European Sealing Association e.V.

What are the important considerations for the proper torque of a valve packing gland?

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When compression packing is used as a valve stem seal it requires an appropriate compressive load to be applied in order to achieve the correct balance between sealing force and stem friction. This compressive load is often accomplished by compressing the packing by a fixed percentage of its axial height, but a more reliable method is to use torque measurement on the bolts or studs which are used to apply the compressive load. Users should consult the packing manufacturer's installation instructions to determine the recommended compression percentage or the recommended sealing stress. Once the required sealing stress is determined, the torque required to provide the stress must be calculated.

This article concentrates on achieving the correct load through torque measurement. When torque measurement is used to apply the correct stress on a compression packing there are two important considerations to achieve the desired result. First it is essential to determine the appropriate load and then complete and accurate transmission of that load to the packing.

Appropriate load and transmission

Users should always consult the packing manufacturer when determining the appropriate torque method for a packing set. Some variations exist between manufacturers in how the torque is determined and in the sealing stresses that are recommended for specific packing materials. The following is an example of the type of calculations that are used. First, the overall load on the packing is calculated:

$$\text{Total load} = \text{Packing area} \times \text{Recommended sealing stress (or Load factor, LF)}$$

$$= \frac{(\text{Bore diameter}^2 - \text{Stem diameter}^2)\,\pi}{4} \times \text{LF}$$

The load on each bolt can then be determined:

$$\text{Load per bolt} = \text{Total load} \div \text{Number of bolts}$$

The bolt torque can then be derived from the equation:

$$\text{Torque} = \text{K Factor} \times \text{Load per bolt} \times \text{Bolt diameter}$$

The K factor, also known as the nut or friction factor, is a coefficient which consolidates many aspects of the interaction of the male and female threads. It will vary depending on the thread type and quality of lubrication, but a typical average value is around 0.2 and this figure will normally give a good result although some manufacturers may recommend slightly different values.

If torque is used, then the packing gland hardware must be in good condition so that the conversion of bolt torque to compressive load is not degraded because of friction. Friction can have a significant effect, always reducing the amount of load that is converted from torque to compressive stress on the packing. Excessive friction may compromise sealing simply because the material is not being compressed as it should be.

The compression hardware on a typical valve packing gland will consist of a gland yoke, gland follower, swing bolts or studs, flat washers, and nuts (see Figure 1). Each component's condition should be assessed before installation begins:

- The gland yoke should not be bent. Hardened, flat washers should be used on top of the gland yoke to prevent galling of the yoke and the nuts.
- The gland follower should be cleaned with a wire brush to ensure that no corrosion, paint or other debris can contact the stuffing box bore and cause resistance to movement or transmission of compressive load.
- Bolts or studs should be replaced if they are corroded, stretched, nicked, cross threaded, excessively worn or otherwise damaged in a manner that would affect the transmission of compressive load. Bolts or studs should be cleaned with a wire brush to remove debris.
- The nuts' threads should be in good condition and clean, free of corrosion. The nuts should turn freely over the bolts or studs over their entire length of travel.
- Lubricant should be applied to all fasteners and nuts.
- Flat washers should be clean and free of any galling.
- To apply the appropriate torque, a properly calibrated torque wrench must be used.

Proper Lubrication

All fastener hardware should be lubricated with an oil and graphite mixture, anti-seize compound, or another appropriate thread lubricant. Lubricants should be properly applied to the fasteners and nut only. Do not assume that the same lubricants should be applied to the packing. Consult the packing manufacturer for guidelines regarding packing lubrication.

