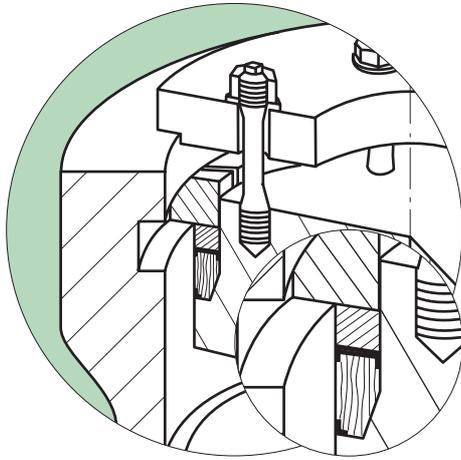
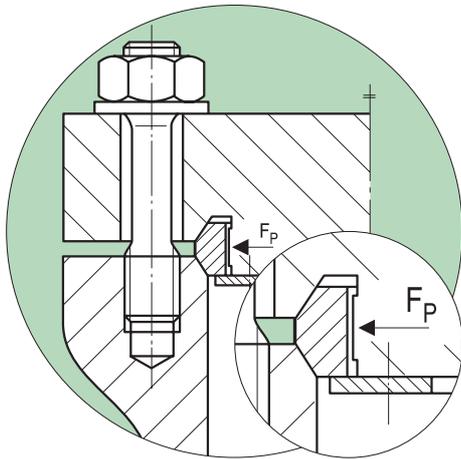


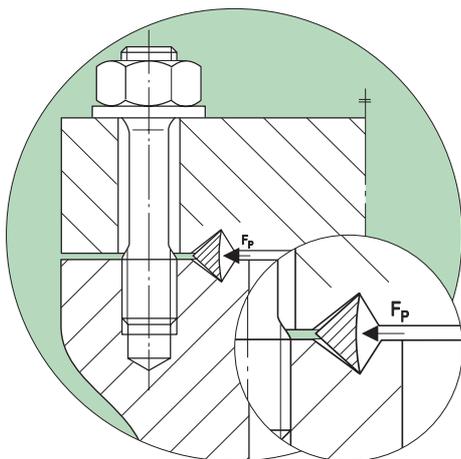
Gaskets for *Self-Sealing* Cover Plate Closures



Graphite Cover Plate Gaskets



Double-Cone Gaskets



Delta-Gaskets

kemOchen
the right choice !

Gasket Styles

Cover plate gaskets are especially for high-pressure, high-temperature apparatuses designed to withstand high working conditions. Self-sealing closures offer a large variety of advantages in comparison to commercial flange connections. On the basis of the function principle much of flange and cover material can be saved, provided the design is optimized.

For high-pressure apparatuses and fittings, closures with soft material cover plate gaskets have been proven more successful than commercial flanged connections, especially for the larger sizes.

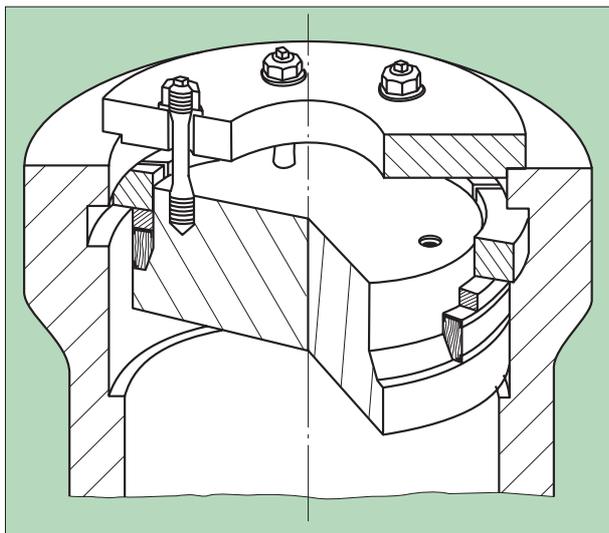
Rope packings and lamellae packings of asbestos rope are completely replaced by graphite rings or compound rings of graphite and PTFE.

Metal cover plate gaskets are classified as main load gaskets. As long as the inner pressure is lower than the bolt seating pressure, the total seating stress flows across the sealing areas. As soon as inner pressure exceeds the seating pressure, the bolts will be strained strain and the distance between the sealing areas increases. The internal pressure will expand the gasket to maintain the seal. In other words the gasket acts as self-sealing element. It is important that radial expansion and compression through initial bolt seating stress can be compensated by the elastic behavior of the gasket material.

The typical initial seating stress for self-sealing gaskets is lower than the necessary values for gaskets in the main load. However, the bolts must to be designed to withstand the internal pressure.

