FIXMASTER® Metal Magic Steel™ is pressed over the mesh to fill and seal the application area. The pipe is ready for service in just minutes.

NORDBAK® EPOXIES

Problem: Uneven tiled lining

Equipment: Inlet section of heavy media cyclone

Solution: NORDBAK® Brushable Ceramic



In this two-step process, NORDBAK® Wearing Compound is used to rebuild the flat disk area of the cyclone intake. NORDBAK® Brushable Ceramic is then applied to provide a low-friction finish to prevent turbulence created by irregularities in the tile profile.

Problem: Eroded processing equipment

Equipment: Cyclone apex

Solution: NORDBAK® Wearing Compound



A form on the end of the apex is used to rebuild the interior to its original dimensions. NORDBAK® Wearing Compound is applied here with a gloved hand to fill the eroded area and smooth the finish.

Problem: Damage from abrasive coal handling

Equipment: Heavy media cyclone

Solution: NORDBAK® Wearing Compound



Both the inlet section and vortex finder of this heavy media cyclone are rebuilt and protected with NORDBAK® Wearing Compound.

Problem: Erosion of internal structure

Equipment: Side suction media pump

Solution: NORDBAK® Wearing Compound



A pump divider designed to reduce the turbulence inside the pump was almost completely worn away due to abrasion. It was rebuilt using a form over which NORDBAK® Wearing Compound was applied until the repaired section replicated the original divider.

Problem: Worn bronze parts

Equipment: Propeller casting

Solution: NORDBAK® Pneu-Wear and Brushable Ceramic



Severe abrasion had worn out a critical part of a marine propeller. To rebuild the surface and provide maximum protection from salt water exposure, NORDBAK® Pneu-Wear was applied. The area was then coated with NORDBAK® Brushable Ceramic to provide a durable, low-friction finish.

CHOOSING THE BEST LOCTITE® EPOXY FOR YOUR APPLICATION

A wide range of high performance repair epoxies are available to you from Loctite. Since each application has specific requirements relative to equipment type, operating conditions, application and operating temperatures and other critical factors, it is important to know how to choose the best product for your application.

The following is a brief description of each type of Loctite® repair epoxy with typical recommended applications. Use this information along with the Physical Properties Charts on pages 20 and 21 to determine the Loctite® repair material that is suitable for your particular application.

LOCTITE® REPAIR EPOXIES

FIXMASTER® EPOXIES

Steel Putty and Liquid: Steel-filled epoxies in putty and liquid forms cure to a metal-like finish that can be drilled, tapped and machined. A versatile repair compound, this epoxy is used for routine surface rebuilding applications that do not require outstanding wear resistant properties or a low friction, non-rusting finish. Recommended for pipe and tank repair.

	Product #	Size
Steel Putty	99913	1 lb.
	99914	4 lbs.
	99912	25 lbs.
Steel Liquid	97483	1 lb.
	97484	4 lbs.
	97482	16 lbs.



Fast Set Steel Putty: Steel Putty in a special formula that cures in just 10 minutes. Recommended for emergency and temporary repairs that require a fast-setting material. This material can be used to make initial repairs, followed by an application of a second, higher performance epoxy for long-term durability of the application.

Product #	Size
39917	1 lb.



Metal Magic Steel™: Fast curing epoxy in a convenient stick form for plugging holes in pipes and tanks and other emergency repairs.

Product #	Size
98853	4 oz./ 114 g



Wet Surface Repair Putty: Non-rusting repair material adheres to damp and wet surfaces, even cures underwater. Recommended for repairing pipes, tanks, and other equipment when the application surface cannot be fully dried.

Product #	Size
96583	1 lb.



Aluminum Putty and Liquid: Similar in properties to Steel Epoxy, Aluminum Epoxy is recommended for rebuilding and repairing aluminum or other non-rusting equipment.

Aluminum Putty	Product #	Size
	97463	1 lb.
Aluminum Liquid	97453	1 lb.



Stainless Steel Putty: Recommended for rebuilding and repairing stainless steel and other non-rusting equipment.

Product #	Size
97443	1 lb.



Wear Resistant Putty: Trowelable putty with excellent wear and abrasion resistance provides a smooth, low friction surface for equipment exposed to wear and erosion. Recommended for rebuilding and repairing pumps, keyways, tube sheets and valves. Non-rusting.

Product #	Size
98742	1 lb.
98743	3 lbs.



Superior Metal: Similar in properties to Wear Resistant Putty, this ferro-silicon filled material is a non-rusting putty with outstanding compressive strength and chemical resistance. Recommended for rebuilding and protecting pumps, shafts, keyways, splines, bearings, tube sheets, impellers, and valves.

Product #	Size
97473	1 lb.



