

How can I compare the performance of pump packing?

This month's "Sealing Sense" was prepared by FSA member Phil Mahoney.

Compression packings are not created equal. A wide variety of compression packing materials and constructions are available, and many different packing products may be suitable for a given application. Also, packings that look exactly the same may have widely different performance characteristics because of variations in their makeup.

Leakage

Compression packing generally requires some leakage to provide lubrication and cooling during operation. The amount of leakage determines whether a packing overheats and fails, or runs cool and performs properly. The definition of acceptable leakage from a packed pump can vary significantly from plant to plant, mechanic to mechanic and application to application. This is often based on the practical experience of the plant personnel that install and adjust the packings. What is considered low leakage by one mechanic may be considered excessive by another. Installation and break-in of compression packing must be completed carefully to ensure proper performance.

Packing Performance

Experience of the user is also a key factor in the success or failure of pump packing. The user's practical experience comes into play since equipment condition and operating parameters vary widely and greatly affect packing performance. Factors such as shaft speed, fluid temperature, shaft surface finish, concentricity to the stuffing box bore, run out and clearances all affect the ability of a packing to seal properly. With these variables that are beyond the packing manufacturer's control, quantifying and comparing the packing's performance parameters can be difficult.

When choosing a compression packing for a pump (or other rotating equipment), the most likely source of information for the user is a manufacturer's brochure or data sheet

that specifies the maximum temperature, pressure and speed parameters, as well as chemical incompatibilities of the packing. Some values, such as temperature, are based on the properties of the material used in the packing. Other values, such as shaft speed capability, are determined through in-house testing by each individual manufacturer or simple estimates based on similar, more established products. The parameters and methods used to determine these limits are not typically provided in the product literature. This is because, historically, no standard functional test has been used across the industry to establish performance limits for pump packing.

Pump Packing Test Method Development

The Compression Packing Divisions of the European Sealing Association (ESA) and the Fluid Sealing Association (FSA) recently released a jointly prepared document, "A Specification for a Test Procedure for Packings for Rotary Applications," to help address this problem. Fifteen representatives from 10 member companies participated in this project, with a goal to create a standard test procedure that could be used by any manufacturer to provide test data to compare the performance of pump packing.

The procedure defines the test equipment to be used, standard test parameters and procedures, as well as reporting criteria. Standardizing the test fixture and using a specific procedure ensures that all products are tested under the same conditions, making it possible to compare test results. The procedure does not specify performance criteria, but it does define leakage classes that the end users can apply in their evaluation of a product. After the ESA/FSA working group drafted the test procedure, extensive verification testing was conducted by member companies and an independent laboratory (CETIM based in France) before it was finally approved and released.

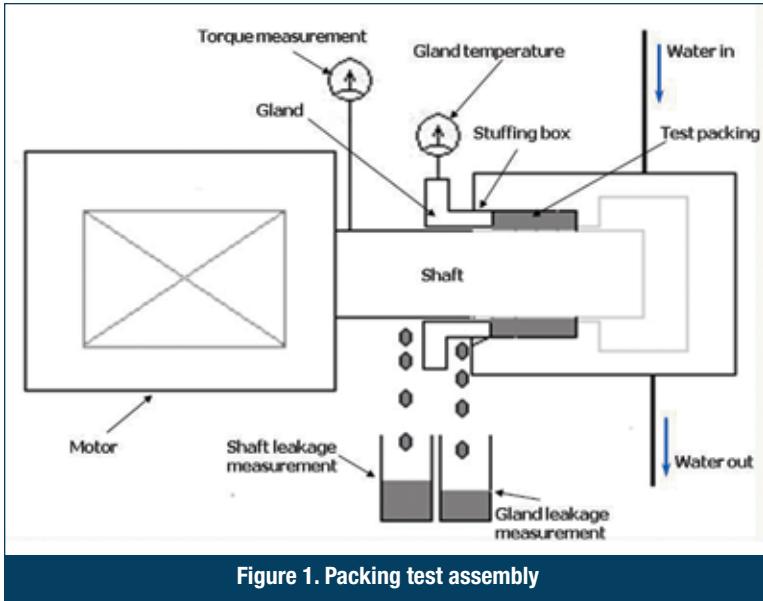


Figure 1. Packing test assembly

Test Apparatus

The test assembly is shown in Figure 1. It is a simulated pump stuffing box with a standard bolted packing gland arrangement. The shaft can be 40 to 65 millimeters, with a nominal packing

