



User's Guide/Specifications

Metal-Filled Epoxy Repair Systems



Metal-filled epoxies allow economical, fast, permanent repairs to plant and equipment, cure quickly and resist corrosion and harsh chemicals.

Pourable compounds that provide accurate detail reproduction. Ideal for making molds, patterns, holding fixtures and forming dies.

Emergency repair epoxies cure rapidly, even under water. Minimize spills due to leaks or accidental punctures.

BIGA GROUP Ltd. HRVATSKA
tel.: +385 52 880 882
fax: +385 52 880 883
Intervention (24h): biga@biga.hr
www.bigagroup.com



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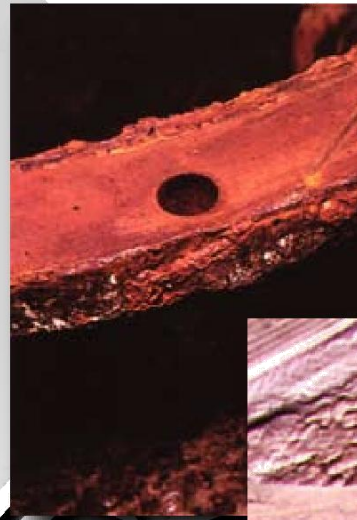
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Surface Preparation

Successful application is largely due to proper surface preparation.

Lack of proper surface preparation can cause premature failure of any repair.

Surface conditions will vary from job to job, and the following guidelines will help in the preparation of most substrates.



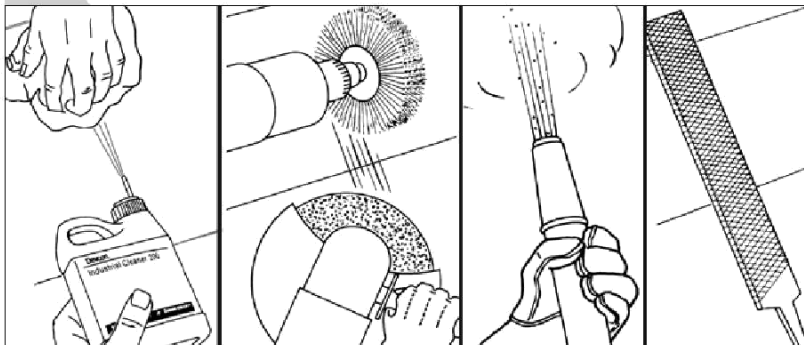
Un-prepared surface



Prepared surface

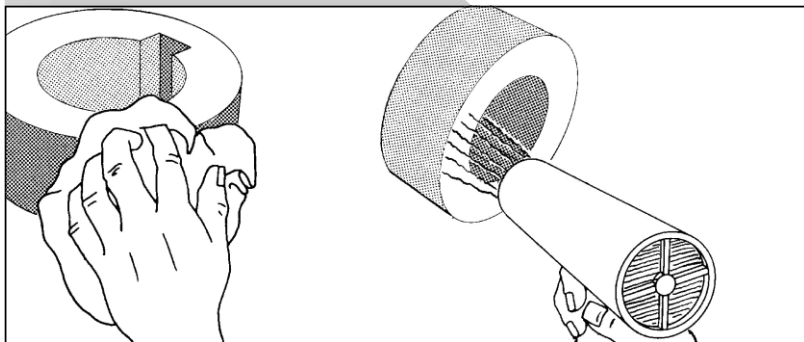


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CLEAN SURFACE PREPARATION

1. Degrease area with Devcon® **Cleaner Blend 300 #19510**.
2. Remove all surface contamination (paint, rust, and grime) from surface by abrasive blasting, sanding, filing, coarse grinding wheel (60 grit or coarser), a needle gun, or high velocity water blasting with abrasive medium, or other mechanical means.
3. The blasting medium should be angular grit such as silicone carbide, Black Beauty, or aluminum oxide. A .003 to .005 mil profile should be attained. The medium Black Beauty (size 1240 medium grade) will produce this grade.
5. Degrease again with **Cleaner Blend 300 #19510** to wash away any remaining blasting medium.
6. **Immediately** apply epoxy to a dry, rough surface to avoid oxidation or flash rusting. If this is not practical, apply a general coating of Devcon® **FL-10 Primer #15980** to protect surfaces. This will stop further rusting for up to 30 days under ideal storage conditions.



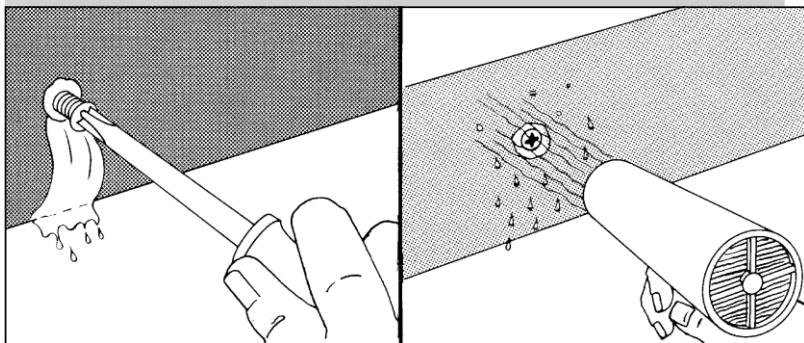
DEGREASING NOTE:

With surfaces immersed in oil, there is always the possibility that oil absorbed into the metal surface (such as pump shafts or bearing housings) will cause an adhesion problem after curing.

