How to Prevent Procon Pump Failure and Diagnose Problems

PLEASE FOLLOW THESE SIMPLE RULES TO AVOID PUMP PROBLEMS:

1. Glycol mix maximum: 40 Glycol / 60 Water
2. Pumps can fail leaking from the drain hole due to debris damaging the graphite plate
3. Pumps can leak due to glycol breaking down and becoming acidic

USE THE FOLLOWING GUIDE TO DIAGNOSE PROBLEMS:

PUMP ANALYSIS

There are only a few visual inspections that can be performed on a failed pump to help determine the cause of failure without actually disassembling the unit. They include the checks listed below. Each of the conditions listed would void the manufacturer's warranty, as they are situations beyond Procon's control and are not a manufacturing or workmanship defect.

1. Check for physical deformities in the housing such as compression marks from the pump being placed incorrectly in a vise during fitting installation, flat spots on the outer diameter of the housing which occur when a pump is dropped, and signs of pump/motor misalignment which may have caused abnormal wear to the mounting flange on the pump as well as the pump shaft.

2. Inspect the nameplate for flatness. A nameplate that is bulged outward is a sure indication that the pump has been subjected to abuse. There are only two causes for a bulged nameplate. The most common cause is pump over-pressurization, which can occur when the pump is subjected to extreme high-pressure situations (generally in excess of 300 PSI). The nameplate may also bulge if liquid is left in the pump while the unit is exposed to freezing temperatures, causing the liquid to solidify and expand. See example below.

3. Look into the inlet port of the pump to see if any corrosion, debris, scale, rust, chemical residue, etc. has been introduced into the pump. If this has occurred, there is a good chance the internal tolerances of the pump have been distorted, causing degraded pump performance or breakup of the internal carbon graphite components.

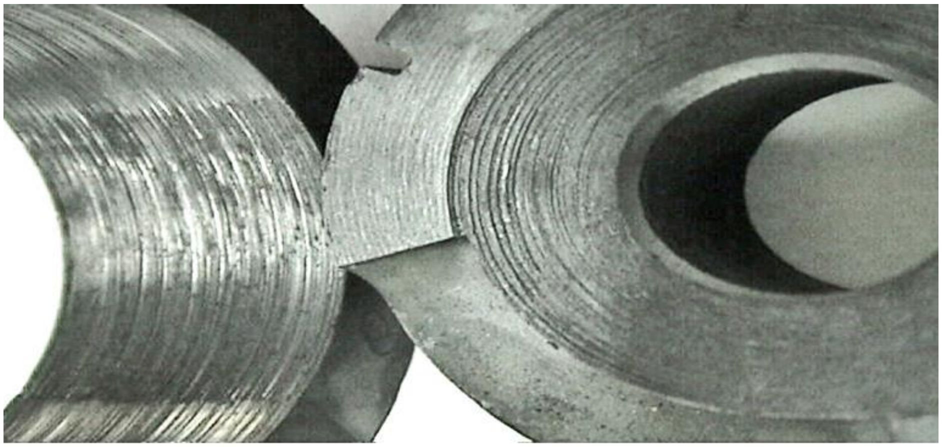
4. Inspect the paint on the nameplate near the snap ring to determine if the snap ring has been removed. If it is obvious the snap ring has been removed, an accurate failure analysis is not possible because if the pump has been disassembled prior to your receipt, it will be difficult to determine what damage occurred during pump operation and what damage occurred in the customer's disassembly and re-assembly of the pump.

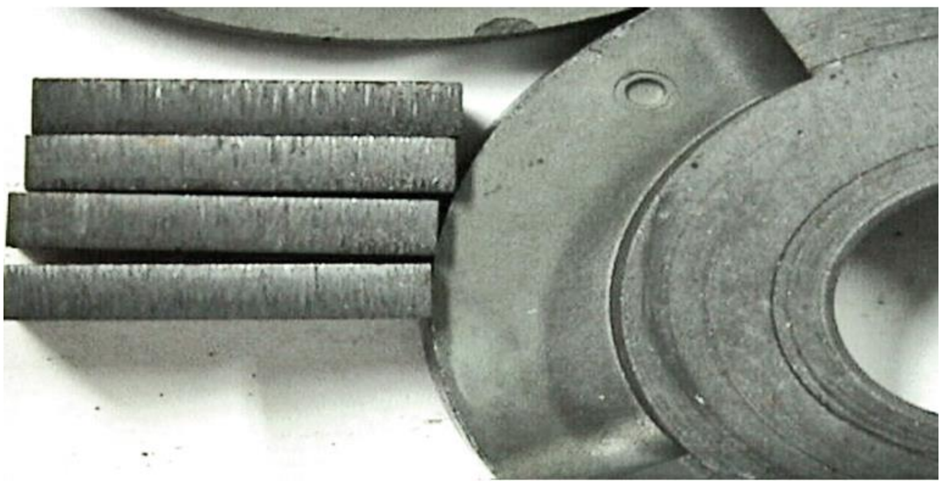
To obtain further information on the cause of pump failure, the unit must be disassembled for inspection. For warranty considerations, this disassembly and inspection process must be performed by Procon. The manufacturer's warranty will be void if the pump is disassembled by anyone other than Procon personnel. Below are some of the signs which one should look for when examining the components of a disassembled pump:

1. If any debris, such as scale, Teflon tape, rust fragments, or other particulate is found in the pump, it is likely that one or more of the carbon graphite components will be damaged, which would have caused performance degradation or complete failure.

2. Look for signs of residue buildup on the internal components in the form of a chemical residue or a chalky mineral buildup. Such a condition may cause premature wear of the carbon graphite components and/or cause distortion of tolerances resulting in a pump which requires an abnormal amount of torque for proper operation. This may cause the motor overloads to trip or simply make the motor operate at a higher temperature than expected. Dissolved calcium and magnesium compounds mainly cause mineral residue and mineral buildup and deposits. The quantity of these compounds determines water hardness. They are found in all municipal and well water supplies in varying quantities. These compounds form deposits similar to limestone in pipes, water heaters, washers, and other fixtures, and also combine with soap to produce soap scum. These deposits build up in pipes, appliances, etc., which reduces water flow and interferes with operations. This buildup also distorts the tight internal tolerances in our pumps.
See example below.

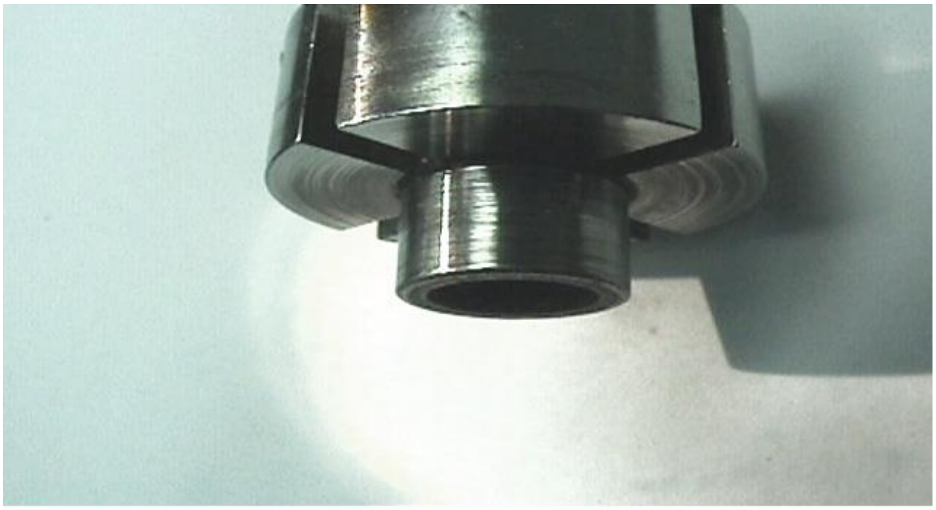
3. If proper filtration was not performed on the incoming fluid, it is possible that severe scoring could have occurred to many of the contacting surfaces within the pump. Look for signs of this on the rotor shaft journals, the I.D. of the carbon graphite bearings, the edge of each vane where it makes contact with the liner surface, the I.D. of the liner, and the mating surfaces of the mechanical face seal. When debris such as sand, silt or undissolved chemical has passed through the pump and caused scoring to the components, it is likely the pump was no longer able to perform at high discharge pressures or deliver the proper amount of flow, due to the recirculation which could have occurred within the pump because the proper tolerances were no longer present. See examples below.

