

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

This month's "Sealing Sense" was prepared by FSA member Chris Boss.

Compression packing used as a valve stem seal requires a compressive load. The appropriate compressive load can be accomplished by the most common method—to compress the packing by a fixed percentage of its axial height. An alternate method is to use torque measurement on the packing gland hardware. 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. Torque measurement will be this article's focus.

When torque measurements are used to apply the stress on a compression packing seal, two important considerations are the determination of the appropriate load and complete, accurate transmission of that load to the packing.

Appropriate Load and Transmission

Users should always consult the packing manufacturer to determine 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:

If all dimensions are given in inches and the load factor is expressed in psi, the load will be expressed in pounds. This load will be divided among all the gland bolts:

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

$$\begin{aligned} \text{Total load} &= \text{Packing area} \times \text{Recommended sealing stress} \\ &\quad (\text{or Load factor, LF}) \\ &= \frac{(\text{Bore diameter}^2 - \text{Stem diameter}^2) \pi}{4} \times \text{LF} \end{aligned}$$

Bolt torque is determined by converting this equation:

$$\text{Torque} = 0.2 (\text{K factor}) \times \text{Load per bolt} \times \text{Bolt diameter}$$

The K factor is an average number, meant to cover a variety of thread types and lubricants. Some manufacturers may recommend slightly different K factors. If the dimensions are expressed in inches, the resulting torque value will be expressed in inch-pounds. Divide this number by 12 to convert to foot-pounds.

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 (or stuffing box) 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,

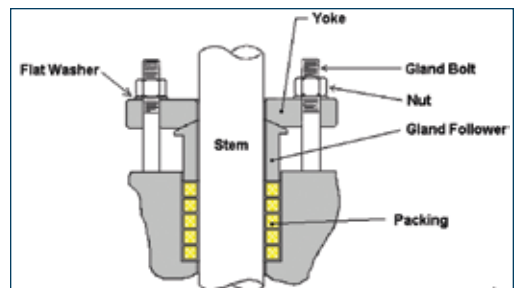


Figure 1. Typical valve packing gland components

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.

Image 1 illustrates a packing gland that is not in acceptable condition and does not have all the required components. These conditions, uncorrected, will lead to sealing problems. To apply the appropriate torque, a properly calibrated torque wrench must be used.



Image 1. Example of unacceptable packing gland conditions

Proper Lubrication

All fastener hardware should be lubricated with an oil and graphite mixture, an 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.

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, a valve packing should offer reliable sealing service for the long term.

Next Month: *How does seal face topography affect mechanical seal performance?*

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