Pump Repair Tips – Part 3

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Pump repair is a natural fit with motor repair, because most pumps are motor-driven. Here is the third part of a series of repair tips that will help you improve your pump performance.

While most end users schedule their electric motors for semi-regular maintenance, pumps could be described as "out of sight, out of mind." When the motor is removed for repair, it is a good time to also remove and refurbish the pump.

There are several easy ways to improve pump performance – especially if the pump has not been serviced for several years. A pump's efficiency decreases by approximately 2 percent per year of service in benign environments. Corrosive or abrasive materials may reduce pump life to months instead of years, with comparable deterioration of efficiency.

The efficiency of pumps can be increased up to 30 percent or more just by applying some pump repairer "tricks of the trade." These tricks will pull some of those methods for efficiency improvement and repair tips together in one place. Let's continue with our next set of tricks.

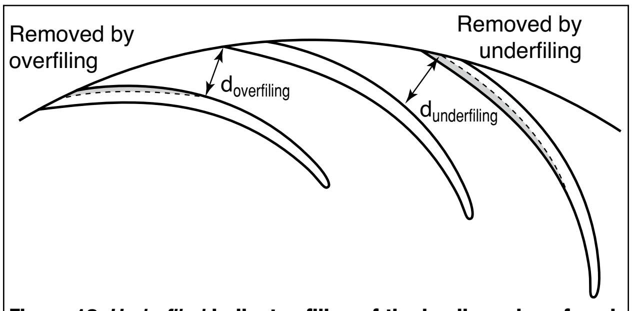


Figure 12. *Underfiled* indicates filing of the leading edge of each impeller blade on the underside (concave side). The dotted line indicates the increase in distance to the next vane. This small increase, viewed facing the opening, increases the cross-sectional area of the opening, which reduces the velocity of the pumped liquid. The result – increased head and power at the same capacity – improves efficiency. *Overfiling* also reduces turbulence but does not cause the same increase in area between vanes. The impact on efficiency is not as significant.

Angle of Attack of the Leading Edge of Each Impeller Blade

We tend to compare the leading edge of an impeller blade to that of an airplane wing. It is similar, except that: the impeller blade is not creating lift, it spins in a confined tight circle within an enclosure, most liquids pumped are considerably denser than air, and the impeller is moving the liquid.

It is quite different from an aircraft wing after all, so it is no surprise that the ideal leading edge of an impeller is not very much like an airplane wing either.

The "ideal" impeller has a leading edge with an angle of attack of 6-deg. The sharpened leading edge slices more smoothly through the liquid, so it creates less turbulence. Pump efficiency increases by roughly 6 percent when the leading edge of an impeller is correctly filed.

Once we establish that the leading edge is thick, the question becomes which edge to file. *Underfiling* is preferable to *overfiling* (as illustrated in Figure 12). Underfiling increases the opening between vanes, which reduces

Figure 13. A variety of specialty ceramic coatings can be used to reduce the surface roughness and improve efficiency.

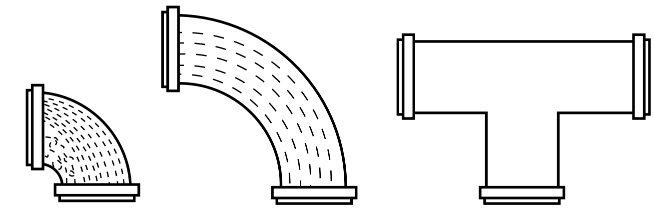


Figure 14. Pipe elbows and pump efficiency: relative friction compared to a 90-deg elbow.

average velocity of the fluid. That increases head and power at the same capacity, and increases efficiency slightly more than that achieved by overfilling. It also lowers the chance of cavitation.

The interior of the pump should be as smooth as possible. The rougher a surface, the more friction and the more turbulence we expect. Grinding of very rough areas, especially on large parts, is time-consuming but beneficial.

There are several manufacturers of specialty coatings for pump repair. Ceramic putties (Figure 13), high-wear putties, and other products are specially made for improving the surface finish of the parts that a pumped liquid flows past.

The potential improvement for this effort is significant: 12 percent. If the surface finish lasts longer because the repair putty extends part life and reduces future wear, the benefit is even greater. When abrasive material is in suspension in the liquid being pumped, part wear is accelerated. Chemical corrosion can erode some materials just as quickly. There are severe applications where pump life is measured in weeks.

