European Sealing Association e.V.

What gasket thickness should I use in my flange system?

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The question of what gasket thickness to use for a particular flange system application arises frequently, but is difficult to answer easily. "Should I use 1.0 mm or 3.0 mm thick gasket?" Sounds like a simple question, but requires more than a simple answer.

Thicker gaskets can deal with more flange irregularities because they can compress more. If flanges are corroded, uneven or not parallel, a thicker gasket may be needed. The best solution is obviously to repair or adjust the misalignment of the flanges, but that's not always realistic.

So why do most gasket manufacturers recommend using thinner gaskets **wherever possible?**

Thinner gaskets offer many advantages:

- Greater blow-out resistance due to the smaller cross sectional area exposed to the internal medium pressure.
- Lower leakage rates again due to the smaller cross sectional area.
- Better compressive strength and therefore higher gasket surface loads (pressure) can be safely applied to a thinner gasket.
- Better fastener torque retention due to the lower creep relaxation characteristics of thinner gaskets.
- Lower cost of the gasket itself.

"**Wherever possible**" is difficult to apply in reality. As mentioned above, thicker gaskets conform better to badly damaged or warped flanges, because a gasket's ability to fill flange irregularities is based on the amount of gasket compression at a given load.

Since compressibility at a particular load is normally expressed as a percentage of the gasket's original thickness, a thicker gasket with a larger original thickness actually compresses a larger distance. For example, a 10 percent compression of a 1.0 mm gasket means a compression of 0.1 mm. In a 10 percent compression of a 3.0 mm gasket, the gasket will compress for 0.3 mm. This extra gasket compression means the thicker gasket will fill-in deeper scratches or low spots better than the thinner gasket. One example of gasket thickness change depending on gasket compressibility is shown for 1.0 and 2.0 mm thick gaskets in Chart 1.

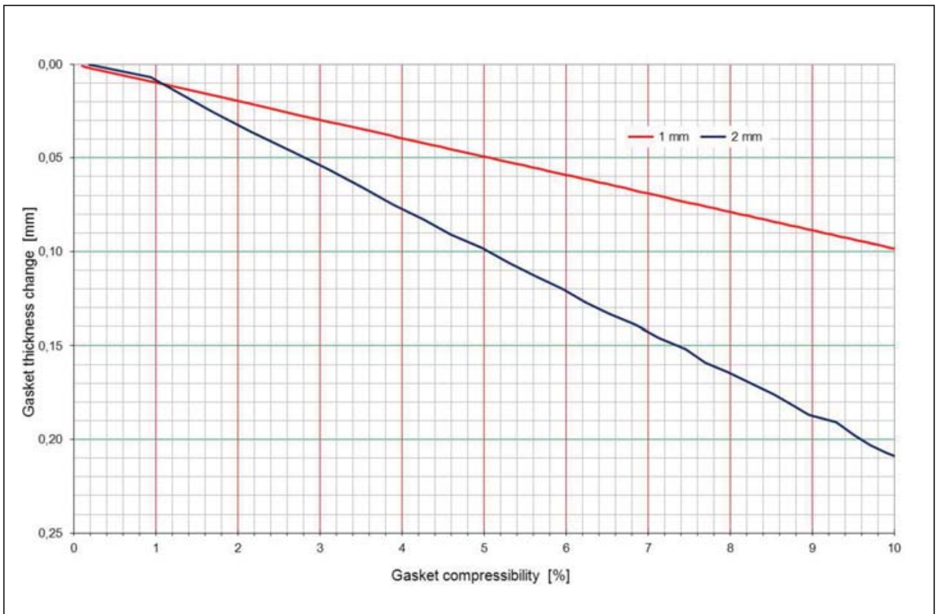

Chart 1: Gasket thickness change versus gasket compressibility.

However, the advantages of using a thicker gasket can be misleading. While the thicker gasket seals more flange irregularities, it can also lead to other problems. A thicker gasket is more affected by heat, so has a higher creep relaxation. The change in surface pressure after exposing the gasket to temperature for two gaskets of different thicknesses is shown in Chart 2. If a gasket is loaded with 220 MPa and exposed to an elevated temperature of 100°C for 4 hours, the residual gasket surface pressure for 1.0 mm thick gasket will be 210 MPa and for 2.0 mm thick gasket 190 MPa (for a stiffness of 500 kN/mm). That means that thicker gasket has lost more gasket surface pressure, which can lead to a shorter life time of the gasket and greater leakage rates during operation. The loss of gasket surface pressure is even more apparent at higher temperatures.

A thicker gasket also has a lower compressive strength and therefore the maximum gasket surface load to which the gasket can be exposed to without causing damage is lower. This applies to both room and elevated temperatures. The maximum surface pressure that can be applied to a gasket changes with temperature and is shown for 1.0 and 2.0 mm thick gasket in Chart 3. The maximum gasket surface pressure can be determined according to standards such as EN 13555.

