sgl carbon

SIGRAFLEX® flat graphite gaskets

Sealing surface roughness and surface condition

Many gasket types are very demanding when it comes to surface finish and surface condition. However, with SIGRAFLEX graphite gaskets the story is quite different as these are highly fault tolerant. In the following paragraphs, we evaluate the performance of SIGRAFLEX flat gaskets where the sealing face is graphite.

Flange face finish
According to EN 1092-1 and ASME B16.5 the typical flange face surface finish is as follows:

Table 1	R_z [μm]	R_z [μin]	R_a [μm]	R_a [μin]
EN 1092-1	3.2...50	126...1,970	0.8...12.5	30...500
ASME B16.5			3.2...12.7	125...500

SIGRAFLEX flat gaskets often consist of graphite foils reinforced with stainless steel foils. Tests with these materials compressed against metallic flange faces with an R_z surface roughness of 3 to 160 μm (118 to 6,300 μin) demonstrate that the roughness of the flange surface has little to no impact on the tightness of the seal.

This performance can be explained by the high compressibility and the excellent adaptability of our SIGRAFLEX materials, the following Table 2 shows the typical compressed thickness for some of our products.

Typical compression behavior relating to gasket stress

Table 2	Units	SIGRAFLEX HOCHDRUCK	SIGRAFLEX UNIVERSAL PRO	SIGRAFLEX iNXT	SIGRAFLEX BSSC	SIGRAFLEX BTCSS
Initial thickness prior to compression	mm in	2.00 0.079	2.00 0.079	2.00 0.079	3.05 0.120	3.05 0.120
Typical compressed thickness at 20 MPa (2,900 psi) gasket stress	mm in	1.40 0.055	1.26 0.050	1.20 0.047	2.11 0.083	2.16 0.085
Typical compressed thickness at 100 MPa (14,500 psi) gasket stress	mm in	1.18 0.046	1.04 0.041	1.00 0.039	1.73 0.068	1.78 0.070

For example, in Table 2, for SIGRAFLEX UNIVERSAL PRO at an initial thickness of 2 mm and a gasket stress of 20 MPa (2,900 psi), the compression ratio results in a typical thickness reduction of 740 μm (29,234 μin).

Owing to this good compressibility and the excellent adaptability of the flexible graphite surface, an even greater flange roughness than the maximum values mentioned in Table 1 can be tolerated. To avoid effects such as localized over-compression of the gasket material, we recommend that the depth of original machined concentric grooves does not exceed the afore mentioned 160 μm (6,300 μin).

Surface defects of flange sealing surfaces

Other than the concentric finish of the flange faces mentioned, flange waviness or other surface damage such as scratches etc. need to be viewed from a different perspective. The following is true for circular flanges:

Surface defects being significantly smaller than the effective sealing face or scratches that run in the circumferential direction of the sealing surface have little or no influence on sealability.

In contrast, to compensate for any flange distortion or any radially running scratches bridging the effective sealing face, we need to take a closer look. Generally, it can be said that the higher the compressive stress on the gasket – up to its maximum permissible compressive stress – the better the tightness, and conversely in areas of low compression a higher leakage rate is observed. This is down to the fact that under the initial compressive stress applied, the graphite faces mold themselves into the opposing flange sealing faces and it is this good adaptability of the graphite that allows for a good seal.

An evaluation of allowable surface defects

On the assumption that the allowable leakage rate does not increase by more than a factor of ten in areas of lower compression, we have shown that only a proportion of the thickness reduction of the gasket mentioned in Table 2 should be used. How much depends on gasket design and gasket stress level. As a rule of thumb, we recommend that the depth of such localized defects does not exceed one-third of the total compression of the gasket, considering that

- the total area of all defects is less than 10 % of the sealing surface
- gasket stress within an unfavorable defect is still high enough to prevent a blow out
- the geometry of the defect allows for a good adaptability of the graphite surface of the gasket. Which is not the case for sharp narrow scratches!

Another view on this topic can be read in ASME PCC-1 Appendix D ("Guidelines for allowable gasket contact surface flatness and defect depth").

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