SEALING SENSE

What are the fine points of pump packing installation and adjustment?

This month's *Sealing Sense* was contributed by FSA Member Chris Boss.

Proper installation and adjustment can make the difference between the success and failure of a packed pump. By keeping in mind the fine points of a few key principles, the chances of success are greatly increased.

Remove

Remove all old packing. This can be the most difficult step in the process of packing a pump. Repacking equipment during a system outage is often performed under time constraints. Resist the temptation to simply remove a few rings of packing that are near the top of the stuffing box. Instead, get to the bottom of it! If the pump uses a flush injection and lantern ring be sure to remove the lantern ring and the packing below it.

Packing removal tools such as picks and corkscrew-type packing hooks typically have sharp ends. Take care to ensure they do not damage the shaft and bore surfaces as they are used.

Inspect

The opportunity to see inside the stuffing box does not happen often. Take this opportunity to check the equipment condition and do some record keeping to make the job easier the next time the equipment needs to be serviced.

The surface condition of the shaft or sleeve is critical since it is the moving surface that needs to be sealed. Axial scratches and pitting on the shaft or sleeve can quickly damage the sealing surface. The surface finish of the shaft should be in the range of 16 to 32 µin Ra. The shaft should be resurfaced or the sleeve should be replaced if significant wear is seen. Braided packings can usually tolerate slight wear in the form of smooth shallow waviness that is uniform around the circumference of the shaft or

Figure 1. Measuring flush port location

sleeve surface.

The bore diameter surface is not a moving surface, but it still needs to be sealed. Axial scratches can create direct paths for leakage to the environment. Split case pumps typically have two seams that run axially along the length of the stuffing box. There is usually a gasket in these seams. Check to ensure the gasket is cut to create a smooth surface to the inside of the stuffing box. If the gasket has receded into the seam, it can result in a direct leak path. This will appear as a concentrated jet of leakage on the outside of the gland follower in the area of the seam.

Measure and Record

Measure and record key dimensions such as shaft diameter, bore diameter and box depth. If a flush injection is used, measure the length of the lantern ring and the location of the flush port. These last two measurements can be used to ensure proper alignment of the lantern ring with the flush port. They are especially important to measure if the pump has a history of problems maintaining proper flush operation.

A short length of wire can be used to measure the flush port location. Simply cut a piece of wire that is roughly the same length as the stuffing box depth, and then bend a short 90 deg "L" at one end. Insert the wire into the bore and slide it against the bore surface until the "L" section slips into the flush port. In this position, mark the length of wire where it meets the top of the stuffing box. This will give a rough measurement of depth at which the flush port enters the stuffing box (see Figure 1).

Figure 2. Tamping tools: split tubing, metallic bushings, cardboard

Cut

Packing should be cut into individual rings so that the cut ends come together without a gap when they are inserted in the stuffing box.

Install

As each ring is inserted, it should be seated firmly into the bottom of the stuffing box before the next ring is installed. This will help maintain a more even compressive load throughout the depth of the packing set. Various types of materials such as metallic bushings, short lengths of split tubing and even cut lengths of corrugated cardboard can be used as tamping

Fluid Sealing Association

Sealing Sense is produced by the **Fluid Sealing Association** as part of our commitment to industry consensus technical education for pump users, contractors, distributors, OEMs and reps. As a source of technical information on sealing systems and devices, and in cooperation with the **European Sealing Association**, the FSA also supports development of harmonized standards in all areas of fluid sealing technology. The education is provided in the public interest to enable a balanced assessment of the most effective solutions to pump technology issues on rational total Life Cycle Cost (LCC) principles.

The **Compression Packing** division of the FSA is one of six with a specific product technology focus. As part of their mission they develop publications such as the new joint FSA/ESA *Compression Packing Technical Manual* and *Pump & the Valve Packing Installation Procedures* pamphlet. These are primers intended to complement the more detailed manufacturer's documents produced by the member companies. In addition to English, they are available in a number of other languages, including Spanish and German.