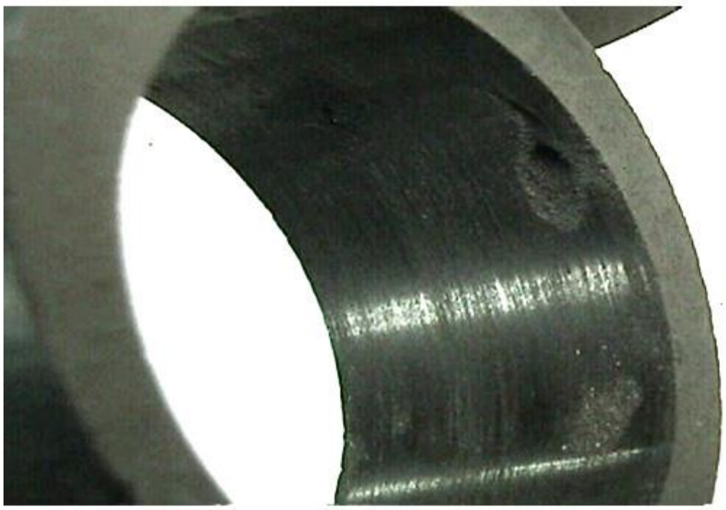




4. Because our pumps are positive displacement, it is imperative that an adequate amount of fluid be available to always feed the pump inlet. If there is a restriction of the incoming fluid flow to the pump in the form of a blocked pre-filter, inadequately sized I.D. piping, etc., cavitation may occur and cause a deterioration of the internal components. Generally if a pump is cavitating during operation, a chattering noise will be present and if there is a pressure gauge on the discharge line, a noticeable vibration of the needle may be detected. Whenever a customer mentions that a pump was noisy prior to its removal from the system, very often the problem was due to cavitation.

Cavitation is easily distinguishable during pump evaluation because if a pump has been harmed by a cavitation condition, there will be undeniable evidence of the damage. The damage is exhibited in the form of very small pits being present on one or more of the carbon graphite surfaces. Typically, the damage will be most obvious on the bearing and liner surfaces. Holding the components with the alignment pin notch at the 12:00 o'clock position, look for damage from the 3:00 o'clock position to the 8:00 o'clock position. Depending on the severity of the damage, very small holes may be present or many small holes may have been created forming deep craters in the surface. No other condition will leave behind this type damage. See example below.

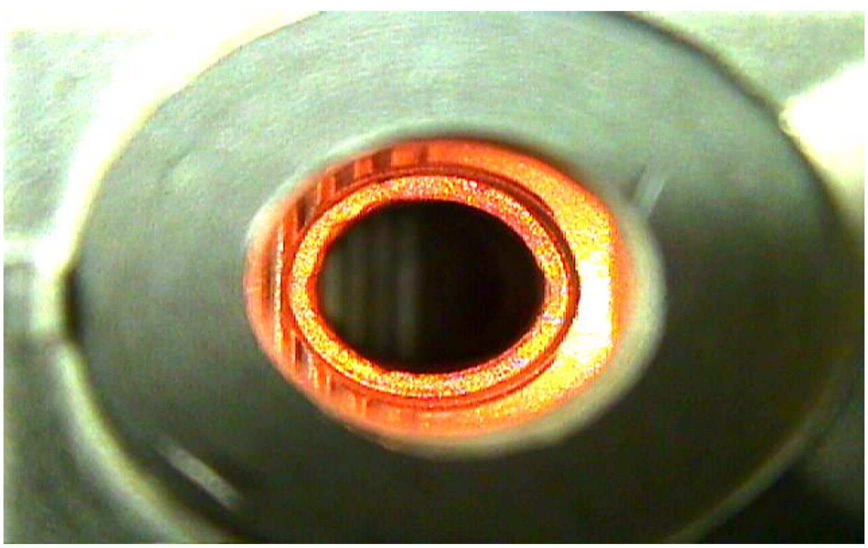




5. If a large piece of debris enters the pump and gets caught between the edge of the vane and the liner, either of the components may break. Liner breakage will generally occur in this situation at the 9:00 o'clock to 11:00 o'clock position on the discharge side of the pump, with the alignment pin notch held at the 12:00 o'clock position. Some scoring may occur to the other components from the resulting loose carbon graphite, but generally it will be in the form of a few deep scores, not like the even, more shallow scoring which can occur from the passage of sand, silt, or undissolved chemical, as mentioned previously.

6. When a pump is operated without any fluid, due to a depleted reservoir, faulty solenoid valve, blocked inlet line, etc., the pump may get extremely hot. This is a result from the internal friction, which will occur when there is no fluid passage through the pump to dissipate the heat. Because the pump is positive displacement and capable of high discharge pressures, the internal tolerances are extremely tight. When the components begin to get hot, they also begin to swell, distorting the already close tolerances. When this occurs, severe scoring may occur to the stainless steel rotor journals, the I.D. of the carbon graphite bearings, and in some cases, the front and rear faces of the rotor and the opposing surfaces of each bearing.

7. Constant internal recirculation through the relief valve or operating the pump less than 50psi below the relief valve setting, will result in damage to the relief valve housing seat and the valve itself. This damage is visible on both valve seat and valve in the form of removed/eroded brass material. Loss of flow and pressure is the failure mode in this situation. See example below.



