

Gasket selection using the gasket design factors as per EN 13555

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The European Standard EN 13555, updated in the summer of 2014, defines the sealing gasket design factors and test methods for round flange connections. This allows the comparison of the properties of gaskets. Among other things, the standard establishes a new definition of the maximum surface pressure. What changes does this bring for the operators of plants and what criteria should be considered in the selection of gaskets using the characteristic as per EN 13555?

There are several reasons (see Fig. 1) why plant operators should deal with the tightness of the flange connections. For example, they can increase the safety at work with well-sealed plants as it prevents hot or harmful gases and liquids from escaping. At the same time, of course, various regulations stipulate the leak tight-

ness of equipment, for reasons of environmental protection. In addition, costs can be saved, as they prevent loss of media due to leaks. By using premium-quality gaskets, companies benefit from safer workplaces, regulatory compliance, higher plant availability, environmental friendliness, better product yield and other strategic advantages.

Flange connections should not only be tight, but also remain tight. This is guaranteed if no significant changes in the mechanical properties are to be expected. Concerning the gasket, this means permanent resistance to thermal, chemical and aging effects, as well as low creep properties. These requirements are defined in Germany by, for example, environmental legislation, such as the Federal Pollution Control Act, respectively the Clean Air Act and the Hazardous

Incident Ordinance, or the Water Resources Act. There is also occupational safety legislation such as the Industrial Safety, Hazardous Substances or Pressure Equipment Regulations that applies.

Strict limits

The strict local requirements on the tightness of a flange system are underlined by the VDI 2290 directive created in 2012, which is defined by the Clean Air Act (TA-Luft) for steel flanges. Here, a leakage limit value for the operating state, that is under pressure and temperature, of 0.01 mg/(m²s) helium is specified. This partly entails exchanging gaskets and bolts in flange connections as they can no longer meet the leak tightness requirements. In addition, it calls for flange connections to be tight permanently. A “proper” life expectancy can be up to 30 years. The majority of applications are in the range of several years, though.

There are four parameters for meeting the leak tightness requirement that have similar global definitions:

- Maximum surface pressure of the gasket (above this, the gasket or the flange is destroyed)
- Minimum surface pressure to remain tight (below this, leakage increases)
- Applied surface pressure when installing the gasket
- Leakage rate

These gasket parameters and the creep properties of the gasket are key selection criteria for a gasket and are uniformly defined in the EN 13555. However, the new definition of the maximum surface pressure (Q_{Smax}) represents a challenge in this regard. This standard previously looked at “the maximum surface pressure at which the gasket may be loaded with-

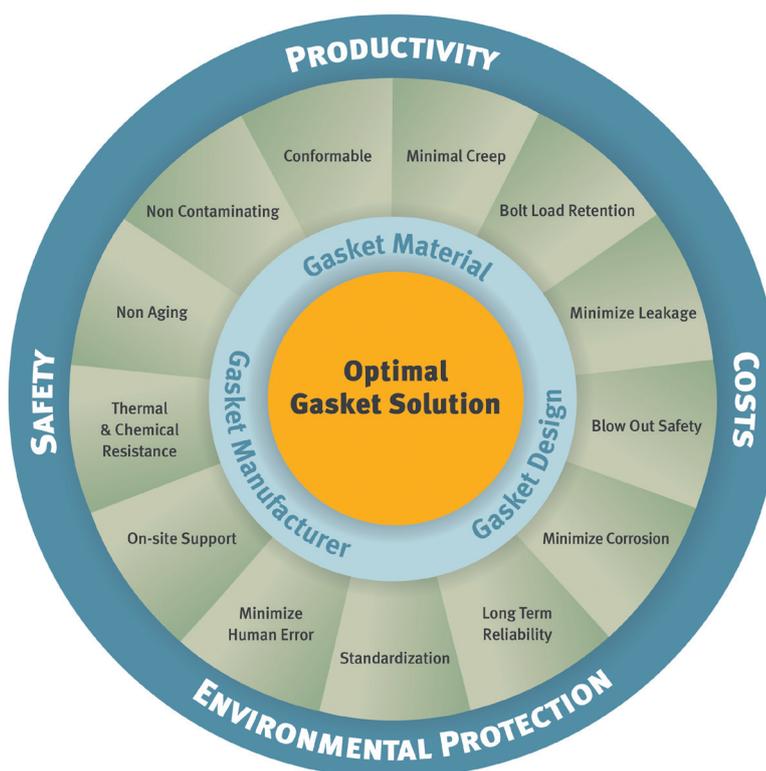


Fig. 1: Challenges in the selection of gaskets

out mechanical failure occurring ...". This definition was aimed at mechanical damage to the gasket without consideration to dimensional stability. However, it was not taken into account that creep reduces the inner diameter and so represents a flow obstacle inside the pipeline. But, "due account has to be taken of the potential damage from turbulence and the formation of vortices", as the Pressure Equipment Directive already states.