When a liquid must make an abrupt 90-deg turn, it requires energy to get around that corner, causing efficiency to suffer (Figure 14).

Turbulence increases and with it the likelihood of cavitation that can damage the impeller by eroding material away. Replacing sharp 90-deg bends with transition elbows can increase pumping system efficiency by 10 percent. This improvement must be made outside the pump and requires some re-plumbing at the job site.

Construction is expensive enough that designers often look for ways to reduce first cost. Plumbing with 90-deg elbows instead of transition elbows is common, but the energy savings for transition elbows makes this a worthwhile change in most cases.

Cap and Cable Assembly

Some submersible pumps use a potted cap and cable assembly (Figure 15) to exclude water while simultaneously protecting the lead cord from mechanical damage.

When these are inspected, the entire cord should be

immersed in water overnight, with only the ends of the separated cable leads projecting above the water. Use a megohmmeter to check resistance to ground, and also between each possible combination of cables (A-B, B-C, C-A, etc.).

It's better to discover damage before the submersible is repaired and returned to service. If the cable is damaged, water may seep through the outer sheath and wick down the leads to the interior of the pump. For this reason, some manufacturers use a unique potted cable design to stop the water from making its way to the windings.

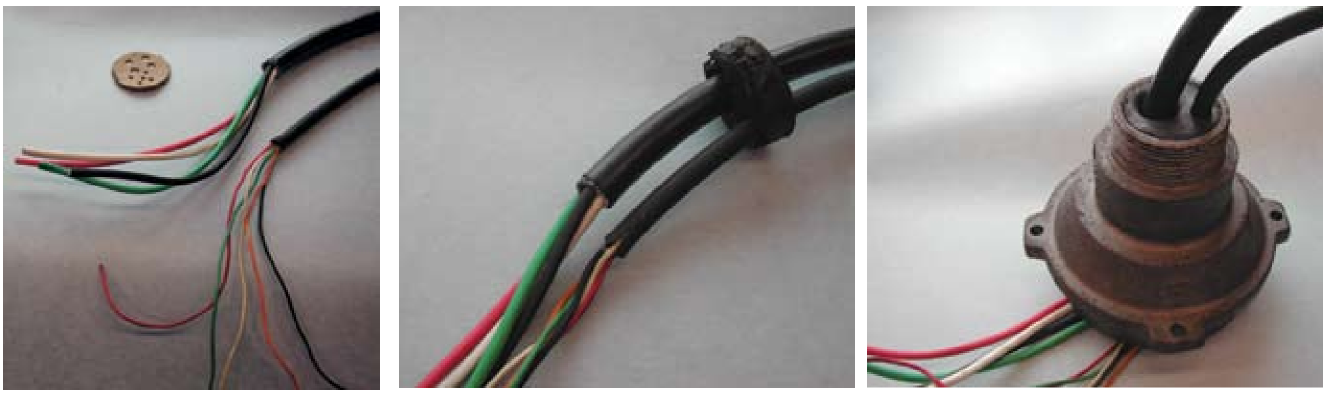
To save the considerable expense of a factory replacement, it is possible to replace only the cord. The replacement cord must be of the correct size and type, suitable for underwater use. The key steps (see Figure 16) to successfully potting the new cable into the old cap are:

- Cut off the old cable near the cap.
- Process the cap through the burnout oven to remove all residue.
- Sandblast the cap, inside and out.
- Cut the sheath to separate the leads, trim the sheath evenly.

Figure 15. S.O.W. cords should be inspected for nicks and damage, otherwise the pumped liquids might wick down the cable to the motor interior.

- Place the cap inverted in a vice, clamp securely.
- Position the replacement cable in the cap so that the end of the sheath is approximately halfway up the depth of the potting compound.
- Wipe the lead insulation with denatured alcohol to remove contamination.
- Use an appropriate potting compound rated for water immersion.
- Warm the potting compound to reduce the viscosity so that it flows well.
- Do not move the cap assembly until the potting compound has completely cured.

Figure 16 process cap and cable assembly.