1. Repeated applications of Devcon® **Cleaner Blend 300 #19510** will help "pull-out" the oil from the surface.
2. Also, heating the part with a heat gun, or by putting the part in an oven, will force the oil out of the pores.
3. Allow part to cool and clean again with **Cleaner Blend 300 #19510**.

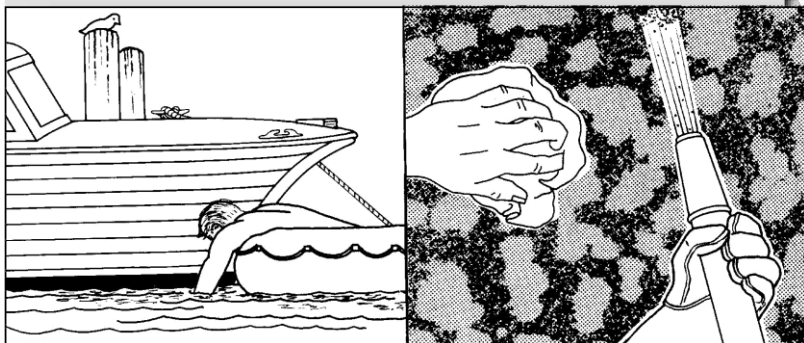
CHLORIDE CONTAMINATION:

Metals in salt water inherit high chloride (salt), levels over time. After blasting, test for chloride contamination as these salts act as a release agent and will disbond most coatings.



WET SURFACE PREPARATION

1. The general procedure concerning any surfaces to be repaired is **"IT MUST BE DRY"**. (An exception is when you use Devcon's **Underwater Repair Putty UW #11800**. See the Underwater Repairs below)
2. Stop all leaks or seepage, using one or more of the following methods:
 - A. Shut off the flow or pressure.
 - B. Fit a wooden peg or sheet metal screw into the hole to stop the flow.
 - C. Stuff with wax, cork, plumbers caulk, Mortite, or a cloth into the opening to stop the flow.
3. If the leak is caused by corrosion, the side wall might be weak. Open the orifice until good metal is exposed and the walls thick enough to be plugged.
4. Remove surface condensation, "sweating", and dampness by using a hot air gun or similar device.
5. Continue surface preparation (following steps in **CLEAN SURFACE PREPARATION** above).



UNDERWATER REPAIRS

Use Devcon's **Underwater Repair Putty UW #11800** to make these repairs. It bonds and cures underwater. Surfaces underwater require preparation.

1. Remove all dirt, flaking paint, barnacles, algae and seaweed from the substrate.
2. Wipe area with clean cloth to remove film.
3. Abrase surface if possible by mechanical means (file, compressed water, grit blasting or chemicals).

ALUMINUM REPAIRS

Oxidation of aluminum surfaces reduce the adhesion of an epoxy, and must be removed before using Devcon's **Aluminum Putty (F) #10610** or **Aluminum Liquid (F-2) #10710**.

1. Remove by mechanical means, such as grinding, blasting, or by chemical means.
2. Continue surface preparation (following steps in **CLEAN SURFACE PREPARATION** above).

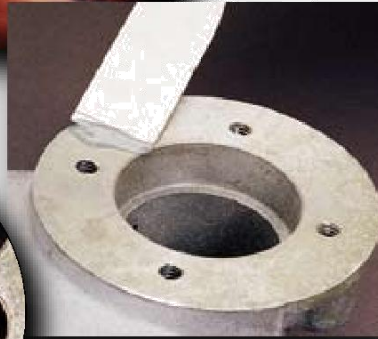


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Metal Rebuilding & Precision Machining



SHAFTS generally have two types of repair areas: the shaft itself and the keyways machined into the shaft. Wear is caused by vibration, rubbing, abrasive contaminants moving over the area, and fretting corrosion.

KEYWAYS become worn through constant pressure from starting and stopping and become ineffective.

METAL SURFACE repairs are often used to restore the integrity of the metal, and are relied upon to rebuild metal surfaces that are worn or missing.