cross section of 9.5 millimeters ($\frac{3}{8}$ inch) to 12.7 millimeters ($\frac{1}{2}$ inch). Pressurized fluid is supplied to the casing, which is sealed by the packing set being tested. The shaft is driven by a drive motor just as it is on a pump.

The gland temperature is measured during operation and leakage along the shaft and stuffing box bore is collected separately. The procedure clearly defines the concentricity of the shaft to the stuffing box, surface finishes and hardness (particularly the sleeve) and materials of construction.

The overall test schematic is shown in Figure 2. This setup supplies the test apparatus with test fluid at a constant pressure and regulates the fluid temperature inside the apparatus regardless of leakage rate. The test system is fairly straightforward and relatively inexpensive to construct.

Test Procedure

Prior to any test, the procedure requires:

- The measurement of the cross section (width) of each packing ring
- The diameter of the stuffing box bore and shaft and their respective surface finish

circle 171 on card or go to psfreeinfo.com

circle 178 on card or go to psfreeinfo.com

- The weight of each packing set prior to installation (which will be checked again at the test's completion)

Four rings of packing are used for every test to avoid any variability from differences in packing configuration. The standard installation procedures ensure that the rings are installed one at a time, tamped firmly to eliminate spaces between installed rings and the joints staggered appropriately. The packing gland is then installed and tightened slightly to begin the test.

The standard test conditions are:

- The test fluid is water.
- Shaft speed is between 8 and 9 meters per second (1,574 to 1,771 feet per minute).
- Pressure is 6 bar (87 psi).
- Test fluid temperature is 20 C (68 F).

The procedure has an allowance for other test conditions, but these are not considered standard and would be reported separately.

Break-in Procedure

A key component of the procedure is a clearly defined break-in procedure. The most critical period for compression packing is the first hour or two of operation. During this time, the packing settles or “beds-in” and temperature and leakage can fluctuate until it reaches equilibrium between acceptable leak rate and frictional heat generation. The procedure allows the packing to leak initially (under the standard test conditions) at a liberal rate of 15 to 30 milliliters per minute. Then the packing is adjusted incrementally over the first hour until it reaches a steady state condition for the desired leakage class and operating temperature. The number of adjustments and total compression of the packing are recorded.