Extended definition

The new version of EN 13555 that came out in the summer of 2014 defines the Q_{Smax} value accordingly "as the maximum surface pressure at which the gasket may be loaded at the specified temperatures without it collapsing or failing mechanically, or that a compressive failure, an inadmissible intrusion of the gasket into the bore or damage to the compressed sealing surface occurs". For a DN40/PN40 gasket, the inner diameter may not be less than 43.1 mm (original 49 mm), otherwise the value for the maximum surface pressure has to be reduced accordingly. However, the lower the mounting surface pressure, the higher the risk of creeping and the leakage

rate. Because then the creep relaxation factor (P_{QR}) is smaller, which adversely affects the safety of the flange. In addition, the flange must be tightened more frequently.

Creeping represents one of the major factors in terms of plant safety and availability. The creep relaxation factor corresponds to the ratio of the sealing surface pressure after aging (creeping, setting) to the originally applied surface pressure at installation. A factor of 0.80, for example, means that the residual surface compression is 80 per cent of the originally applied surface pressure. The more this factor approaches the number 1 (= 100%), the lower the creep of the gasket.

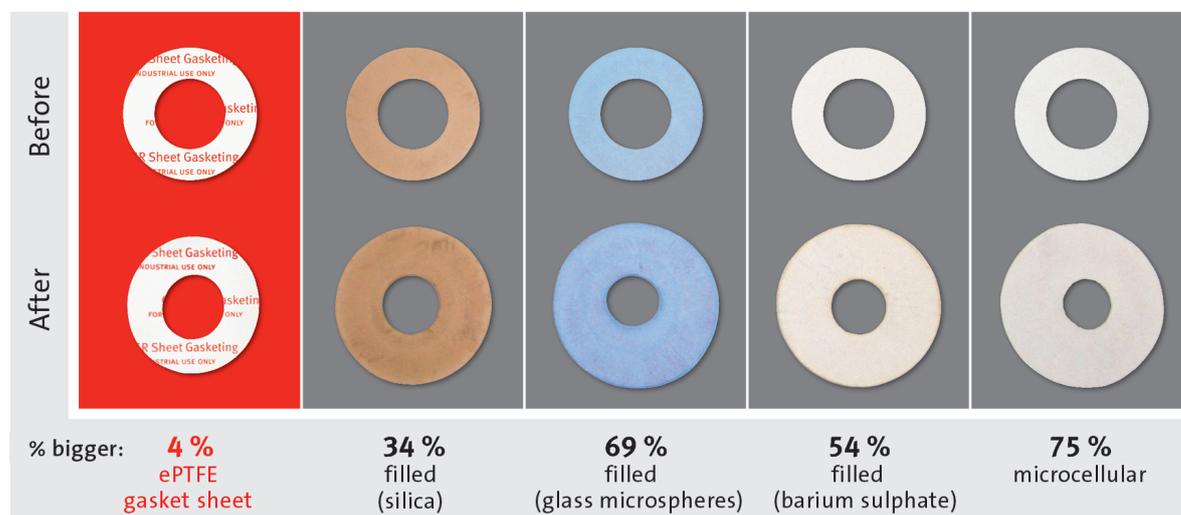
Consequences of the new regulation

The new definition of the maximum surface pressure, however, does not make it clear what to do with the gaskets currently in use that no longer comply with the limit values. It is also linked to other regulations such as the "Guidelines for the assembly of flanged joints in process plants" of the VCI, the EN 1092-1 or AD 2000 B7. The values specified here will by far no longer be reached as per the new defi-

nition of the maximum surface pressure of some affected gaskets.

Accordingly, plant operators should look for gaskets that reach the values according to the new definition. They can get the sealing characteristics and select the optimum gasket for a flanged joint using the www.gasketdata.org database. The datasheets posted there should have a creation date of 2016. This online site shows the great differences between the different materials but also between the same materials from different manufacturers. A simple creep test (compression under temperature with constant force) already illustrates how great the differences in material can be. After only 15 minutes under 35 MPa and 230 °C, these tests showed an increase in the gaskets by only 4% for ePTFE, in contrast by 34% for silica filling, 54% for barium filling, 69% for glass microsphere filling, 75% for microcellular PTFE and as much as 125% for sintered PTFE (see Fig. 2). In the latter case, this represents an enlargement of the gasket to more than twice the surface area and a correspondingly large obstruction of the material flow in the plant due to the gasket protruding into the inner diameter of the pipe. Furthermore, the enor-