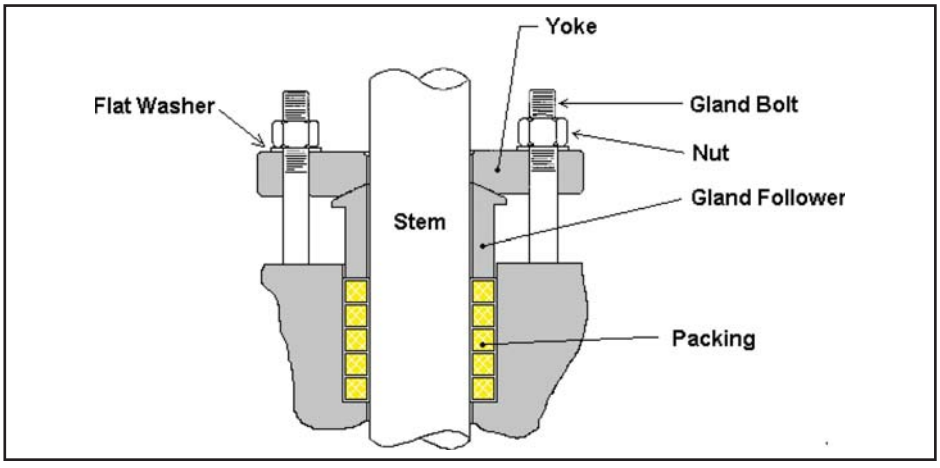

Fig 1. Typical valve gland components.

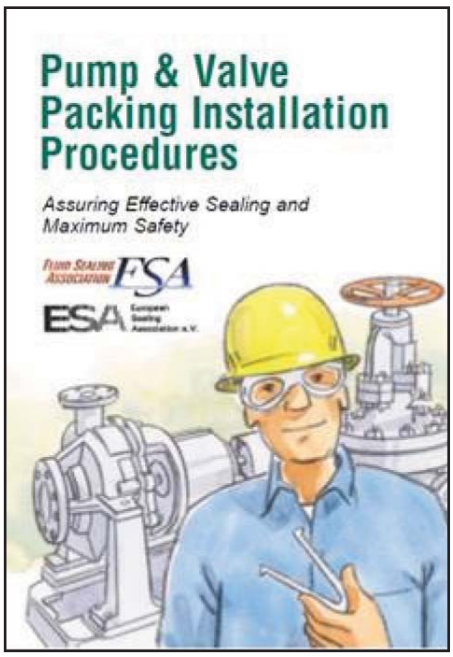

Fig 2. Guide for fitters.

Fitting Advice

All reputable packing suppliers will supply fitting instructions for their products, and there is a handy guide to all of the correct procedures available from the European Sealing Association at **http://tiny.cc/ps3dfx**

Increasing understanding

The sealing industry is constantly striving to improve its understanding of the technologies surrounding its products, and the members of both the European Sealing Association and its US counterpart the Fluid Sealing Association work together with research organisations and end users to achieve better products through increased knowledge. Currently support and technical advice are being given to a project which has been established by French research specialists CETIM and the French valve industry. It is an ambitious 4 year programme which aims to develop test methods and mathematical models to characterise all aspects of valve packing design. One of the most important aspects of the study is to look into how the axial load generated by the gland bolts is translated into compression of the packing and consequently radial sealing force. This should then give significant insight into the balance between sealing force and stem friction. The ultimate outcome should be even better valve sealing products but they will only deliver the benefits if they are fitted and maintained correctly.

Conclusion

Using torque to provide the required stress for effective sealing begins with packing gland components that are in good condition, ensuring the transmission of the required load. With the application of the proper compressive load, modern valve packings will offer reliable sealing service for the long term.

The European Sealing Association (ESA) has produced this article as a guide towards Best Available Techniques for sealing systems and devices. These articles are published on a regular basis, as part of their commitment to users, contractors and OEM's, to help to find the best solutions for sealing challenges and to achieve maximum, safe performance during the lifetime of the seal. The ESA is the voice of the fluid sealing industry in Europe, collaborating closely with the Fluid Sealing Association (FSA) of the USA. This article is derived in part from an original FSA paper which first appeared as a Sealing Sense article in Pumps and Systems magazine. We are very grateful to our colleagues in the FSA for their assistance.
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