SpiralTrac™ Throat Bushing

APPLICATION CONSIDERATIONS

General Information

SpiralTrac is designed to improve the operating environment for the mechanical seal or packing through the use of a variable geometry spiral grooving system that achieves several functions:

- It shears off a volume of the rotating fluid flow in the chamber on each revolution, and pumps that volume from the bore, spiraling it radially inward. About 60 to 70% of the flow is spilled at the shaft. This creates the circulation within the seal chamber that cools the seal face, and draws abrasives from the cavity bore.

- Draws the other 30 - 40 % of the flow created by the spiral, out of the seal chamber in the exit groove to remove frictional heat.

- Allows air to escape through a specially designed vent at the 12 o'clock position. This prevents air from surrounding and thermally isolating the seal faces. It also avoids product crystallizing on the seal components.

- Collects and expels abrasives from the seal chamber. This avoids cavity and seal erosion, and prevents accumulation, to ensure heat transfer from the faces.

There are instances where SpiralTrac performance can be enhanced through the use of better installation techniques or set up. Conversely, there are a few applications in which it cannot be expected to contribute much in terms of improvements. In service, SpiralTrac will automatically work to provide the above benefits to the sealing environment, and each individual factor will result in extended service life. This is why customers are astonished at how high the success ratio is, and why it should be installed in most process equipment, regardless of application.

The following pages outline areas that can affect the performance of SpiralTrac, and therefore have a direct affect upon the seal. These have been realized through feedback from customers and specialists, or through direct observations over the past 6 years.

1. Make sure the exit groove is clear all the way through to the impeller, with space behind the impeller to allow contaminants to get out.

A SpiralTrac was installed into a backplate, and when the impeller was mounted, the boss came hard up against the back of the device, blocking the exit from expelling the dirt. The same situation can be created by a step in the shaft or sleeve. This leads to contaminants accumulating in the chamber, and seal failure.

2. When using Type B, Type S, or Version P make sure that the cast in throat will allow the expected size of contaminant to pass underneath.

   These types of SpiralTrac are pressed through the cavity to rest against the cast in throat at the bottom. The exit from the cavity is the gap between the shaft and the cast in throat at the bottom. Flush is often drawn from ponds, lagoons, streams etc. and large contaminants could be introduced into the chamber that SpiralTrac will capture, and deliver to the opening between the shaft and the cast in throat. If the particulate is too large to pass under, it will accumulate at this point. Today, most SpiralTrac types are designed to accommodate and store some of this particulate, but if sufficient contaminants accumulate, the exit groove will eventually plug and the SpiralTrac benefits will be lost. If this is identified as a problem, the bottom of the seal chamber should be opened up to allow the abrasives to pass under, or a finer screen should be used in the main supply line.

3. Check for air in the process.

   As shown in the SpiralTrac video, air in the process will be broken into microscopic sized bubbles, and will make clear water appear gray. Any of this air in the fluid column between the impeller and the backplate, extending out into the volute, is in a centrifuge with its center at the shaft. The air will be driven inward to form a single bubble, growing outward from the shaft. When centripetal force grows strong enough, the air will be driven into the cavity and around the seal. Seal failure can occur rapidly if the seal faces are not protected by a quench or double seal arrangement, or if a small flush is not used. Note that the SpiralTrac air vent cannot help with air that enters during operation of the pump, because centripetal force drives the air inward and around the shaft and seal. A quench, double seal, or flush are required to cool the seal faces.

   This situation will be typically found in paper mills in the first pumps after pulpers, repulpers, etc.

4. Make sure the air vent is oriented toward the top of the seal cavity.

   One device was found to be installed with the air vent not at the top. This occurred because the backplate did not fit at any specific orientation. Care must be taken to ensure that the backplate is fitted with the SpiralTrac air vent at the top so that air does not trap in the cavity during flooding of the pump.

5. Put check valves on any flush connections.

   The pressure fluctuates in most flush systems, and when it drops below chamber pressure, a reverse flow will occur that can bring contaminant into the chamber and the flush piping. This can block the supply pipe and prevent the flush from operating permanently. Also with the split type, the reverse pressure can displace the device forward onto the back of the seal, blocking the spiral groove, and preventing it from operating. The simple addition of a check valve prevents all of this from occurring.

6. Type B is not the first choice for flushless operation.

   The Type B is the easiest to install, since it is simply pressed through the chamber to rest against the cast in throat. To operate without flush, the air vent hole must be drilled, and the exit groove must be extended through the inside of the cast in throat. Extending the exit

groove can be a tedious job at best and the probability of having it done correctly is not great. It is far preferable to have a small amount of machining done and install a Type A or type I.