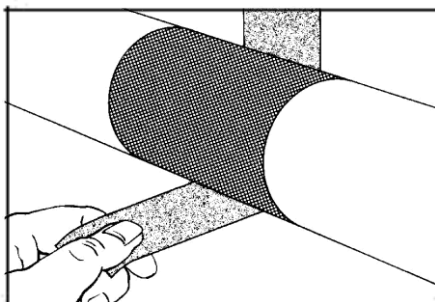
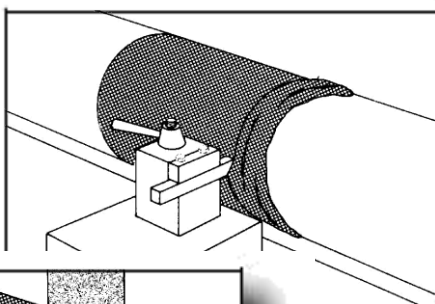
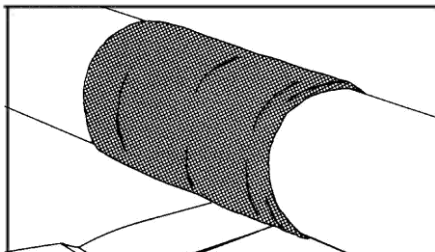
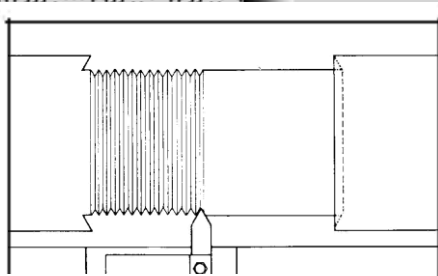
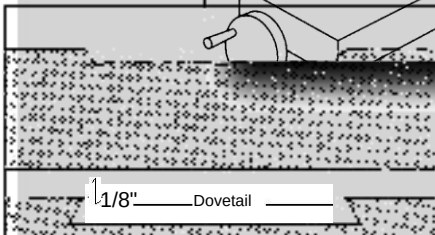
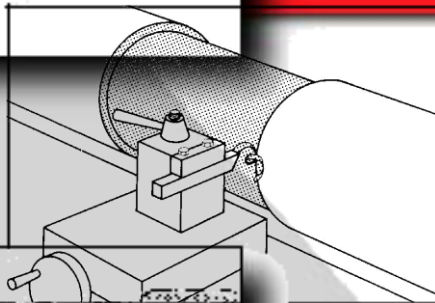
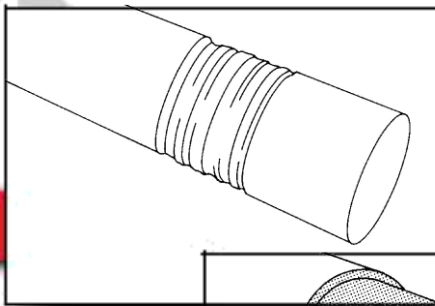
HEAT EXCHANGER repairs are required where galvanic corrosion occurs between the dissimilar metals of the tubes and tube sheet, and are accelerated by the wet conditions inside the cylinder.

PUMP wear and abrasion caused by cavitation, improper shaft and/or impeller balance can be repaired saving you thousands of dollars.

Hydraulic Rams that become rough and gouged tend to leak oil.



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Shaft Repair

Shaft, bushing, sleeve, seal and bearing areas are excellent candidates for repair.

Follow the guidelines previously described for *SURFACE PREPARATION*.

NOTE: Use **Titanium Putty # 10760** for shaft repair as its compression strength is the highest (18,800 psi) in the Devcon® product line.

1. Most important is to "smooth out" the shaft by using a lathe (**Figure 1**), unless the worn area already meets the undercut depth. A usual guideline for machining depth is:

SHAFT SIZE	UNDERCUT BY
1/2" - 1"	1/16"
1" - 3"	1/8"
2. Dovetailing the ends of the worn area would make the application lock into place and help prevent the epoxy from being sheared or forced out of the threaded area (**Figure 2**).
3. Machine a "threaded" pattern over the repair area to increase surface area (**Figure 3**). The larger the shaft size, the deeper the groove. The smaller the shaft size, the shallower the depth and closer together.
4. With shaft turning at a very slow speed, apply the epoxy over the area. Using a putty knife or plastic spatula, force the epoxy into the threads. Use enough epoxy to fill out above the diameter of the shaft (**Figure 4**).
5. Before machining (**Figure 5**), allow the epoxy to cure at least 4 hours at room temperature.
 NOTE: To speed up the curing process, apply a hot air gun or heat lamp to repair area. Machine the shaft using these guidelines:

Lathe speed: 150 f/min	
Feed rate:	Rough: .020 in./rev
	Finishing: .010 in./rev
Top Rake: 6 degrees (+/- 2°)	
Side/Front clearances: 8° (+/- 2°)	
Cut: Dry	
Tools: Carbide bits	
6. Finish by polishing using 400/650 emery paper (**Figure 6**). A 25-50 micron finish can be achieved using this method (**Figure 6**).

NOTE: To repair a shaft worn by mechanical packing is not practical. The frictional heat developed by the packing will soften the epoxy.



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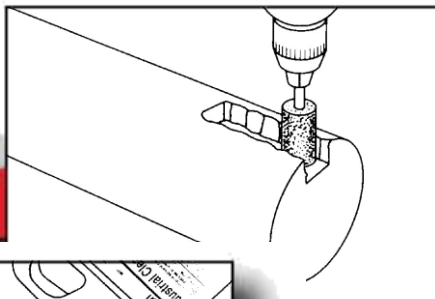


Figure 1

Keyway Repair

One of the more simple repairs to perform, saves time and money, and will get your equipment up and running quickly.

