KLINGER Kempchen

GASKETS
PACKINGS
COMPENSATORS

www.klinger-kempchen.de

INTRODUCTION

KLINGER Kempchen means…

… EXPERIENCE
Know-how · Continuity · Professionalism

KLINGER Kempchen is a thoroughly reliable company, distinguished by its consistency in quality and service. With the knowledge we've gathered over the years, we can offer well-developed solutions for any specific client requirement in the area of sealing technology.

Our objective, up-to-date expertise and practical problem-solving competence is what makes us the preferred partner for discerning clients. The Kempchen brand stands for confidence in thought and action..

… TRUST
Close contact · Clarity · Reliability

Our brand stands for nearness. Human proximity and an understanding of individual needs determines our relationship with clients and partners.

We work for and with the client to develop the best solutions for each individual requirement. We operate on the basis of our clear and proven convictions. We therefore represent a consistently reliable partner – even in times of rapid change.

Our total reliability provides the foundation for a close, confident partnership. It's this partnership which forms the basis for our continued success.

… LEADERSHIP
Commitment · Performance · International presence

KLINGER Kempchen is the leading market expert in static sealing technology. Our advanced service and e-logistics allow us to operate successfully at an international level.

We are determined to further consolidate our leading position and international market presence as part of the KLINGER Group.

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COMPANY PROFILE

01

Leading in static sealing technology

Since the establishment of our company in 1889, we have made a significant contribution to the advancement of sealing technology with the development of our gaskets, packings and compensators. This is a tradition that we continue to this day. Thanks to the years of technical knowledge available to us, we can offer clients not just standard solutions, but individually-tailored system solutions. Our clients can take advantage of this added value every day.

The quality of a product is determined by the materials used to make it. We only use approved materials which have also undergone continuous quality control in a modern chemical and physical laboratory.

All test results are documented and linked to the relevant batch. We keep the most commonly-used materials in our semi-finished products store, so our clients can always be supplied quickly.

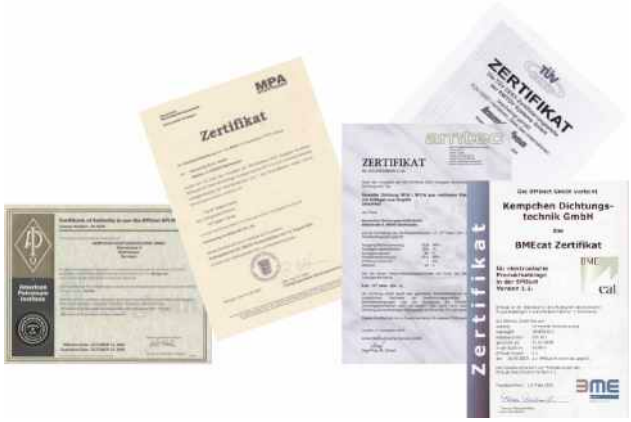
On request, we and our distribution partners can keep many standard and non-standard dimensions of our products in an extensive buffer stock. Our warehouse holds a range of more than 17,000 different articles in a variety of shapes and sizes.

The most modern machines and facilities guarantee that our products are produced to a consistently high standard – quickly and efficiently.

Consulting engineers plan the sealing system for the client and calculate the necessary bolt loads for complex connections, in order to ensure the highest and safest level of system availability.

In order to beat the usual delivery times, we support our clients with assembly and production control on-site, on their own premises. The control system is managed by a specialized team based in its own self-contained premises, with online access to the head office.

In order to meet demand, we keep a variety of quality marks, registrations, permits and certificates in stock. Numerous subsidiaries and partner companies both at home and abroad work with us in our efforts to meet the expectations and demands of the market.



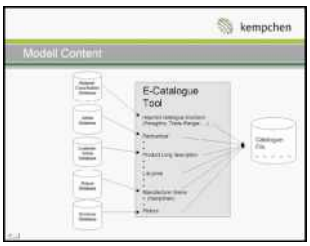
Expertise in static sealing technology

The close contact we have had over the decades with clients through our distribution partners and field staff – beginning right from the planning phase – means we can offer a significant contribution to solving problems.

What really stands out in this service is our expertise in the field of static sealing technology – especially when gaskets are used at high pressures and with critical media.

COMPANY PROFILE

Reducing costs along the supply chain



A number of years ago we started a project called "Reducing costs along the supply chain".