Graphite Cover Plate Gaskets

In most cases high-pressure seals for cover plates and closures are installed as self-sealing gaskets. The necessary seating force is not provided by the bolts but by the internal process pressure. Therefore bolts with small diameters can be used. The result is a compact design. The below drawing depicts the design principle.

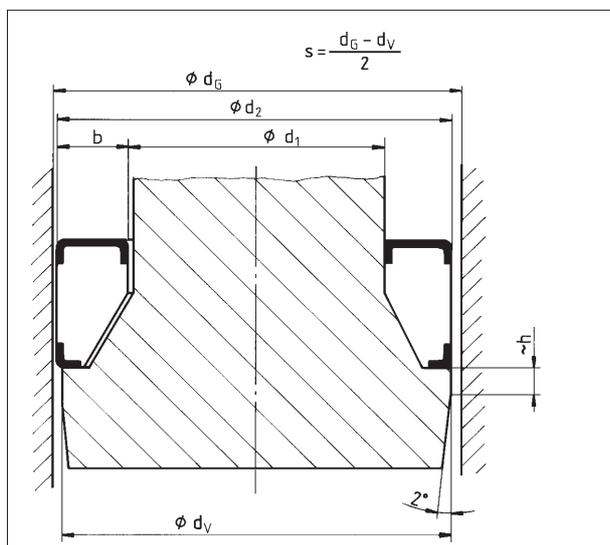


For high pressures or refurbished closures anti-extrusion caps are used and thus avoid graphite extrusion into the gap between housing and cover plate. Pressed caps of 1.4541 (AISI 321) with a thickness of 0.4mm are available. For ultra high pressures solid machined caps are standard.

Tolerable Maximum Gap Values:

b [mm]	5	10	15	20	30	40
s [mm]	0,4	0,6	0,8	1,0	1,2	1,3

The gap width s is defined as half of the actual existing gap. Please see drawing below.



In a new design the gap should be chosen as small as possible. Please refer to the recommended tolerances in the table below. Vessel manufacturer is responsible for design and tolerances.

Diameter d_2	Tolerance field d_G/d_V
$d_2 < 500$ mm	D9/h8
$d_2 > 500$ mm	E8/h8

For easier installation the cover plate can be sloped 1 to 2 degrees (see drawing).

Cross sections for high-pressure seals for cover plates, closures and valves are usually of rectangular shape. Sloped gaskets are also available. Two proven profile styles and seven assembly types are available to solve all gasketing challenges. Other lamellae materials are available upon request. The cover plate bolts provide the necessary pre-deformation to adapt the gasket to sealing surfaces.

Weight and location of the cover plate should be taken into consideration when sizing the bolts.

Depending on gasket profile and geometry a suitable seating stress, respective of the internal process pressure, is necessary to achieve the minimum necessary deformation.

The necessary inner pressure for a self-sealing connection is called p_{krit} :

$$p_{krit} = K \cdot \left(1 - \frac{d_1}{d_2} \right)$$

Where d_1 = inner diameter and d_2 = outer diameter of the gasket. The factor K was determined by tests and is listed in the table "Styles of High-Pressure Seals for Cover Plates, Closures and Valves" on the following page.

The maximum allowable operating or test pressure can also be estimated in using p_{krit} . Very important are the specified tolerances and whether the gasket is equipped with anti- extrusion caps (pressed or machined) or not.

Design recommendations:

Pressure	Assembly Type
$p_{max} \leq 3 \cdot p_{krit}$	without anti-extrusion caps
$3 \cdot p_{krit} < p_{max} \leq 6 \cdot p_{krit}$	with pressed anti-extrusion metal caps
$6 \cdot p_{krit} < p_{max} \leq 12 \cdot p_{krit}$	with solid machined anti-extrusion metal caps

For sufficient seating stress the initial seating force can be calculated as follows:

$$F_{sv} = \frac{d_2^2 \pi}{4} \cdot \frac{p_{krit}}{2}$$

Depending on operating conditions higher or lower seating stress values may be appropriate.