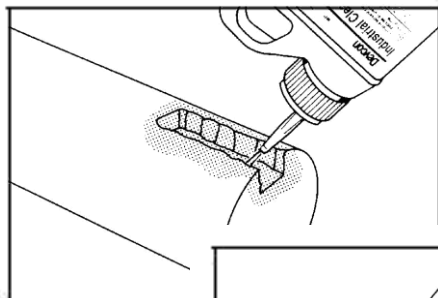


Figure 2

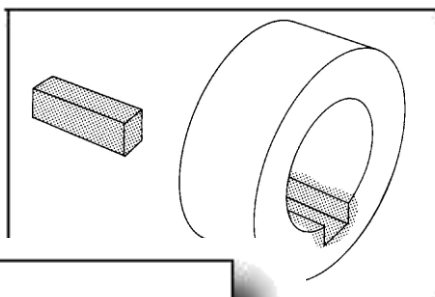


Figure 3

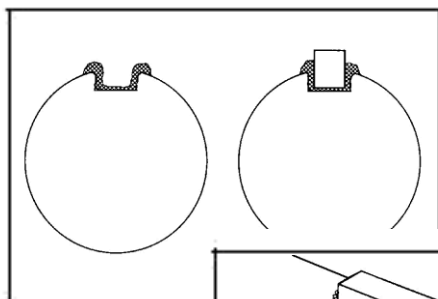


Figure 4

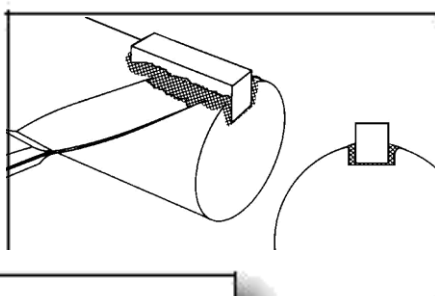


Figure 5

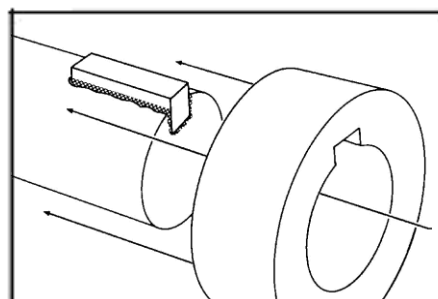


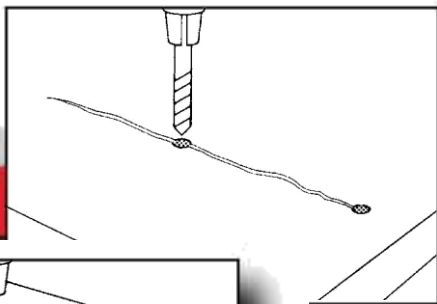
Figure 6

First, follow the guidelines previously described for *SURFACE PREPARATION*.

1. Roughen the surface by any mechanical means to develop a good surface profile is acceptable (**Figure 1**).
2. Clean and degrease the entire area according to guidelines described in *DEGREASING* in the Surface Preparation section (**Figure 2**).
3. Apply a thin layer of Devcon's **Release Agent #19600** to the key itself and let dry. Then apply a small amount of **Release Agent #19600** to any area where you do not want the epoxy to bond to. (**Figure 3**).
4. Mix a sufficient amount of **Titanium Putty #10760** to do the repair job. Apply **Titanium Putty #10760** to the keyway area with a putty knife or plastic spatula. Build up a thicker area on the side walls than on the bottom so as not to raise the key up and ensure a close tolerance fit (**Figure 4**).
5. Scrape away excess material from the sides of the keyway (**Figure 5**).
6. Immediately align the shaft on the hub for proper alignment. You may leave the coupling assembled as you previously coated everything with **Release Agent #19600** (**Figure 6**).



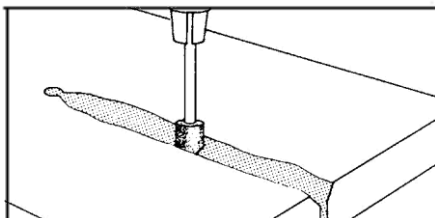
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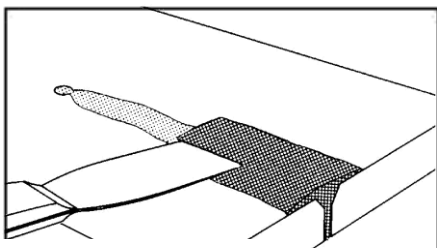
◀ Figure 1

Metal Surface Repair

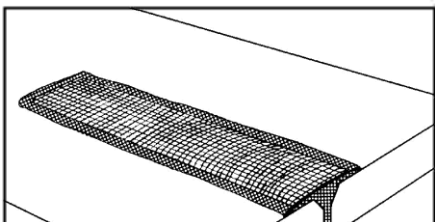
Use Devcon® metal filled epoxies for general repairs to cracks in pump casings, valve bodies, tanks, bearing housings, and gear boxes.



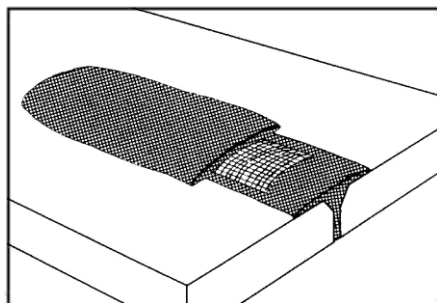
◀ Figure 2



◀ Figure 3



◀ Figure 4



◀ Figure 5

Follow the guidelines previously described for SURFACE PREPARATION.

NOTE: Use **Titanium Putty #10760** for all metal surface repairs. If short "downtime" is necessary, use **Plastic Steel® 5 Minute® (SF) #10240**, or **FasMetal™ #10780** to get equipment back into service in 3 hours.

1. Drill holes, 1/8" larger than crack at each end, or multiple holes if crack is over 5 inches long, to relieve further cracking (**Figure 1**).
2. Use drill or edge grinder with an abrasive to make a "V" groove along crack to increase surface area for application of epoxy. Degrease the grooved area to remove any contamination (**Figure 2**).
3. With putty knife or spatula force the epoxy into the crack and completely fill the "V" groove. Overlap approximately 1" on each side of the crack to ensure adhesion (**Figure 3**).
4. Embed a piece of reinforcing mesh (fiberglass, nylon or wire screening) onto top of epoxy pressing in until epoxy oozes through mesh (**Figure 4**).
5. Apply another coat (1/16" - 1/4") over the mesh, smooth and "feather" out the edges for a good finish. Use a heat gun or heat lamp to speed up curing. (**Figure 5**).