CHOOSING THE BEST LOCTITE® EPOXY FOR YOUR APPLICATION

NORDBAK® EPOXIES

Wearing Compound: Large ceramic bead filled repair compound provides extra protection against extreme abrasion as may be required to protect pumps that process heavy, abrasive slurries. Available in 6 formulas.

	Product #	Size
Wearing	99813	5 lbs.
	99812	25 lbs.
Castable	98992	25 lbs.
Fast Cure	96373	6 lbs.
High Impact	39918	25 lbs.
High Temp.	99112	25 lbs.
Ultra High Temperature	96392	25 lbs.



Pneu-Wear: Small ceramic bead formulation is a patented design that provides maximum protection against fine particle abrasion. Available in 4 formulas.

	Product #	Size
Pneu-Wear	98383	3 lbs.
	98382	25 lbs.
Fast Cure	98363	6 lbs.
High Temperature	98372	25 lbs.
	98382	25 lbs.
Ultra High Temperature	96332	25 lbs.



Combo Bead Wearing Compound: Large and small ceramic bead formulation protects against hard sliding abrasion by multiple particles.

Product #	Size
96303	6 lbs.



Brushable Ceramic: Ceramic-filled, brushable epoxy. When used on its own, can fill cavitated areas and protect equipment from corrosion and abrasion. Used as a top coat over an epoxy putty, Brushable Ceramic provides a low friction coating that protects pump casings, impellers, fans and other processing equipment against turbulence, abrasion and wear. Available in 2 formulas.

	Product #	Size/Color
Brushable Ceramic	98733	2 lbs./Grey
	98732	6 lbs./Grey
	96443	2 lbs./White
High Temp. Brushable Ceramic	96433	2 lbs./Red



The following Loctite® products are also referenced in this guide and are available from industrial distributors:

	Product #	Size
Nordbak® Chemical Resistant Coating	96092	12 lbs.



Nordbak® Ceramic Tile Adhesive	97762	20 lbs.
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ODC-Free Cleaner & Degreaser	22355	15 oz. Aerosol
	20162	16 fl. oz. Pump Spray
	20260	1 gallon can



Silicone Lubricant	51360	5.3 oz. Tube
	81246	13 oz. Aerosol



Fixmaster® 4-Minute Epoxy	97434	50 ml Cartridge
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Fixmaster® Underwater Repair Epoxy	82093	4 oz. Stick
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Product Selection

FIXMASTER® EPOXIES PROPERTIES CHART

PRODUCT	Product Number	Container	Coverage, ft. ² @ 1/4" thickness	Color	Maximum operating temperature, °F	Compressive strength, psi †	Tensile strength, psi †	Hardness (Shore D)	Working time, minutes	Functional cure, hours	Mix Ratio by volume, r:h	Mix Ratio by weight, r:h
Aluminum Liquid	97453	1 lb. kit	17 in. ³	Alumin.	200	17,000	6,000	85	20	6	5:1	9:1
Aluminum Putty	97463	1 lb. kit	0.5	Alumin.	225	11,300	4,000	87	20	6	4:1	6.3:1
Fast Set Steel Putty	39917	1 lb. kit	0.4	Grey	200	10,800	4,600	80	3	10 min.	1:1	6.3:1
Metal Magic Steel™	98853	4 oz.	7 in. ²	Grey	250	12,000	2,500	80	3	10 min.	N/A	N/A
Stainless Steel Putty	97443	1 lb. kit	0.25	Grey	225	14,000	4,600	85	20	6	4:1	9:1
Steel Liquid	97483 97484 97482	1 lb. kit 4 lb. kit 16 lb. kit	13 in. ³ 52 in. ³ 208 in. ³	Grey	225	13,500	6,000	89	25	6	4:1	9.5:1
Steel Putty	99913 99914 99912	1 lb. kit 4 lb. kit 25 lb. kit	0.3 1.2 7.5	Grey	225	13,000	4,900	90	30	6	2.5:1	6.25:1
Superior Metal	97473	1 lb. kit	0.25	Dark Grey	250	18,000	5,500	90	20	6	4:1	7.25:1
Wear Resistant Putty	98742 98743	1 lb. kit 3 lb. kit	0.36 1.1	Grey	225	11,600	4,900	86	30	6	4:1	8:1
Wet Surface Repair Putty	96583	1 lb. kit	0.5	Grey	150	12,500	3,500	85	30	18	1:1	10:9

Properties are based on mixing one lb. mass at 77°F, 7 days cure.
†Ultimate cure.