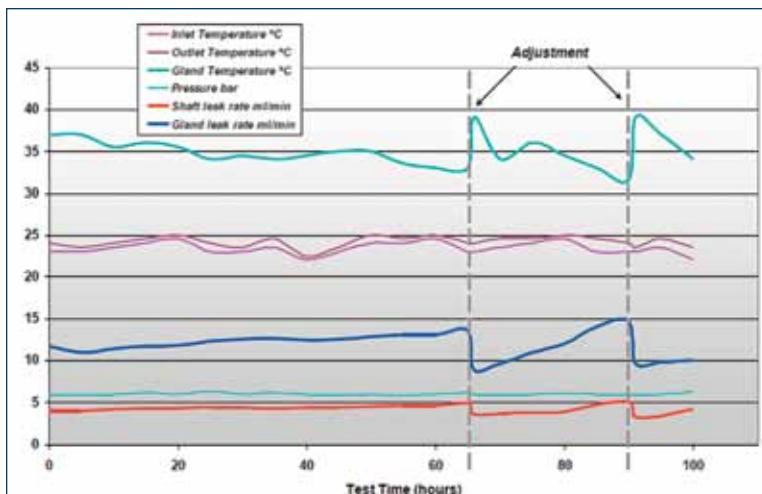


Figure 3. Typical test results

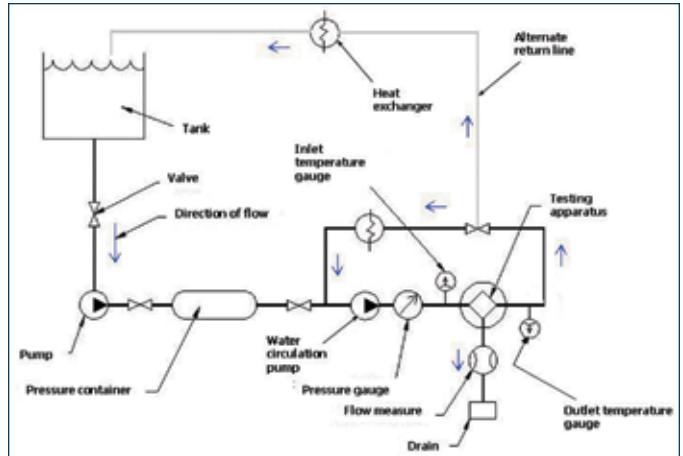


Figure 2. Test schematic

Final Phase of Test Procedure

At the end of this break-in period, the power consumption, temperature and leakage are measured and the test begins. The total test duration is 100 hours of continuous operation with measurements taken at least twice every 24 hours. Up to three gland adjustments are allowed, with temperature and leakage recorded just before and 30 minutes after each one. The procedure specifies that at least two tests must be completed per packing type to ensure consistency of results.

Figure 3 shows a graph of typical results. At the end of the 100-hour test, the packing set is removed, and a final measurement of weight, compression and overall condition of the set is noted. The condition of the test apparatus—such as shaft wear—is also documented. The procedure provides a format for reporting results that makes comparing results from different tests easier.

Conclusion

With this standardized procedure, developed cooperatively by numerous global compression packing manufacturers, a method is established to compare the performance of pump packing. The document is available to the public and can be found on the ESA website under “Packing” at www.europeansealing.com/publications.html.

For more information on this topic, read the newly published *FSA-ESA Compression Packing Technical Manual*.

Next Month: *How can gaskets solve some unique sealing problems?*

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.



“Sealing Sense” is produced by the Fluid Sealing Association (FSA) as part of its 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 (ESA), FSA also supports the 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 systems technology issues on rational total life-cycle cost principles.

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

The following members of the Compression Packing division sponsored this “Sealing Sense”:

- American Braiding & Mfg.
- ChemStar Mechanical Packing, Inc.
- A. W. Chesterton Co.

- Daikin America, Inc.
- EGC Enterprises, Inc.
- Empak Spirotallic Mexicana SA de CV
- The Flexitallic Group
- Garlock Sealing Technologies
- W.L. Gore & Associates, Inc.
- GrafTech International Holdings, Inc.
- John Crane
- Latty International S.A.
- Lenzing Plastics GmbH
- New England Braiding Co., Inc.
- Nippon Pillar Corporation of America
- Palmetto, Inc.
- SEPCO - Sealing Equipment Products Co.
- SGL Technic Polycarbon Division
- Slade, Inc.
- Teadit International
- Teijin Aramid USA, Inc.
- YMT/Inertech, Inc.

Conhagen
Rotating Equipment Specialists

KEEPING INDUSTRY IN MOTION

Alfred Conhagen Inc. provides "one stop" repair, engineering and upgrade services for pump, turbine, gearbox and mechanical seal repairs. Conhagen has over 65 years of proven experience supporting Industry.

- Boiler feed pump repair
- Pump upgrades to latest industry standards
- Pump re-rate designs
- Field Service for power, refinery, and petrochemical facilities

Benicia, California • (707) 746-4848
New Orleans, Louisiana • (888) 534-9361
La Marque, Texas • (409)938-4226
www.conhagen.com

circle 169 on card or go to psfreeinfo.com

Your trusted partner for **bolted joints**

The Nord-Lock Group is a world leader in bolt securing. Our innovative solutions include wedge-locking technology and Superbolt tensioners. Discover safe and easy bolting for your critical applications today!

NORD-LOCK
SUPERBOLT

new catalog available:
www.superbolt.com
www.nord-lock.com

circle 177 on card or go to psfreeinfo.com