8. Excessive vane wear may cause a pump to operate below specifications, so all four vanes should be inspected to determine if abnormal wear has occurred. Under normal operation, the original rectangular shape of the vane should still be preserved, with slight wear occurring to the edge of the vane in contact with the liner surface and on the back sides of the vane where it contacts the rotor slots while sliding in and out of the slots. Generally there is also a small worn spot where the vane spacer pin contacts the back edge of the vane.

If the sides of the vanes are worn so significantly that the rectangular shape is no longer present (with the edges beginning to come to more a point rather than a rectangular corner) and/or the vane spacer pins have been driving into the back edge of the vane so severely that a deep indentation has occurred or the vane has actually been cut in half, then the pump has been exposed to unacceptable operating conditions.

There are two basic causes for this type of wear. The first cause is when a pump is operated at very high discharge pressures, in excess of our recommended maximum, for an extended period of time. The other cause is a slight cavitation problem, where there is a lack of fluid present in the center of the rotor and the vane spacer pins are actually having to force the activation of the vanes. The vane spacer pins are designed to aid during the initial start-up of the pump. Once the pump reaches operating speed, centrifugal force causes the activation of the vane and the vane spacer pins simply float in the center of the rotor and move in harmony with the movement of the vanes. Under normal conditions, they are not “pushing” the vanes. When this slight cavitation occurs, it may not leave behind damage to the bearing or liner as mentioned previously in describing typical cavitation.

9. The mechanical face seal should be inspected closely to determine if damage has occurred during operation. The mating surfaces of the carbon seal head and the ceramic seal seat are crucial. Any distortion of either of the surfaces can result in pump leakage. If there is any scoring to either of the surfaces from small debris passing through the pump, or if there is buildup of a residue on either of the surfaces, leakage may have occurred (refer to the seal assembly drawing for clarification).

10. Leaching is caused by “aggressive” high ionic strength fluids that contain a high number of free ions which scavenge the oppositely charged particles of zinc and copper in the brass. The wall of the large bore is eroded or etched by the impingement of the fluid particles flowing across the surface. This is more common in high-pressure applications. The result is a brass housing that cannot be rebuilt due to the extra clearances created between the internal diameter of the bore and the carbon cartridge. Procon suggests using stainless steel pumps to negate the effects of aggressive fluids.

Remember to always consider special circumstances before voiding a warranty. Special consideration should be given when inspecting newly rebuilt or newly manufactured pumps. Often pumps returned with recent date codes have no evidence of failure at all, where the pump has been misdiagnosed as the system problem. This can be determined by placing pumps on bench test to confirm operating characteristics before disassembly.

When performing analysis for audit, it is necessary to randomly select units returned from the field for bench testing. Depending on the situation all returned pumps may need to be tested for audit purposes. Listed below are the steps used to bench test pumps for audit before disassembly analysis. Use the Audit Data Collection sheet to record data retrieved while testing.

1. Begin by performing a dry rotation torque test. This can be accomplished by using a manual or electronic torque screw driver or nut driver. If torque exceeds 48-inch ounces, the pump is considered too tight. Tight pumps should be sequentially numbered and set aside for disassembly analysis. Numbers on pumps should correspond to numbers on data collection sheet. Number all remaining pumps to be bench tested and record date codes. A space is provided to discern a newly produced or rebuilt pump.

2. Be sure to replace missing or tighten existing strainer caps and acorn nuts. Check that o-rings for both are in place. Replace missing strainers or valve components. Missing or loose components can be documented on the data collection sheet as possible contributors to pump failure.

3. Place pump on test rig and record flow rates at 50, 100, and 200 psi. Deadhead the pump to determine the relief valve setting. Occasionally, the relief valve has been tampered with or the setting changed. This should be noted. Attempt to return the relief valve to its original setting and perform normal test. Document results on data collection sheet.

4. Observe abnormal vibration, noise or gauge pulse. Document these conditions on the data collection sheet. This information is useful during disassembly analysis to confirm failure mode.

5. Check for leaks at nameplate and weep holes. Use a mirror if necessary to determine where the leak might be coming from.

6. If flow rate is lower than specification, remove relief valve assembly and insert valve plug (will provide) into valve housing. The plug will assure flow does not circulate through the relief valve housing due to erosion of the valve or valve seat during operation. Should the flow rate improve with the plug in place, erosion of the relief valve or valve seat is contributing to the low flow condition. If flow does not improve RV erosion can be ruled out as cause of failure. Document all results.

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