Proper Installation of a Bolted Joint Gasket

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If bolted joint gaskets are not properly installed, it can cost thousands to replace them and their associated parts. Follow these tips to ensure savings.

Bolted flange gasket technology continually evolves with new designs and materials that provide more reliable and durable seals. Plant operators can choose from a wide variety of gasket products that meet the needs of each application; however, selecting the optimal gasket product is only half the battle.

The installation process is as critical as the design and quality of the gasket itself. In fact, a study by the Application Engineering Department at Garlock Sealing Technologies (Palmyra, NY) found that 82 percent of gaskets returned for analysis (after the joint leaked) showed signs of problems with compression, while only 14 percent of the failures resulted from the selection of the wrong product for the particular application (see Figure 1).

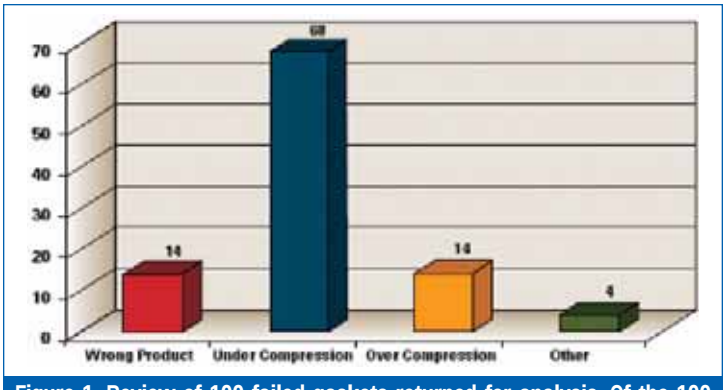

Figure 1. Review of 100 failed gaskets returned for analysis. Of the 100 gaskets analyzed, 82 showed signs of improper compression. This type of failure has multiple causes including, but not limited to, incorrect installation procedures, warped or misaligned flanges and flanges that are too thin. *(Source: Garlock Sealing Technologies)*

Joint leakage due to improper installation and lack of preventive maintenance can greatly impact a plant's financial performance. The cost of replacing flanges, gaskets, bolts, nuts and/or washers—including associated labor—can total hundreds of thousands of dollars per year in a large plant. Additionally, leakages can affect plant productivity and cause safety risks and environmental hazards. Most significantly, plant operators understand the financial impact of taking a process or plant offline to deal with a leak.

The Right Amount of Bolt Load

Proper installation primarily involves the method of tightening the bolts. After all, a bolted flange gasket is a mechanical system fundamentally based on the spring-like force exerted by the stretched fasteners and the other compressed joint components. Sufficient torque must be applied to create the compressive load that causes the gasket to consolidate and flow into and fill any irregularities in the sealed mating surfaces.

The bolt load also causes serrations of the flange seating surface to bite the gasket, mitigating lateral gasket movement and blowout. The higher the compressive load, both initially and during service, the higher the blowout (gross leakage) resistance. However, if too much torque is applied, the seal will be compromised (crushed) and destroyed. Of the 100 failed gaskets in the study, 68 of the failures were attributed to under-compression (insufficient torque) and 14 to over-compression (excessive torque).

Best Practices

The importance of proper installation is well-understood by the makers and users of bolted flange gaskets. In May 2005, the Pressure Vessel Research Council (PVRC) held a conference on "Best Practices for Flange Maintenance and Assembly

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Technology." Currently, the ASME Post Construction Committee is developing a certification program to qualify assemblers of bolted joints.

In addition to industry-wide best practices, individual plants need to develop documentation of the proper gasket installation procedure for each joint location, as well as institute training and quality control measures to ensure that the documented procedure is followed carefully and precisely every time the gasket is changed. Gasket procedures should conform to the manufacturer's installation and handling instructions. Regular preventive maintenance programs also need to be documented and consistently executed.

A study conducted last year highlights the significance of how maintenance personnel are trained and managed. Bolted flange gasket users representing plants of various sizes were surveyed, with 57 percent of the respondents reporting 200 or more critical bolted joints at their plants. Of the 149 plants that reported using external contractors, 58 percent had bolted joints that leak. Of the 93 plants that reported they did not outsource this function, only 29 percent had bolts that leak.

This data does not necessarily point to external contractors as a source of incorrect installations. Both external mechanical contractors and internal personnel trained in proper installation procedures will likely install gaskets correctly, preventing these joint leaks. We recommend companies using external contractors ensure that installers have received this training, and are supplied with installation guidelines and torques tables that align with the company's best practice policies.