Creep resistance and dimensional stability



Test methods: 34.5 MPa load, +230°C for 15 minutes

Fig. 2: Creep resistance and dimensional stability

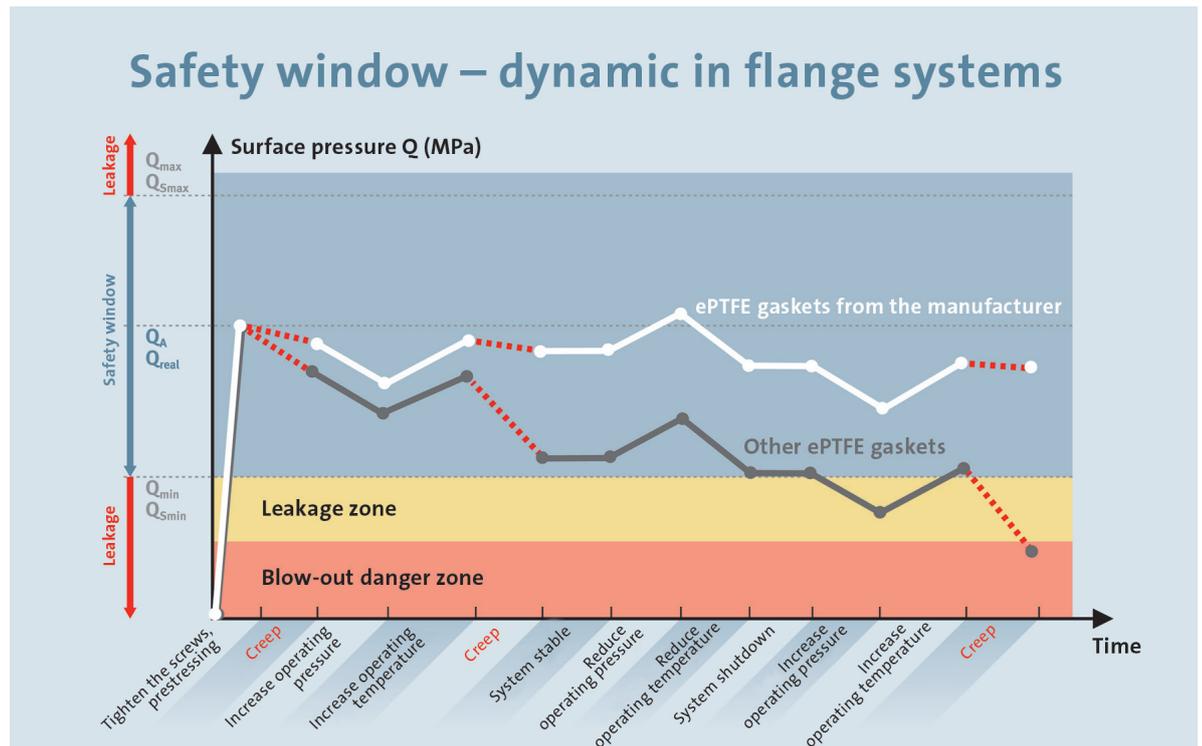


Fig. 3: Safety window – dynamics in flange systems

mous creep leads to surface pressure losses, which results in an increase in leakage.

However, a comparison of the gaskets is only possible when the sealing parameters are taken into consideration under the same prevailing conditions. When the gasket thickness, pressure level and mounting surface pressure are the same, lower minimum surface pressure in the operating state then means a higher safety window (see Fig. 3), that is, greater plant safety and availability. When the gasket thickness and temperature are the same, higher maximum surface pressure in the operating state means a larger safety windows and a greater possible installation surface pressure during assembly. And when the gasket thickness, temperature and mounting surface pressure are the same, a higher creep relaxation factor means

less creep, higher residual surface pressure, less leakage, less retightening and greater plant safety and availability.

Conclusion

The plant operator should also use premium-quality gaskets regardless of the legal requirements. Because a leakage puts occupational safety at risk by emitting substances, environmental pollution, corrosion of plant components caused by aggressive media, product loss and cost.

Also pay attention to the following properties when selecting gaskets:

- Good conformability
- High resistance to aging, temperature and chemicals
- No contamination

- Low leakage rate (L_N)*)
- Large maximum permissible surface pressure of the gasket (Q_{Smax})*)
- Small minimum permissible surface pressure of the gasket (Q_{Smin})*)
- Large mounting surface pressure (Q_A)*)
- Large creep relaxation factor (P_{QR}) (= little creep)*)
- Gasket as thin as possible and as thick as necessary

*) Refer to EN 13555 at www.gasketdata.org

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