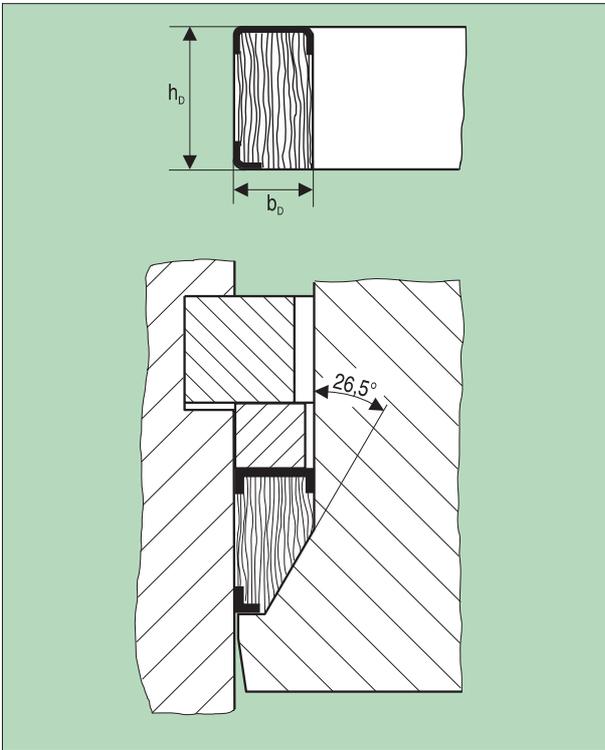
Graphite Cover Plate Gaskets

Gasket design and material								R _z * [μm]
Graphite ring, profile series P70 chemically pure expanded "RivaTherm" graphite	P71	P71K	P71KL	P74	P74K	P75	P75K	12,5 bis 25
K value [N/mm ²]	100	110	90	70	80	70	80	
Graphite ring, RivaTherm graphite, reinforced with 1.4541 (AISI 321) lamellae.	P81	P81K	-	P84	P84K	P85	P85K	
K value [N/mm ²]	120	130	-	80	90	80	90	

The material of metal caps is: 1.4541 (AISI 321). Other materials are available upon request.

*Recommended height flange surface finish peak to valley.

1) Using packing sets consisting of two or more rings the inner anti-extrusion caps can be omitted. Please specify your requirements.



Profile P71KL with a U-shaped and a L-shaped pressed or machined metal cap has proven very successful at high pressure. The cover plate is beveled 26.5 degrees extending to half of the gasket width. During installation the gasket ring adapts to the beveled shape and compresses, mainly radially, about 12%.

Advantageous is that all gaps are protected with anti-extrusion caps.

Style P71KL combines the advantages of the beveled ring and the rectangular ring: low initial seating forces and is easy to dismantle especially in regards with high pressures and large diameters.

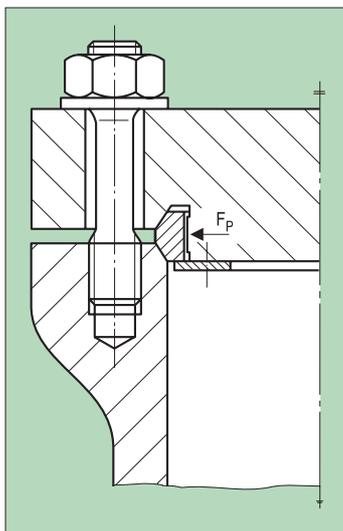
Vessels of 720 mm I.D. and 770 bar test pressure are operating very satisfactorily. Larger diameters of more than 1000 mm I.D. are operating at 500 bar. These are only a few of the thousands of examples where cover plate gaskets have been proven to be safe and reliable. For maximum sealing performance h_D must be specified as $h_D = 2 \cdot b_D$.

All rings are die formed. Tools in diameters of a few millimeters to more than 1000 mm are available. Since we are continuously adding more tools it is not possible to list every available size. Please contact us with your application and we gladly will advise if the tool is available or a tooling charge will be necessary.

Double-Cone Gaskets

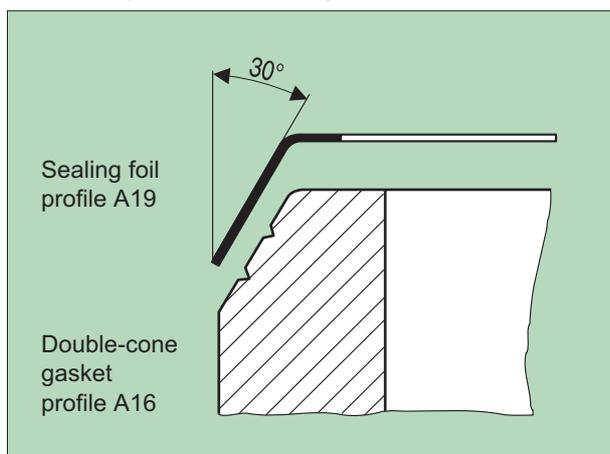
Double-cone gaskets are radially energized by the bolt forces like a toroidal spring. Generally an initial seating stress of 1/3 to 1/5 of the test pressure is sufficient to achieve initial sealing. A defined gap between cover and gasket prevents gasket overloading. After bolting up, the gasket initially contacts the inner side of the cover plate. While pressurizing the vessel the internal process pressure widens the gasket elastically and provides a reliable seal for all operating conditions.