The following members of the **Compression Packing** sponsor this *Sealing Sense*:

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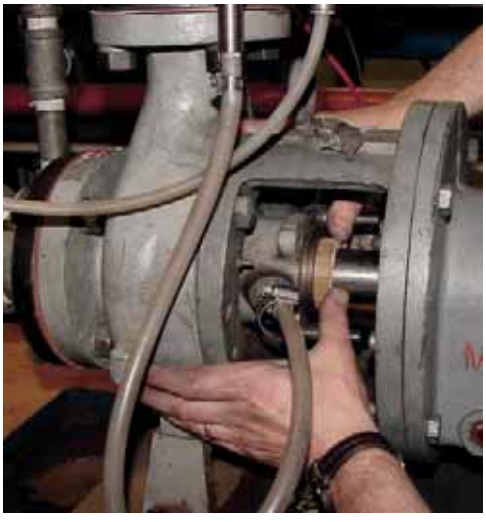


Figure 3. Using cardboard tamping tool

tools. Remember to remove these tools before the next ring is installed! The seam of each successive ring should be offset by 90 deg.

Adjust

For most braided pump packing, liquid leakage is absolutely necessary to provide lubrication and cooling of the sealing surface and ensure the seal's long life. When adjusting pump packing, the goal is to arrive at the lowest acceptable leak rate while maintaining thermal equilibrium. Overtightening is the most common cause of packing failure.

When making adjustments to a packed pump, remember the following principle: **Make adjustments that are proportional to the leakage rate.**

If the pump is spraying large amounts of leakage, then large adjustments can be made until the leakage is controlled in the form of a small, steady stream. After leakage is reduced, further adjustments should be small. One-sixth of a turn on the gland nuts (one flat) can have a significant effect. Several minutes should pass before the next adjustment is made.

Leakage

There are two principal paths that leakage can take out of the stuffing box:

- *Inside diameter (ID)* leakage occurs along the interface between the packing and the rotating shaft. This leakage serves to cool and lubricate the dynamic surface and is necessary for most braided pump packing applications.
- *Outside diameter (OD)* leakage exists when the liquid runs along the interface between the packing and the stuffing box bore. While it will have some cooling effect on the packing, it is unnecessary.

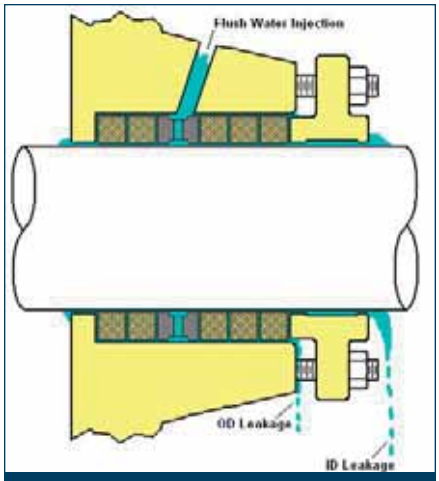


Figure 4. Pump packing leakage paths

Key Packing Properties

Various packing materials respond differently to adjustment. Two key material properties determine how a packing will respond to compressive adjustment: *thermal conductivity* and *thermal expansion*.

Thermal conductivity determines how fast heat will travel through the material. Materials such as carbon fiber and flexible graphite are effective heat conductors. When frictional heat is generated between the packing and the high speed shaft, these materials will effectively conduct the heat out to the body of the pump. Some synthetic polymer materials, such as PTFE, are thermal insulators. When frictional heat is generated, these materials tend to retain the heat and concentrate it near the shaft surface. They typically require higher leakage rates so the frictional heat does not build up and result in burning of the packing.

Thermal expansion determines how much the packing material will grow when it is heated. PTFE fibers or coatings exhibit relatively high thermal expansion. Packing that has a high PTFE content should be monitored more closely at start-up. After adjustment, the leakage rate will usually be reduced. Frictional heat will then increase, and the temperature will rise during the next several minutes. As the temperature rises, the material will expand and result in a tightening and further reduction of the leakage rate.

