The Magazine For Pump Users Worldwide
PUMPS & SYSTEMS®

What Are Bolt Torque Considerations for Valve Packing that Ensure Reliable Performance?

Originally published
September 2008

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What are bolt torque considerations for valve packing that ensure reliable performance?

Today, there are ever increasing economic and environmental needs to minimize industrial leakage and emissions. Continued developments in valve packing design and materials have greatly improved the abilities of compression packings to provide reliable sealing performance for years in a wide range of applications and valve types. Proper installation and maintenance are essential to achieve optimum performance from these packings. Since the majority of the current emissions come from valves, an understanding of the importance that proper valve packing gland loading has on meeting these needs is essential.

Often perceived as simply "tightening" the gland to achieve an initial seal, improper torque methods will result in reduced packing life, increased valve maintenance, leakage and potential system issues when the valve cannot be actuated.

Applying Sealing Force

Torque, applied to the gland bolt nuts during valve packing installations and readjustment, creates an axial force on the packing gland. This axial force transfers to the packing, causing it to compress axially and expand radially with a resultant force that achieves a seal against the static stuffing box bore and the moveable stem. It also provides the packing materials with the resistance needed to contain the system pressure (see Figure 1).

This radial force of the packing against the stem is a major factor in the amount of friction that the valve stem must overcome when actuated. This is an extremely important factor in mechanically operated valves. When torqued properly, the packing set can create a tight seal with the least amount of friction.

The gland nuts should not be over-torqued or under-torqued. When over-torqued, the resultant stem friction can be high enough to prevent the valve from operating properly, resulting in reduced plant efficiencies and safety. Over-torqueing results in increased packing consolidation, which reduces gland adjustment travel and shortens the service life of the packing. The potential for packing material degradation and extrusion also increases when excess torque is applied. Under-torqueing may result in immediate leakage and possible loss of the packing due to under consolidation. Packing material blow out is possible under this condition. It is important, particularly with the number of packing manufacturers and packings available, to fully follow the manufacturer's instructions for proper torque requirements and gland loading.

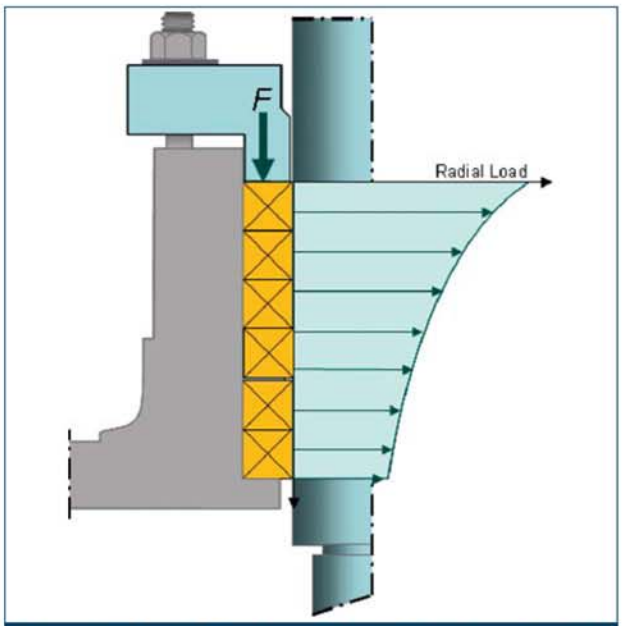

Figure 1. Valve stuffing box with axial force transferred to radial load

For the radial force to be evenly distributed through the packing, the axial force must be applied evenly from the gland nuts. Use of a packing gland with a beveled nose will result in uneven application of torque. Uneven radial loading may result in development of a leak path(s) within the valve.

Even when properly torqued, the ability of the packing to maintain an effective seal over its life can be adversely affected by service conditions that compromise the gland loading. In conditions where temperature cycles cause the expansion and contraction of the dissimilar materials comprising the sealing system, gland re-torques become common. Engineered disc springs can reduce the rate of load loss on the packing gland and set. The stored energy from the disc springs can compensate for the expansion and contraction that occurs during temperature cycling and improve sealing life of the packing set. These washer-shaped springs are added to the bolt, under the nut, and then tightened to the manufacturer's recommended torque value (see Figure 2).