NOTE: Damaged parts due to metal fatigue or stress cracks should be replaced. You cannot repair metal where the integrity of the metals are in question.



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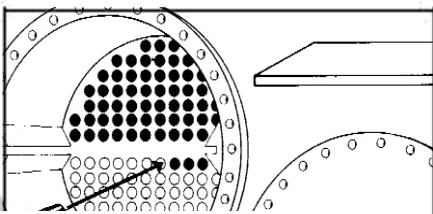


Figure 1

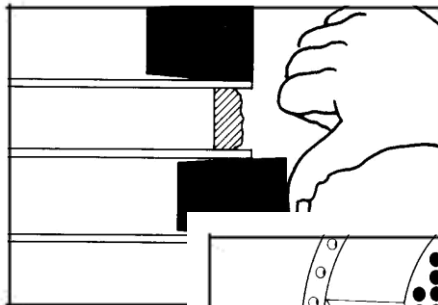


Figure 2

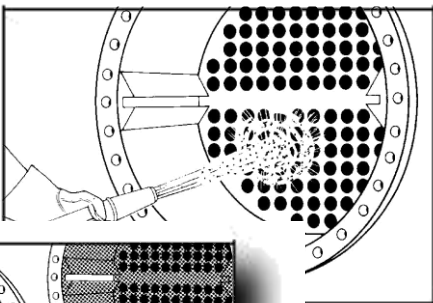


Figure 3

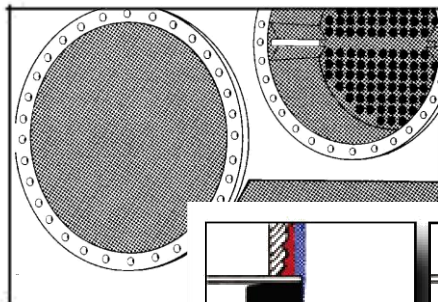


Figure 4

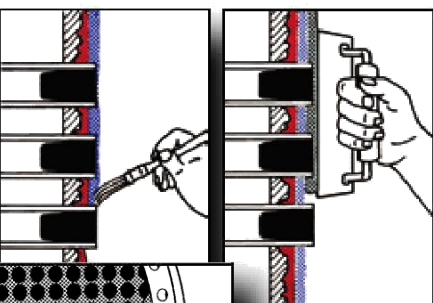


Figure 5&6

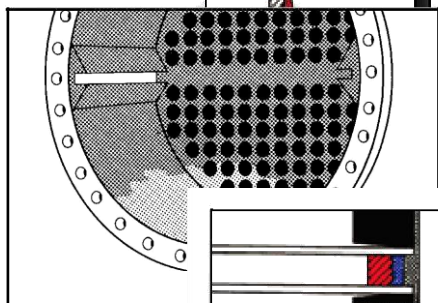


Figure 7

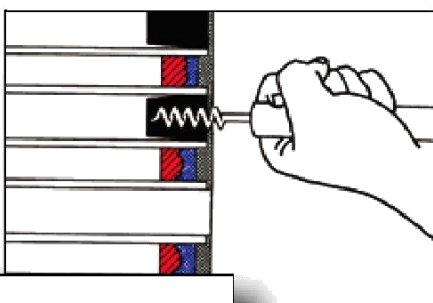


Figure 8

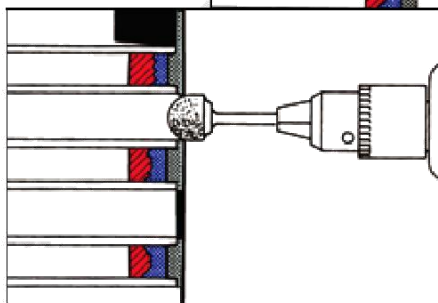


Figure 9

Heat Exchanger Repair

Heat exchangers, chillers and condensers are subject to heavy corrosive damage. If not protected from corrosion, this can lead to complete destruction of the equipment.

- 1. SURFACE PREPARATION.** Remove end plates and baffles (if any). Clean/degrease tube sheet before blasting. Insert rubber stoppers into the ends of the tubes. It is critical that you use the right size stoppers. The stoppers should protrude above the end of the tube, no more than 1/32" to 1/16".
NOTE: Condenser tubes are not always flush with the tube sheet face. If not flush, find a stopper that is flush with the end of the tube when inserted (Figure 1).
 - Worn tube sheet faces may be eroded 1/32" to 1/8" from the edges of the tubes. It is important to find stoppers that are flush with the tubes. The best way to install stoppers is to push each one snug by hand (Figure 2).
 - Once the stoppers are installed, sandblast the entire sheet face. For detailed procedures, follow the **CLEANING** section of the Surface Preparation Guide. The stoppers will protect the tubes from becoming worn or rounded. After blasting, blow out the debris from the sheet using air. Next, follow the section **DEGREASING** of the Surface Preparation Guide (Figure 3).
 - Prepare baffle plates and end plates of the tube sheet. Blast plates to a SSPC5 as a guideline. (Figure 4).
 - Mix Devcon's **Brushable Ceramic Red #11760**, and coat the tube sheet, reaching all the sandblasted areas. Wait 3-16 hours and recoat with **Brushable Ceramic Blue #11765**. The 2-coat system helps detect any "holidays" or misses between coats (Figure 5).
 - If tubes extend more than 1/8" from tube sheet, it may be necessary to build the tube sheet up to the tube level. If so, first coat the sheet with **Brushable Ceramic Red #11760** to wet out (prime) for the next coat. Trowel on **Ceramic Repair Putty #11700** bringing surface up "flush" with tubes. Finish with coat of **Brushable Ceramic Blue #11765** (Figure 6).
 - Coat inlet areas, baffle plates and end covers. Do not apply epoxy to baffle plate hold-down tracks, as this will cause difficulty putting back the plates. Remember, tolerances are closer now (Figure 7).
 - Wait at least 16-20 hours before removing stoppers. Use a packing putter or pliers to pull out all the rubber stoppers. If in good condition, they may be used again (Figure 8).
 - Use a conical grinding bit to smooth the edges where epoxy meets the tube to allow better flow (Figure 9).
- NOTE:** Be sure not to coat machined surfaces that are gasket areas. After torquing down on these areas, you risk the chance of "chipping" the coating.
To rebuild machined surfaces, Titanium Putty is recommended.