7. Check that the shaft and housing are concentric.

   If it is not, measure for proper fit, mark the narrow point and provide the measurements when ordering. SpiralTrac can be made non concentric.

8. Any slurry flooded into the seal chamber must be fluid enough at start up to rotate freely.

   SpiralTrac does not centrifuge the abrasives: It counts on the rotation of the shaft and seal to drive the fluid, and achieve separation of the solids to the bore. Some slurries can have 40 to 60% solids, that settle out when flooded into the cavity. Sometimes they can settle to form a solid mass at the bottom of the chamber that will not break up when the pump starts. We have found that this problem can often be avoided if a small flush is injected during flooding, and again for a few minutes after starting.

9. Use a collector version of SpiralTrac in boiler feed or applications that incorporate closed loop cooling to gain vapor margin.

   SpiralTrac actively exchanges fluid into and out of the seal chamber to remove heat generated by the seal faces. This is only desirable if the seal is able to withstand the temperature at which the fluid is being pumped. Often, in applications involving a fluid at or above its flash point, a pumping ring is employed in the chamber to recirculate fluid to a cooler in a closed loop manner. In this case exchange of fluid into and out of the chamber is undesirable, and should be avoided. Instead, a special version of SpiralTrac is used to collect and store contaminants that form due to the heating and cooling of the chemicals used. This is effective since the solids are often abrasive in nature, but are not generated in large volumes over the normal life of the seal.

10. Install SpiralTrac P with 3 rings of packing above.

    The most consistent results have been obtained when SpiralTrac P has been installed with 3 rings of packing before the gland, on shafts above 2-inch diameter and when the cavity pressure is even moderate to high. The use of 2 rings on small shafts (up to 2 inches), and when the chamber pressure is minimal has not been a problem, but otherwise 2 rings is just not enough to achieve the desired drip rate leakage.

    When only 2 rings of space are available, a custom device may be designed around the chamber dimensions, or a new flush injection hole can be drilled, or some customers have welded extensions onto the front of the cavity to make additional room.

    Note: Normal packing gland adjustments will still be necessary as the packing set conforms to the cavity and sleeve under pressure.

11. Watch first obstruction dimension.

    When ordering SpiralTrac P or S, remember that they have to be assembled onto the shaft before insertion into the chamber. This means that they must be shorter than the distance to first obstruction. Sometimes this means that the SpiralTrac must be manufactured in two individually split sections, if the device is longer than the available space.

12. Watch for the "obvious".

The spiral in the seal version must face the mechanical seal, and the direction of rotation must progress from the bore to the shaft in the direction of shaft rotation. **Don't install it backwards**…the SpiralTrac is very capable of demonstrating in a hurry that it can pump contaminants from one side to the other, especially if it is installed to pump into the cavity. Also note that double-ended pumps require one device of each direction of rotation. When installing SpiralTrac P, make sure to align the lantern ring groove with the flush injection port: if not, it is probably about to be installed backwards.

Factors beyond the control of SpiralTrac

SpiralTrac is essentially a sophisticated bushing with a spiral groove cut into the seal side. The spiral is cut under computer control, and its geometry varies in such a manner that it acts as a pumping ring, using the rotational flow of the fluid. The operation of the SpiralTrac counts on centrifugal effects of the rotational flow to throw contaminants to the bore, so that it can draw them away. In the process of accomplishing this, the fluid is circulated around the seal and exchanged into and out of the cavity, removing frictional heat. A vent at the top permits air to escape from the cavity during flooding, again reducing heat generation.

Please note that this description does not include any capability that will enable mechanical seals to handle situations such as:

- Bearing failures
- Broken shafts
- Cavitation (or running pumps with discharge or suction closed.)
- Dry running of the pump
- Atmospheric side crystallization
- Products that adhere directly to surfaces (e.g. latex)

These problems are only covered when miracle options are specified, because they are all problems that will directly cause damage to the mechanical seal (and most will probably lead to damage to the SpiralTrac as well). They are situations or operational conditions that have to be dealt with in some other manner.

The research information provided as background for the SpiralTrac only outlines the dynamics occurring in the seal chamber of the pump during normal operation. When the pump is operating well outside its operating design point, the forces on the shaft will cause the bending and flexing that will rapidly cause seal failure. The addition of SpiralTrac to this situation will make the seal environment better, but with the seal being thrashed about at pumping speed, an expectation of improved life is not realistic.

Don't expect SpiralTrac to make drinking water in the seal chamber. Its job is to continuously remove contaminants as they are centrifuged to the bore, and in this way prevent particulate from accumulating and impeding heat transfer from the seal faces. It should ensure an active and free flow of fluid around the seal.