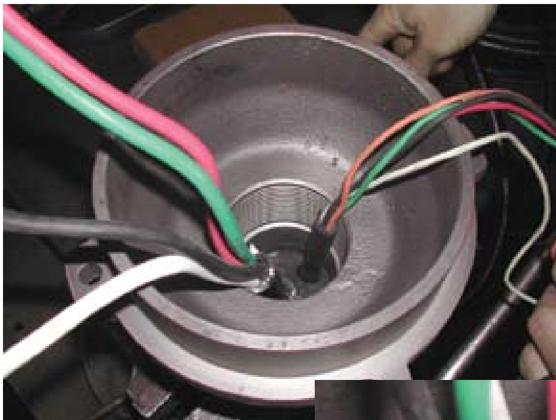


1. Use a stiff gasket material, hole-punched to assure lead separation.

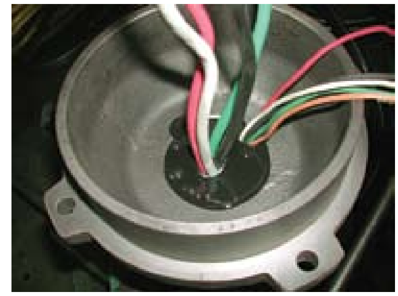
2. Reuse the cable grommet to protect the cable sheath.

3. The grommet should fit the cable sheath tightly to prevent epoxy leaks.

Figure 16 process cap and cable assembly (cont.).

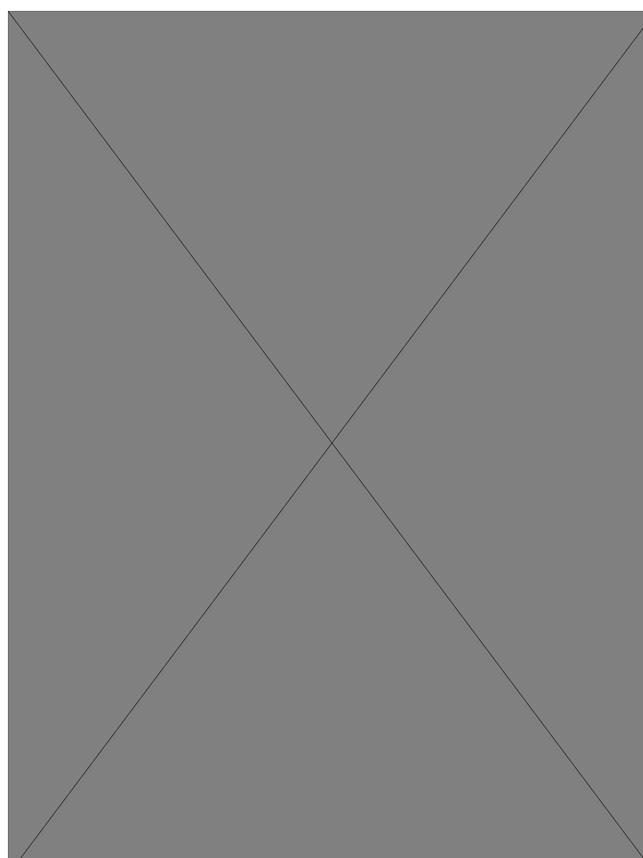


4. The "cap" must be sand-blasted and clean. Position the leads so that the sheath end will be beneath the surface of the potting compound.



5. Pour the potting compound, then fit the gasket.

6. Fit the gasket to space the leads.



7. Pour the potting compound to the final level and make sure the leads are separated.

8. Finished cap and cable assembly with the lead grommet visible.

When a submersible pump uses a cable grip, rather than a potted cap assembly, the cable should be cut back so that the grommet/cord grip "grips" a fresh section of cable sheath. Over time, the cord grip compresses the cable sheath, reducing the interference fit and therefore its ability to form an effective seal. Always replace the cord grip.

For submersible pumps, one final step is to submerge the pump, including the cable (all but the very end of the leads) assembly, and verify that the resistance to ground remains acceptable. A nicked cable is an easily overlooked route of access for water into a submersible.

(Here's a tip: Make cable inspection part of the disassembly process. Immerse all but the very ends of the cable in water for a couple of hours, then hipot between conductors to make sure there are no nicks in the cable sheath that might permit water to migrate down the leads to the windings.)

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