APPLICATION SELECTION GUIDE	Emergency metal repairs	Corrosion protection	Repairing pipes, tanks	Rebuilding shafts, keyways, bearings	Repairing threaded parts	Restoring tube sheets	Pump repair	Repairing engine blocks	Fixtures and prototypes	Rebuilding impellers, valves	Repairing aluminum parts	Repairing stainless steel parts	Forming molds, fixtures	Wet surface repairs
Aluminum Liquid									●		●	◐	●	
Aluminum Putty		◐								●	●	◐		
Fast Set Steel Putty	●		●					◐						
Metal Magic Steel™	●		◐											◐
Stainless Steel Putty		◐								●	◐	●		
Steel Liquid			●		●				◐				●	
Steel Putty			●					●		◐			●	
Superior Metal		●		●	●	●	●	●		●				
Wear Resistant Putty		●		◐		●	●	●		●				
Wet Surface Repair Putty		◐	◐											●

● Preferred Choice ◐ Good Choice

NORDBAK® EPOXIES PROPERTIES CHART

PRODUCT	Product Number	Container	Coverage, ft. ² @ 1/4" thickness	Color	Maximum operating temperature, °F	Compressive strength, psi	Hardness (Shore D)	Working time, minutes, 77°F	Functional cure, hours, 77°F	Mix ratio by volume, r:h	Mix ratio by weight, r:h
Wearing Compound	99813	5 lb. kit	1.75	Grey	250	16,000	90	30	7	2:1	2:1
	99812	25 lb. kit	8.75								
Fast Cure Wearing Compound	96373	6 lb. kit	2.1	Blue	225	10,000	90	10	3	2:1	2:1
High Temperature Wearing Compound	99112	25 lb. kit	9	Grey	450	15,000	85	30	▲	4:1	3.9:1
Ultra High Temperature Wearing Compound	96392	25 lb. kit	9	Grey	550	–	90	30	▲	2.44:1	2.85:1
High Impact Wearing Compound	39918	25 lb. kit	8.75	Grey	250	15,000	85	30	6	2:1	2:1
Castable Wearing Compound	98992	25 lb. kit	277 in. ³	Grey	225	18,500	90	30	6	2:1	6.8:1
Pneu-Wear	98383	3 lb. kit	1.1	Grey	250	15,000	90	30	6	4:1	4:1
	98382	25 lb. kit	9								
Fast Cure Pneu-Wear	96363	6 lb. kit	2.1	Blue	225	12,000	90	10	3	2:1	2:1
High Temperature Pneu-Wear	98372	25 lb. kit	8.8	Grey	450	15,000	90	30	▲	4:1	4:1
Ultra High Temp. Pneu-Wear	96332	25 lb. kit	8.8	Grey	550	–	90	30	▲	2:1	2.27:1
Combo Bead Wearing	96303	6 lb. kit	2.3	Grey	250	13,000	90	25	8	2:1	2:1
Brushable Ceramic	98733	2 lb. kit	12*	Grey Grey White	200	12,500	85	30	6	2.75:1	4.8:1
	98732	6 lb. kit	36*		200	12,500	85	30	6	2.75:1	4.8:1
	96443	2 lb. kit	12*		200	12,500	85	15	5	2.9:1	4.8:1
High Temperature Brushable Ceramic	96433	2 lb. kit	21.5*	Red	600	16,000	90	120	▲	2.6:1	4.25:1
Chemical Resistant Coating	96092	12 lb. kit	74*	Grey	150	10,000	83	20	16	2.2:1	3.7:1
Ceramic Tile Adhesive	97762	20 lb. kit	12	Beige	200	14,000	88	60	12	1:1	3.7:1

Properties based on mixing one lb. mass at 77°F, ultimate cure.

*20 mil thickness.

▲ Requires heat cure. See Technical Data Sheet.

APPLICATION SELECTION GUIDE

PRODUCT	Fine particle abrasion	Multiple particle abrasion	Impact resistance	Chemical corrosion protection	High temperature resistance	Fast cure	Corrosion protection	Tile installation	Pump repair	Elbows	Fan housings	Cyclones	Chutes
Wearing Compound									●	●	●	●	●
Fast Cure Wearing Compound						●			●	●	●	●	●
High Temperature Wearing Compound					●				●	●	●	●	●
Ultra High Temperature Wearing Compound					●				●	●	●	●	●
High Impact Wearing Compound			●										
Castable Wearing Compound										●		●	
Pneu-Wear	●	●							●	●	●	●	●
Fast Cure Pneu-Wear	●	●				●			●	●	●	●	●
High Temp. Pneu-Wear	●	●			●				●	●	●	●	●
Ultra High Temp. Pneu-Wear	●	●			●				●	●	●	●	●
Combo Bead Wearing	●	●								●	●	●	●
Brushable Ceramic				●			●		●				
High Temperature Brushable Ceramic				●	●		●		●				
Chemical Resistant Coating				●			●						
Ceramic Tile Adhesive			●					●					

● Preferred choice ● Good choice

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