Calculation of Torque

The sealing solution provider should provide practical information to assist the plant in documenting gasket installation and maintenance procedures. A critical component of such documentation is the calculation of the optimal torque applied to the bolts at each joint location.

The bolt torque value will depend on the type of gasket, as well as the size of the pipe, the number and size of the bolts, and the internal pressure.

Installation Recommendations from Garlock

Our engineers have developed a set of best practices for bolted joint gasket installation:

- Inspect the flange to ensure that the surface finish and flatness are satisfactory.
- Center the gasket on the flange. Careful centering of the gasket is especially important when raised faces are involved. Take care when bringing the flanges together to ensure that the gasket is not pinched or otherwise damaged.
- Use a recently-calibrated torque wrench, well-lubricated fasteners and hardened flat washers to ensure correct initial loading.
- Lubricate fastener threads and all bearing surfaces (underside of bolt heads, nuts, washers), using only specified or approved lubricants. Apply the lubricant in a consistent manner as a thin, uniform coating (avoid "lumps" of lubricant as this may reduce the efficiency). Ensure lubricant does not contaminate either flange or gasket faces.
- Run the nuts or bolts down by hand. This gives an indication that the threads are satisfactory (if the nuts will not run down by hand, then there is probably some thread defect—check again and, if necessary, replace defective parts).

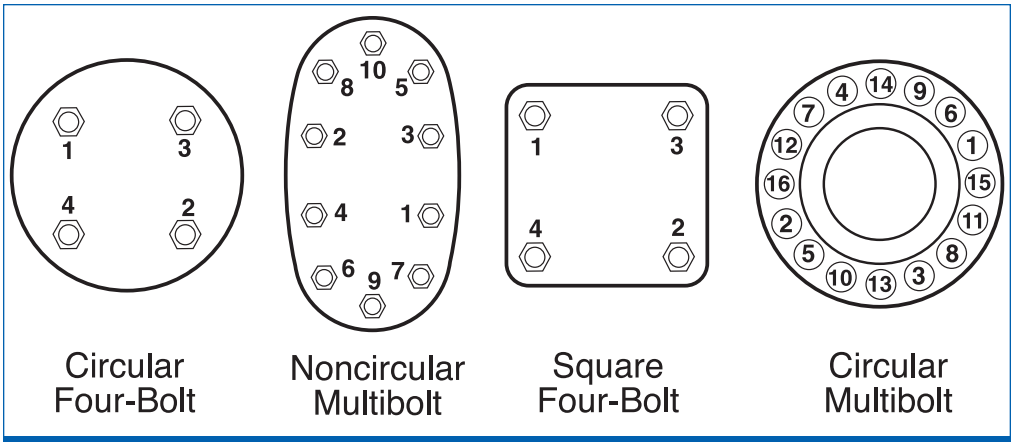

Figure 2. Recommended Star Bolting Pattern

- Tighten the bolts to compress the gasket uniformly, utilizing a star bolting pattern (see Figure 2). After initially bringing all bolts to snug or finger-tight, all bolts should be tightened in one-third increments at each pass. The sequence in which bolts or studs are tightened has a substantial effect on the distribution of the assembly pressure (compression) on the gasket. Improper bolting may move the flange out of parallel. A gasket will usually be able to compensate for a small amount of distortion of this type, but serious difficulties may emerge if the flanges are substantially out of parallel.
- Make a final check pass at the target torque value moving consecutively from bolt to bolt.
- Re-torque 12 to 24 hours after initial installation, whenever possible.
- Observe all safety standards including lockout/tagout procedures.
- Never use liquid or metallic based anti-stick or lubricating compounds on the gaskets. Premature failure could result.

Preventive Maintenance

Best practices also include regular preventive maintenance. Daily or weekly inspections of fluid-handling systems can minimize downtime and allow corrective actions to be taken before irreversible failures occur. Another sound operating practice that can save plants time and money is changing sealing devices on a routine basis to make sure the system is properly equipped.

Consistently following these installation and maintenance recommendations is critical to achieving high performance and long service life with bolted joint gaskets. Proactively preventing leaks in your fluid-handling systems requires diligence and remains a constant struggle if the basics of good installation are not followed. Selecting a high quality, high performance gasket solution wins half the battle. To win the overall battle, consistent and thorough performance and documentation of procedures and system maintenance is a must.

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