If adjustments are made carefully, with time allowed in between adjustments, the packing can reach an acceptable leakage rate without overheating. If adjustments are made too quickly, frictional heat may build to a point where it spirals out of control and causes the packing to fail.

The gland follower should always be adjusted evenly so that a uniform load is applied to the packing surface and the gland follower will not become "cocked" and cause metal-to-metal contact with the spinning shaft.

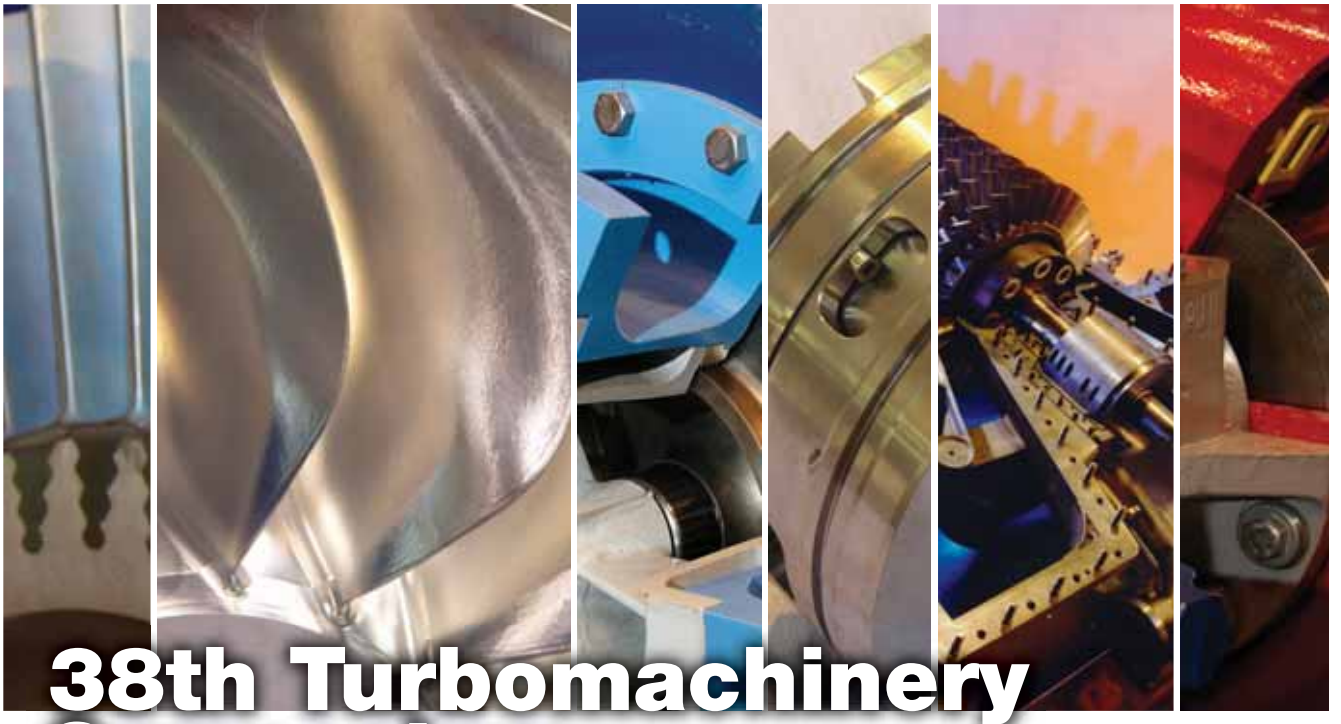
Conclusion

The concept of compression packing is fairly simple: squeeze a compressible material into a gap to create a seal. By choosing the appropriate material and following the fine points of sound installation and adjustment principles, a long lasting, robust, reliable seal can be achieved in some of the most demanding services.

Next Month: *How do expansion joints improve performance of mechanical seals?*

We invite your questions on sealing issues and will provide best effort answers based on FSA publications. Please direct your questions to: sealingsensequestions@fluidsealing.com.

P & S



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