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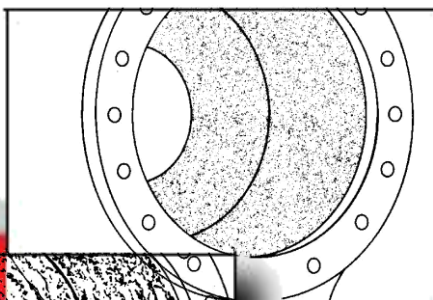


Figure 1

Pump Repair

Pump repairs are very practical as replacement can cost thousands of dollars. Here is how to repair pump volute areas and impellers

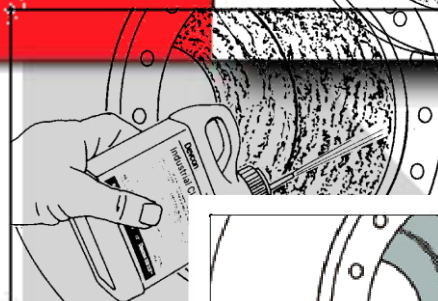


Figure 2

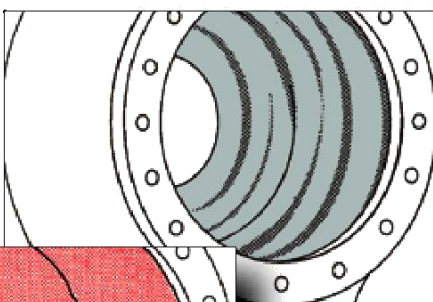


Figure 3

Follow the guidelines previously described for SURFACE PREPARATION.

1. Since worn areas are usually "pitted", and the substrate is usually porous, surface preparation is vital. A good 3-5 mil sandblasting profile is needed for best adhesion (Figure 1).
2. Thoroughly degrease the area to remove any residual abrasive medium lodged in pore of material (Figure 2).
3. Fill all gouges, greater than 1/8" in worn areas, with mixed **Titanium Putty # 10760** or **Ceramic Repair Putty #11700** compound. Use spatula or putty knife to smooth the surface. A simple technique is to wet your hand and gently rub the palm over the epoxy in a circular motion (Figure 3).

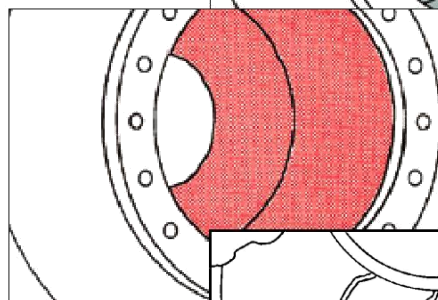


Figure 4

4. Next, topcoat the entire volute area with Devcon's **Brushable Ceramic #11760** or **#11765**. Multiple coats are for a "Pin hole" free finish. This creates a 15-25 mil chemical resistant coating to protect the interior of the casing (Figure 4).

5. For worn impeller blades, follow the same surface preparation as for pump casing. Check for and clean off any chloride contamination, as salts react as a release agent and can prevent epoxy from bonding to surface (Figure 5).

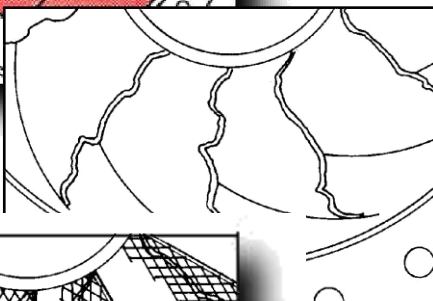


Figure 5

6. Next, rebuild the missing metal from the blades by welding a 3/8" rod for a "leading edge", and then tack weld expandable metal from the leading edge to the existing metal surface for reinforcement (Figure 6).

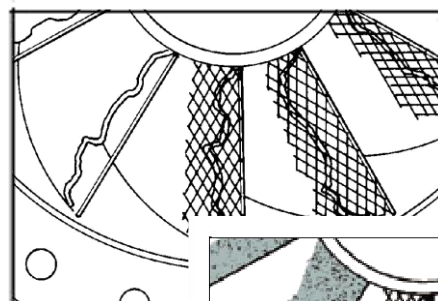


Figure 6

7. Now, fill the missing metal areas with **Ceramic Repair putty #11700**, applying small amounts at a time, to "wet in" the epoxy and prevent air pockets, being sure to push epoxy through until it oozes out the other side. Smooth over final coating as described in step 3 to improve the pumps flow. Plastic forms can be used to support the epoxy while curing (Figure 7).