This offer was met with a huge positive response from our clients. Initially it was taken up mainly by larger clients, but increasingly it has found favour with clients from medium-sized businesses.

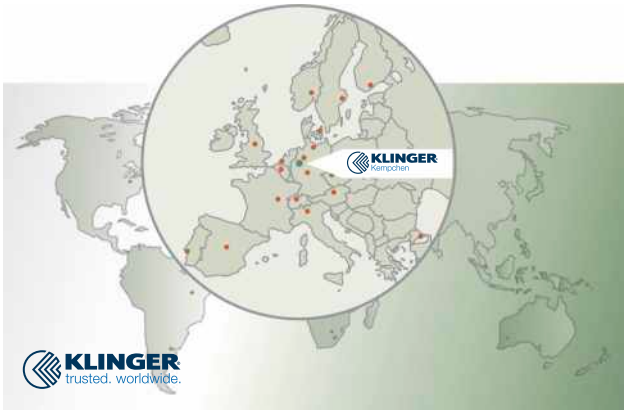
This is an area where we can offer great flexibility. This is because the focus is not on communications, but on the buying process. From telecommunications to the creation of stock lists in client-customized web shops, we've found numerous ways of creating solutions. By working closely with clients and focussing on the specifications required, we bring all projects to a successful resolution.

Today we are one of the leading companies to offer this service.

Worldwide support

Since January 2004, we have been a member of the KLINGER Group, which are integrated into a worldwide distribution network.

This allows us to provide the service our clients are accustomed to on a worldwide basis, making use of a range of high-performance, expert service providers.



FROM LABORATORY INTO PRACTICE

01

The way to high-quality flange connections

Certificates and characteristic values do not state anything about the leak proofness of the flange connection under mounting conditions.

This knowledge gets more and more established. The under laboratory conditions determined gasket values, especially the leakage classes, can be a starting point for calculations, in order to choose the correct gasket. But to get a high-quality flange connection you have to regard the whole situation.

The VDI guideline 2290 (coming into force from June 2012) describes the procedure in order to create a high-quality TA-Luft compliant flange connection.

But not only for flange connections in the scope of TA-Luft the following rules are valid: only if you consider all aspects, you can get a secure sealing.

Among these are:

» the involved components, like screws, adjacent equipment, flange, especially the state of the flange surface

» the to be sealed media

» the preferred sealing method, e.g. KHS/KNS, metallic gaskets, or similar

» the gasket values

» the preferred calculation method for the determination of the screw force

» the security of constant quality of sealing products

» the planned tightening method

» the qualification of the fitters on site

» the planned way of maintenance and the monitoring possibilities

Different ways of sealing might be necessary under the same working conditions due to different auxiliary conditions.

Example: In a pipe line DN1000 ground water shall be transported under 15 bar internal pressure. The temperature varies between - 15 °C and + 60 °C.

A rubber steel gasket in direct force (KHS) shall be used.

In the first scenario you can revert to trained fitters. The screw forces can be calculated based on approved calculation methods e.g. EN1591 -1. The screw force is applied with a controlled/ steered tightening method. The pipe line is easy accessible and is inspected and maintained after a defined servicing plan.

In the second scenario you have to get back to staff that is available on site and had no training for mounting of flange connections. The given/ available tools lead to inexplicable screw forces. The flanges and screws were designed with a lot of safety. The pipe line is not regularly inspected. A service is not planned.

The analysis of the scenarios leads to different gasket types. While the first scenario requires a rubber steel gasket, the second requires the gasket type WL.

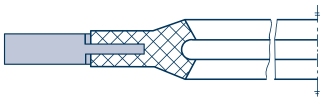


Image Type WL

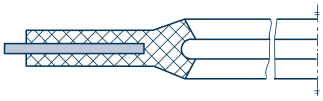


Image Type WS

The gasket type WL enables a secure sealing even under the conditions described in the second scenario. Due to the construction a rubber fold of the rubber lip is not possible. The staff on site shall get the task to tighten the screw as long as they produce a metal-to-metal contact between the flange and the metallic ring of the gasket.

The gasket type WS would possibly be rubber folded under such uncontrollable mounting conditions. Sooner or later this would lead to a leakage.

Media consistency

Media consistency provides the basis of a best possible sealing.

A long media consistency list of the producer provides the correct choice of the sealing material. Here you have to take into consideration that not only the media but also the concentration, the media mix and the working temperature can lead to damages.