Furthermore, the friction between the gasket and flange is also one of the factors

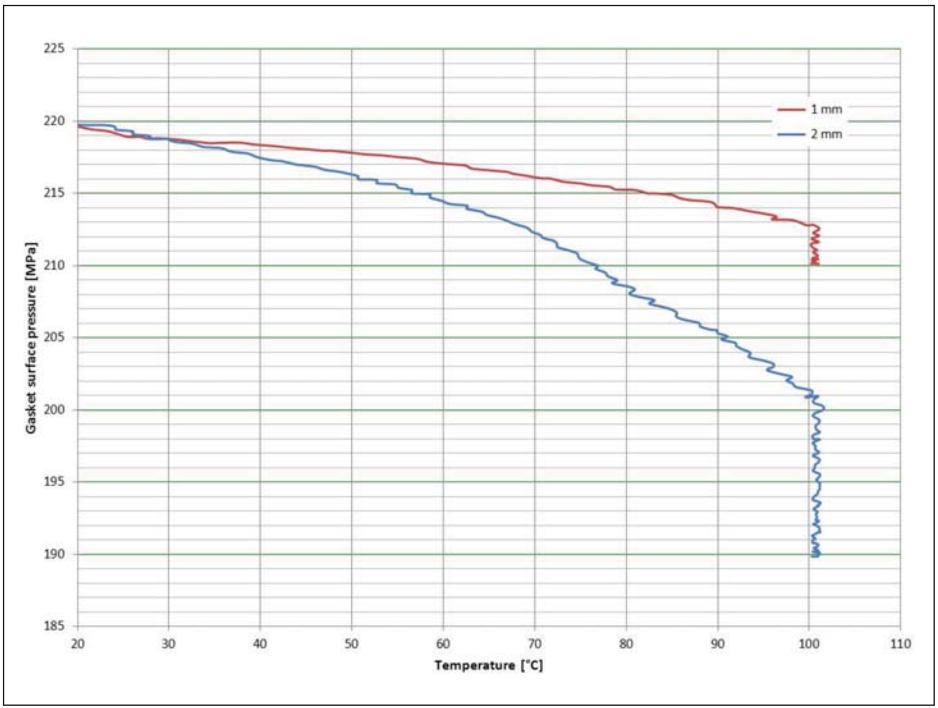

Chart 2: Changing of gasket surface pressure after loading of gasket.

determining the blowout resistance of the bolted flange joint. Friction is a combination of the friction factor between the gasket and flange surfaces and the total bolt load. Because thin gaskets have lower creep relaxation, the joint retains higher bolt load, which leads to better blowout safety.

Lastly, since all gasket materials are permeable to some degree, media can pass through the body of the gasket. Thicker gaskets create a wider path for permeation to occur, and therefore give higher leakage rates, but note that the reverse can also occur. If a gasket is too thin to conform to flange irregularities, the media can leak over instead of through the gasket. This can lead to even higher leakage rates than with the thicker gasket. Therefore flanges which are flat and pristine enough to handle thin gaskets seal much tighter with a thinner gasket.

The type of sheet gasket material and the compressive load available, also affect the thickness required to seal a particular joint. Gaskets with higher compressibility values will not require the same load as harder, less compressible types to effect a tight seal. This is because more compressible gaskets can better compensate for irregularities on the flange surface, and therefore thinner gaskets can be used. Flanges requiring thicker gaskets create problems that a gasket manufacturer cannot control. Therefore the best solution is to use or design flanges with higher available compressive loads, keep the surface finish in good condition, and use 1.5 mm or even 1.0 mm thick gaskets whenever possible.

Less than perfect flanges however still need to be sealed. This is usually accomplished by carefully considering all the variables in the application when selecting the style and thickness of a gasket material. Consult your gasket supplier for specific guidance on any flange system application. Proper installation is, as always, essential. Therefore the gasket should be assembled with a correctly calculated initial gasket pressure and installed using a good installation procedure. To calculate an appropriate assembly bolt torque for circular flange connections we suggest you to use calculation method according to EN 1591 Part 1, and as a background for good installation procedure you can use the European Sealing Association Guidelines.

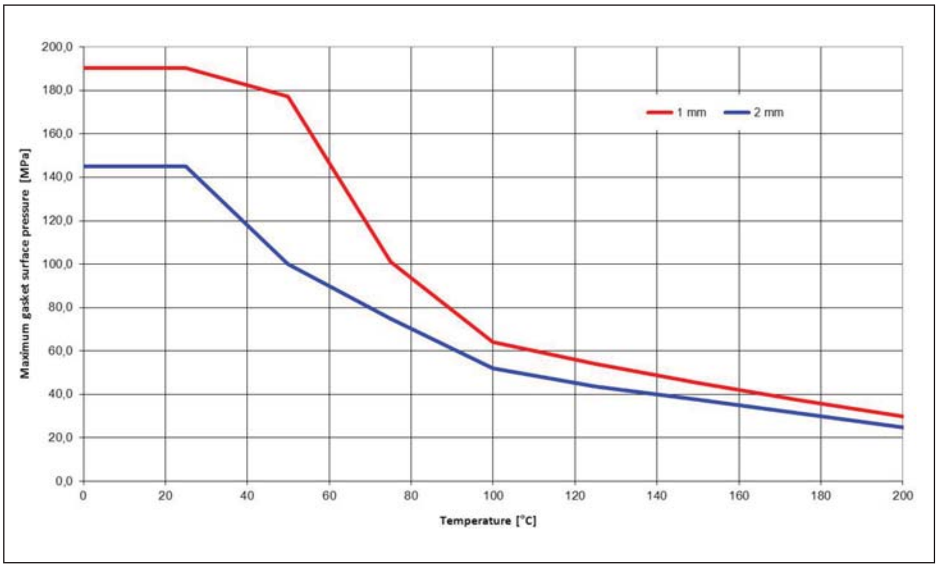

Chart 3: Maximum gasket surface pressure depending on temperature.

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