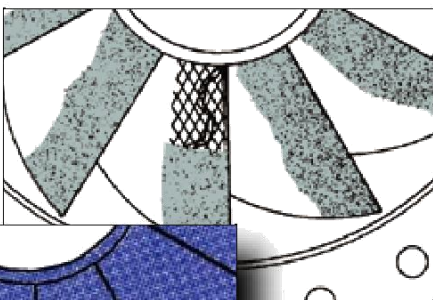


Figure 7

8. Finally, apply **Brushable Ceramic Red # 11760** for the first finish coat for a 15-20 mil thickness to smooth out rough spots in the casing. Within 3-16 hours, apply a coat of **Brushable Ceramic Blue # 11765** to cover any unfilled areas from the first coat (Figure 8).

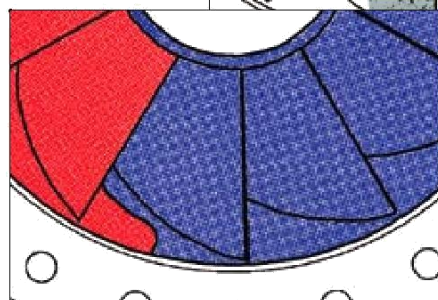
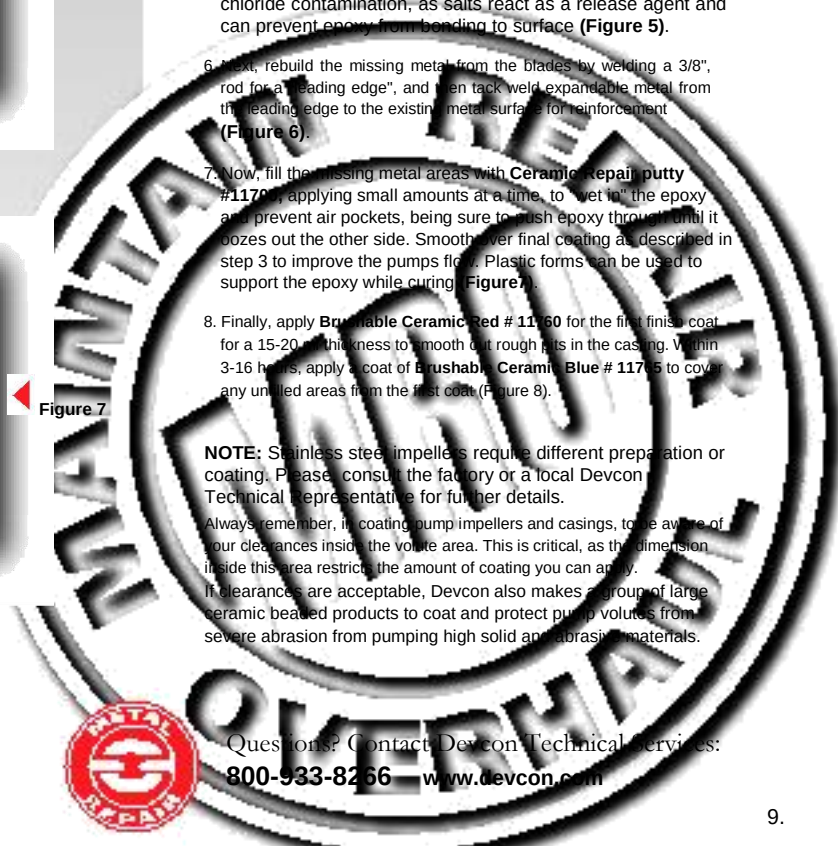


Figure 8

NOTE: Stainless steel impellers require different preparation or coating. Please consult the factory or a local Devcon Technical Representative for further details.

Always remember, in coating pump impellers and casings, to be aware of your clearances inside the volute area. This is critical, as the dimension inside this area restricts the amount of coating you can apply.

If clearances are acceptable, Devcon also makes a group of large ceramic beaded products to coat and protect pump volutes from severe abrasion from pumping high solid and abrasive materials.



Questions? Contact Devcon Technical Services:
800-933-8266 www.devcon.com

Typical Physical Properties

GENERAL REPAIR EPOXIES

Plastic Steel® Putty (A)	10110	1lb.	9.00:1	2.50:1	Putty	11.9	45	48	250	2800	3220	8260	5600	8.5	48	1.37	67.5	30	.0006	85
Plastic Steel® Liquid (B)	10210	1lb.	9.00:1	3.00:1	15/25000	13.1	45	52	250	2800	4900	10,200	7480	8.5	38	1.39	67.5	30	.0006	85
Plastic Steel® 5 Minute® (SE)	10240	1lb.	1.70:1	1.00:1	Putty	12.2	5	49	200	2026	3100	10,400	7680	7.5	34	2.65	35.0	30	.0090	66
Aluminum Putty (F)	10610	1lb.	9.00:1	4.00:1	Putty	17.5	60	70	250	2600	3680	8420	6760	8.0	29	1.73	21.4	100	.0008	85
HVAC Repair Putty	19770	6.5oz.	0.90:1	1.00:1	40000	16.1	60	64	250	2500	3720	8420	6260	7.8	29	1.73	21.4	100	.0008	85
Aluminum Liquid (F-2)	10710	1lb.	9.00:1	5.00:1	15/25000	17.5	75	70	250	2700	5000	9820	3540	7.5	50	1.58	8.60	100	.0009	85
Stainless Steel® Putty (ST)	10270	1lb.	11.00:1	3.75:1	Putty	12.4	58	50	250	2385	3340	8400	5280	8.0	34	1.23	75.0	30	.0010	85
Bronze Putty (BR)	10260	1lb.	9.00:1	3.00:1	Putty	12.4	35	50	250	2680	2640	8540	6180	8.0	33	1.57	75.0	25	.0010	85
Wear Resistant Putty (WR-2)	11410	1lb.	9.00:1	4.00:1	Putty	13.9	60	56	250	2200	4300	9840	6560	7.5	32	1.67	6.30	400	.0005	85

