Back to Basics: Semi-Metallic Gaskets

Fourth in a Series

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This is the second of two articles in this "Back to Basics" series that discusses gasketing. While the first article was on soft gaskets, this article will focus on semi-metallic gaskets.

Many variations of semi-metallic gaskets are available. In general, the combination of metal and a soft material merges the structural integrity of the metal with the sealing ability of the soft material. Common variations include corrugated, jacketed, kammprofile and spiral-wound gaskets.

Corrugated Gaskets

These gaskets consist of a thin metal that is corrugated or embossed with concentric rings and faced with a soft material such as flexible graphite.

Corrugated gaskets use the substrate's geometry to achieve conformability to flange irregularities and promote recovery over the life of the seal; they are essentially a line contact seal. Multiple concentric corrugations provide a labyrinth effect and mechanical support for the facing material.

Jacketed Gaskets

Jacketed gaskets consist of a soft compressible filler, partially or wholly encased in a metal jacket. In some instances, corrugated metal is

Figure 1. Corrugated gasket. Figure 2. Metal jacketed gasket. Figure 3. Kammprofile gasket. Figure 4. Spiral-wound gasket. *(Graphics courtesy FSA)*

Figure 1. A=Metal Corrugations B=Soft Facing Material

Figure 2. A=Metal Jacket (Outer Layer) B= Filler Material

Figure 3. A=Metal Core B=Soft Facing Material C=Metal Outer Ring

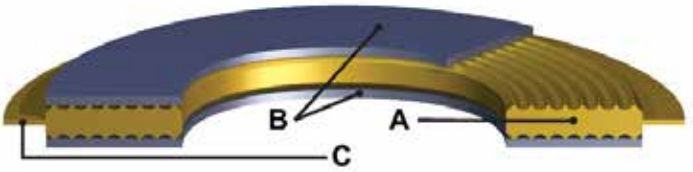
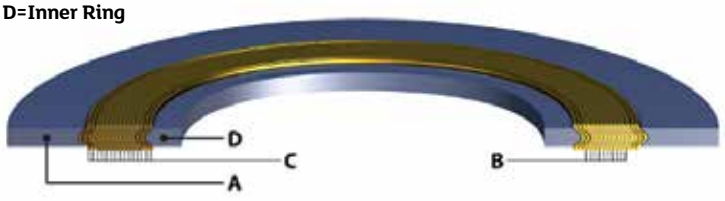


Figure 4. A=Outer Ring B=Filler Material C=Metal "V" Windings D=Inner Ring



used in place of soft filler material and may have a soft surface layer of material such as flexible graphite. The primary seal against leakage is the inner metal overlap, where the density of the gasket is the greatest when compressed.

Kammprofile Gaskets

Kammprofile (camprofile) gaskets are grooved metal gaskets with covering layers. More specifically, they consist of a solid metal ring with grooved faces and a soft facing material on the grooved faces to improve sealability. Typical facing materials are flexible graphite, phyllosilicates (mica and vermiculite) or polytetrafluoroethylene (PTFE).

Spiral-Wound Gaskets

Perhaps the most common semi-metallic type, these gaskets consist of a preformed "V" or chevron-shaped metal strips alternately wound with a conformable filler material.

The metal windings provide strength and resilience, while the non-metallic filler portion, typically graphite or PTFE, conforms to the irregularities of the flanges. This configuration aids in the joint seal. These gaskets can be constructed in a variety of densities accommodating available bolting and pressure conditions.

Spiral-wound gaskets may include a centering ring, an inner ring or both. The outer centering ring of a spiral-wound gasket ensures that the gasket is centered within the flange and acts as a compression limiter. The ring provides additional radial strength, reducing flange erosion while protecting the sealing element.

Helpful Suggestions for Gasket Selection

Proper gasket selection depends on operating conditions, mechanical features of the joint, fluid compatibility and gasket characteristics. Operating conditions and fluid compatibility generally determine gasket material, while dimensional and mechanical features of the joint control the type of gasket.

As a selection guide, multiply the operating pressure in pounds per square inch (psi) by the operating temperature in degrees Fahrenheit. If this value exceeds 250,000, semi-metallic gaskets are recommended.

Soft gaskets typically are made from a variety of materials, with properties suitable for a broad range of service conditions; however, they should not be used for temperatures exceeding 600 F. For further information, users should consult the manufacturer for proper material selection.

Special Considerations for Spiral-Wound Gaskets

The spiral-wound gaskets offer the best performance when compressed to a predetermined specific thickness. The compressibility can be controlled accurately for a specific bolt loading by varying the density (i.e., the number of metal-filler plies or wraps per unit of gasket width). Filler thickness may range from 0.015 to 0.031 inches.

Two gasket thicknesses, 1/8 inch and 3/16 inch, are standard and suitable for most applications. For 1/8-inch-thick gaskets, compression to a thickness of 0.100 inches (± 0.005 inches) is recommended. For 3/16-inch-thick gaskets, a compression to 0.130 inches (± 0.005 inches) is considered correct.

Although spiral-wound gaskets can be used for general, noncritical service with almost any commercially produced flange surface finish, a 125-200 root mean square (RMS) finish is preferred.

Installation

Spiral-wound gaskets are dimensioned so that their cross sections are smaller than the flange faces. When one of these gaskets is installed, the sealing surface is positioned so that it does not protrude past the inside diameter (ID) or the outside diameter (OD) of the flange faces.

Dimensions of gaskets purchased as replacement parts from the original equipment manufacturer have been pre-checked. However, check the dimensions of the gaskets for use between a pipe and a pressure vessel flange. The procedure for checking the dimensions is as follows:

- Measure the ID of the flange contact face.
- Measure the gasket ID.
- If the gasket ID is not at least 1/8 inch larger than the flange ID, do not use it unless it can be installed perfectly centered. In no instance should the gasket ID be less than 1/8 inch larger than the flange contact face ID when used between pipe or pressure vessel flanges.

Bolting Up

A spiral-wound gasket does not have the same feel as other metallic, or even non-metallic, gaskets during bolt up. A spiral-wound gasket is different—more like a thick rubber gasket—because it "gives" as each bolt is tightened.

For this reason, it is important to tighten the bolts in small steps and in proper sequence.

Do not tighten the bolts all the way on the first attempt. This can tilt flanges out of parallel. If using a torque wrench, set the wrench at about one-third of the final torque for the first attempt.

Pay particular attention to the hard-to-reach bolts. Repeat the procedure with the torque wrench set at two-thirds of the final torque.

If the initial attempts at bolting up are done correctly in the proper sequence, the final attempt does not need to follow any set pattern.

What is important is that the final tightening be uniform, with each bolt evenly loaded. This is the best practice to achieve a trouble-free joint.

If the loads of each bolts are not uniform, the joint may leak, particularly if it is used in hot service. ■

Next Month: **Back to Basics: Expansion Joints**

We invite your suggestions for article topics as well as questions on sealing issues so we can better respond to the needs of the industry. Please direct your suggestions and questions to sealingsensequestions@fluidsealing.com.

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