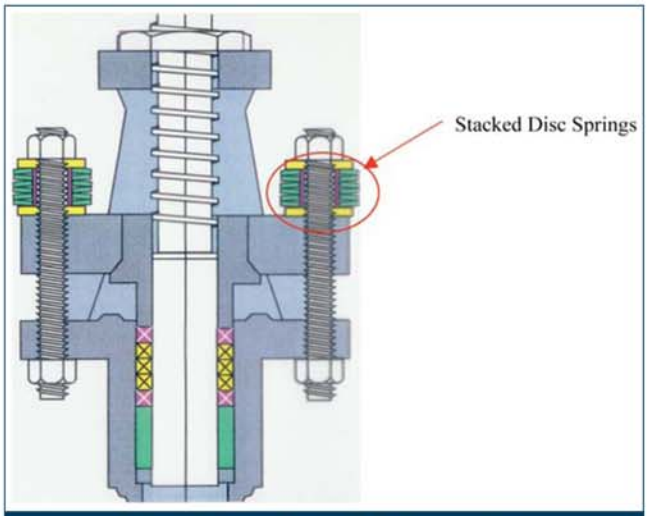

Figure 2. Disc springs installed on a valve

Methods of Applying Torque

There are generally two methods of applying torque based on packing construction. Braided packings are most common and traditional. Die-formed rings are engineered and readily available for higher performance requirements. The method of applying torque for braided packing is to tighten the gland nuts until heavy resistance to wrenching is felt. The method for die-formed rings is to use a calibrated torque wrench. The gland nuts are torqued to the manufacturers' recommended

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. *This month's Sealing Sense was prepared by FSA Member Walter Moquin.* 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 five with a specific product technology focus. As part of their mission they develop publications such as the joint FSA/ESA *Guidelines for the Use of Compression Packings* and *Pump & the Valve Packing Installation Procedures* pamphlet. These are primers intended to complement the more detailed manufacturers' documents produced by the member companies. In addition to English, they are available in a number of other languages, including Spanish and German.

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value. Nuts and studs should be well lubricated, unless otherwise specified. In either case, the torque felt or measured can be incorrect because of the condition of the nut and stud threads and/or operator error. Corrosion, solid contaminants, nicks, burrs or otherwise damaged threads give an inaccurate feel or measurement when determining the applied torque.

Disc springs offer the user the advantage that the proper torque can be set by a height measurement of the spring set. This method simplifies and removes potential errors that can occur during torqueing of the gland nuts.

Torque Calculation

The bolt torque is dependent upon packing cross section, gland bolt diameter, packing style, sealed pressure and the number of bolts. The following equation can be used to determine appropriate bolt torque.

Torque = μDF/12N

Where:

μ = Coefficient of friction between the nut and the stud

D = Stud diameter in inches

F = Packing Area x Pressure

Packing area = $(OD^2 - ID^2) \times \pi/4$ in square inches.

P = Minimum manufacturer recommended pressure, or System Pressure x Safety Factor (e.g. 1.75) determined by packing manufacturer in PSI; whichever is greater

N = Number of Bolts

12 = the conversion from inches to ft

Best Practices

Generally accepted practices can minimize the chances of improperly torqueing the gland nuts:

- Clean and inspect the nut and bolts threads for corrosion and thread damage. The nut should be able to smoothly travel the length of the bolt. Test by finger tightening the nut on the bolt prior to installation.
- Always use hardened flat washers under the gland nuts to evenly distribute the torque to the gland.
- Ensure the nose of the packing gland can be inserted freely into the stuffing box without interference or hang-up.
- Make sure the nose of the gland is seated evenly against the packing and prevent gland and bore interference that could affect the torque feel or measurement.
- During packing installations, finger tighten the gland nuts evenly. Then apply torque to tighten each nut evenly, alternating between the nuts by a percentage of the total consolidation recommended by the manufacturer. This should be done at least three times to achieve the desired compressed height of the packing.
- When using a torque wrench, make sure it is properly calibrated to get accurate readings.
- Apply a smooth, even force and avoid "jerking" the wrench.
- Measure the distance between the gland and box face to ensure evenness. Stroking the valve stem during this process ensures minimal consolidation in-service and consistent long-term sealing.
- Readjust gland nuts after the valve has been actuated a minimum of five times with the valve in the closed stroke position.

Maintaining proper gland load under all service conditions is necessary to ensure effective sealing. However, the gland force on the packing continually relaxes under service conditions. Stem actuation, packing wear and thermal cycling of the system causes consolidation of the packing, which leads to in-service leakage. To prevent leakage, readjustments of the bolt torque are traditionally performed. However, new research shows that reapplying the same torque value may be ineffective at maintaining sealing of the packing set, and measured gland or spring set heights are more appropriate. Proper torque practices are as important during readjustment as during initial installation to attain maximum performance reliability of valve packings.

Conclusion

Application and maintenance of the manufacturers' recommended torque to valve packing is critical to meeting emissions requirements and long service life. While approaches to the application of torque for braided and die-formed packing may be different, the generally accepted practices are important to all valve packing. Consultation with the packing manufacturer on specifics of the application can help to ensure reliable performance.

Next Month: *Are you playing offense or defense with your leak detection and repair?*

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

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