PRECISION REPAIR EPOXIES

Titanium Putty	10760	1lb.	3:1	3:1	Putty	11.7	21	47	350	2000	4000	18800	7700	9.5	22	1.95	44.8	56	.0010	87
Brushable Ceramic - Red, Blue	11760, 11765	1lb.	5.60:1	3.40:1	32000	16.5	40	66	350	2000	3800	15200	8000	9.0	19	1.92	38.7	382	.0020	90
- White	11770	1lb.	8.50:1	5.60:1	40000	16.5	21	66	350	2000	3800	15200	8000	9.0	19	1.92	38.7	382	.0020	87
Ceramic Repair Putty	11700	3lb.	7.00:1	4.3:1	Putty	16.4	25	66	350	2000	3900	12700	6475	9.0	17	1.88	41.0	370	.0022	90
Fasmetal™	10780	.75lb.	1.00:1	1.00:1	Putty	15.5	4	72	250	2000	3145	12700	7700	8.5	32	2.04	18.6	370	.0093	90

EMERGENCY REPAIR PRODUCTS

Underwater Repair Putty (UW)	11800	1lb.	1.40:1	1.00:1	Putty	17	45	68	250	2685	2760	5625	4990	7.5	18	1.41	8.60	150	.0020	82
Zip Patch™	11500	1 Patch	-	-	17000	24.1	5	-	200	2400	10100	-	19000	2.9	64	1.71	43.5	250	.0010	75
Magic Bond™ Epoxy Putty Stick	11600	4oz.	-	1.00:1	Putty	15.3	20	48	250	700	2540	12000	4280	7.0	21	1.24	28.1	300	.0030	70

Chemical Resistance

	ACID	ALCOHOL	KETONE	ALKALINE	HYDROCARBON	CHLORINATED HYDROCARBON	SALT	MISC.
GENERAL REPAIR EPOXIES								
Plastic Steel® Putty (A)	U U V U V U F U F U	U U	U U	V V V V V	F V V V F F	V U V V	V V V V	V V V V
Plastic Steel® Liquid (B)	U U V U V U F U F U	U U	U U	V V V V V	V V V F F	V U V V	V V V V	V V V V
Plastic Steel® 5 Minute® (SE)	U U F U F U F U F U	U U	U U	F F F U F	F V V V F F	U U F F	F F F F	F U U V V
Stainless Steel® Putty (ST)	U U F U F U F U F U	U U	U U	V V V V V	V V V V V	V U V V	V V V V	V V V V
HVAC Repair Putty	U U V U V U F U F U	U U	U U	U U U U U	F V V V F F	V U V V	V V V V	V V V V
Aluminum Putty (F)	U U V U V U F U F U	U U	U U	U U U U U	F V V V F F	V U V V	V V V V	V V V V
Aluminum Liquid (F-2)	U U V U V U F U F U	U U	U U	F F F F F	V V V F F	V U V V	V V V V	V V V V
Bronze Putty (BR)	U U U U U U U U U U	U U	U U	V V V V V	V V V V V	V U V V	V V V V	V V V V
Wear Resistant Putty (WR-2)	U U F U F U F U F U	U U	U U	V V V V V	V V V V F F	F U F F	V V V V	V F V V
PRECISION REPAIR EPOXIES								
Titanium Putty	U U E F E F V F F F	E E U	E E E E E	E E E E E	V U E E	E E E E	E E E E	E E E E
Brushable Ceramic	U U E F E F V F F F	E E U	E E E E E	E E E E E	V U E E	E E E E	E E E E	E E E E
Ceramic Repair Putty	U U E F E F V F F F	E E U	E E E E E	E E E E E	V U E E	E E E E	E E E E	E E E E
Fasmetal™	U U F U F U F U F U	U U	U U	F F U F U	F V V V F F	U U F F	F F F F	F U U V V
EMERGENCY REPAIR PRODUCTS								
Zip Patch™	U U V V V V F F F F	U U	F F	U U U U U	U U U U U	U U U U	F F F F	F F U F F
Underwater Repair Putty (UW)	U U F U F U F U F U	U U	U U	V V V V V	V V V V V	V U V V	V V V V	V V F V V
Magic Bond™ Epoxy Putty Stick	U U F U F U F U F U	U U	U U	F F U F U	F V V V F F	U U F F	F F F F	F U U V V

KEY: E = Excellent
V = Very Good
F = Fair
U = Unsatisfactory

CURE: 7 days @ 75°F

IMMERSION: 30 days @ 75°F



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