Our advisory service gladly calculates and verifies the optimal dimensions for your double-cone gasket application. The drawing above depicts the design principle.



Double-cone gasket dimensions are not standardized. We manufacture gasket rings up to 3200mm diameter. Sealing surfaces are conical with an inclination of $\alpha=30$ degrees. Inclinations of $\alpha=30$ degrees are typical, but not always suitable for every application.

To keep the sealing foils in place two or three conical grooves, a few millimeters wide and a few tenths of a millimeter deep, are machined on each conical surface. Sealing foils can improve the initial sealing behavior. The thickness of the foils should be below 1mm. Aluminum, copper, nickel and silver foils of 0.5mm to 1mm thickness have been proven successfully.



Foils with larger diameters cannot be manufactured of one piece and must be welded.

The thickness of the weld seems differs slightly from the foil thickness (+0.1mm / -0.05mm).

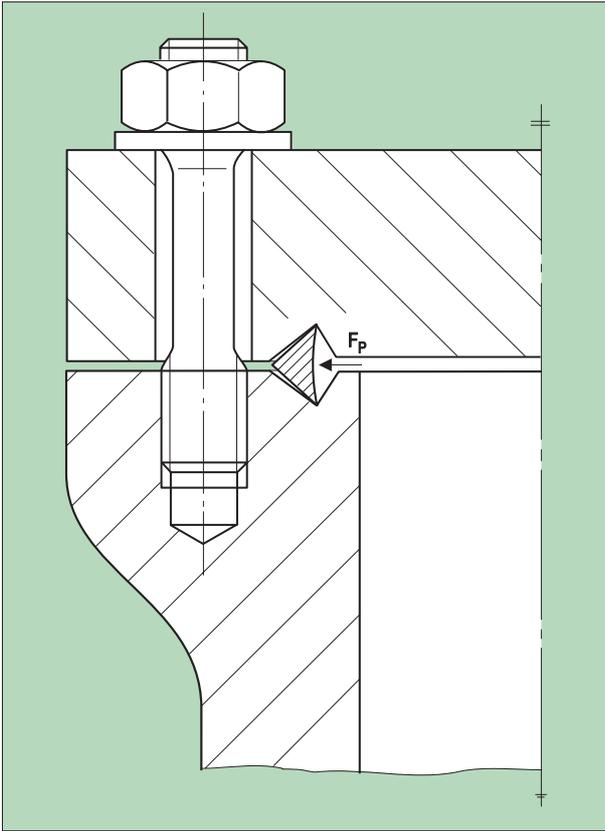
The profile AR16 has convex sealing surfaces. The convex profile has proven successful for applications where the gasket is subject to strain and bending. For these applications no soft material sealing foils are permitted.

Profile	Cross Section	Material	k_0 [mm]	k_1 [mm]	R_z^* [μm]
A16		steel	-	-	1,6 to 3,2
AR16		steel	-	-	
A19		Cu, Ni,	b_D	b_D+5	3,2 to 6,3
		Al, Ag			6,3 to 12,5

* Recommended maximum peak to valley height of flange surfaces

Delta-Gaskets

Due to their geometrical shape delta-gaskets require accurate sealing grooves. Delta-gaskets are used in high-pressure autoclaves only up to 2000mm diameter. Because of the extremely demanding manufacturing requirements on accuracy most of the applications are for diameters below 1000mm. The below drawing depicts a cover plate application.



The result of the wedge profile is an excellent initial sealing behavior. The opposite tips get plastically deformed by the bolt forces and seal metallicly. The internal pressure widens the gasket radially and creates the self-sealing principle.

Profile	Cross Section	Material	k_0 [mm]	k_1 [mm]	R_z^* [μm]
A15		steel	-	-	1,6 to 6,3

* Recommended maximum peak to valley height of flange surfaces,

Delta-gaskets are not suitable for pulsating pressures. Additional sealing foils are not common and not recommended. Delta-gaskets are manufactured of seamless rings. The gasket material should possibly be softer than the flange material. Therefore the fatigue rupture strength of the material of construction must be considered. The gasket thickness is only slightly higher than the total groove depth. For refurbished sealing grooves, therefore, a new gasket with increased thickness must be installed.

We gladly manufacture Delta-gaskets from all common materials of construction and according to customer specifications. Please see our leaflet "Material in Current Use".

All information and technical descriptions contained in this brochure correspond to our state of knowledge at the time of the printing. They are intended as information about our products and their various applications. Therefore, we will only guarantee certain attributes described in the brochure or the suitability for actual intended purposes according to a written express warranty in the actual individual case. Any industrial proprietary rights must be observed. Orders will only be accepted and completed under our standard terms and conditions, which we will make available on request.

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