FROM LABORATORY INTO PRACTICE

In case of doubt examinations in chemical laboratories, e.g. at KLINGER Kempchen, can give confirmation of the media consistency.

A wrongly chosen sealing material that cannot withstand the media increases the leakage rate and leads to an insecure flange connection in service.

Kind of sealing

Gaskets are given in countless variations. You can divide them into rough classifications:

» tongue/ groove gaskets, e.g. A24, A22

» metallic gaskets, e.g. RTJ, H15

» metal-soft-gasket, B9A

» soft-gaskets, A1 Klingersill C4400

» self-sealing gaskets, AR13

Which kind of gasket is usable in the specific case can be determined by respective analysis. Here it is helpful to involve the gasket producer into the decision and construction process at an early stage.

Determination of gasket values

What relevance do gasket values have in practice?

You have to differentiate between the in the past used values σ_V und σ_{max} and the values $Q_{Smin\ (L)}$, Q_{MIN} and Q_{MAX}.

While the Q_{MAX}-value is still comparable with the σ_{max}-value, the two others differ considerably.

Because these two values consider the expected leakage, given in leakage classes (mg • s-1 • m-1).

In the daily business one is frequently confronted with the „old“ values.

Example: For spiral wound gaskets applies the σ_V (= predeformation) value of 50 MPa. Therefore it is recommended to apply 50 MPa on the gasket during mounting, in order to receive the requested adaption on the flange. According to the gaskte values EN 13555 [4] you would reach a visible tightness at Q_{min}=16 MPa, at p = 40 bar helium.

Both is correct: When looking at the table values accurately you will find the 50 MPa between the leakage class L0,001 and L0,0001 for Q_{min}.

But as well it applies:

When announcing and processing the current value according to DIN EN 13555 you have to consider that these values as well are no absolute values.

The leakage values are determined by means of different pressure levels. Interim values can be interpolated.

The relaxation behaviour of gaskets, respectively the flow behaviour is described with the PQR-value. Thereby the gasket is impinged with a certain surface pressure. Then the gasket is heated up and kept onto a determined temperature.

The gasket relaxes under such conditions. The subsequent thickness reduction leads to a decrease of surface pressure.

The relation of the finishing and starting value results in the loss factor (non-dimensional).

Normally E-modules of materials are given for different temperature levels. For gaskets the data field is broadened with the dimension of surface pressure. Gaskets often have a layered structure, e.g. metal folios alternate with soft materials. This heterogeneous structure leads to the fact that the layers do not behave in a constant, linear way; the layers slump down or harden. This leads to the fact that the particular needed E-modulus value has to be taken from the table for the particular temperature and surface pressure.

When determining the E-modulus the gasket is charged and discharged in defined steps. Thereby the thickness change is minuted. If the thickness reduction is noticeable, the previous surface pressure is determined as $Q_{Smax.}$

FROM LABORATORY INTO PRACTICE

01

Calculation of the necessary screw force

The gasket values are the basis of the calculation according to EN1591-1. But they cannot be used to compare gaskets with each other. Single values do not have any validity. As an example, the surface pressure values and the leakage examinations shall be mentioned. Two gasket types with different operating sealing width require different screw forces at the same surface pressure. A comparable overall view of gasket values can also not be used as the basis of decision.

It is for instance not possible to estimate which effective sealing width results in the flange. The eversion of the flange sheets depends on the ceasing lever arm length. These in turn depend on the behaviour of the gasket when mounted. Because this behaviour is based on the complex interaction of the single components.

Currently the calculation according to DIN EN 1591-1 is the only possibility to compare gasket systems with each other.

NB: The calculation according to DIN EN 1591-1 is only one possibility to make an abstract comparison. Reality is not pictured. Even complex FEM calculation cannot show an exact picture of the reality.

Constant quality of gasket products

As soon as the gasket is taken out of the box the fitter is responsible for the professional handling. Although the fitter can influence the functionality of the flange connection he cannot make any conclusions on the functionality of the gasket itself. Only rough deviations, e.g., a kink in the graphite sealing gasket, can be recognized. The material itself does not show anything.

This is especially noticeable with gasket types where the main gasket functions are internal.

It is for instance not noticeable if a spiral wound gasket was coiled with the necessary tension.

If the coil is too tight, the gasket cannot align at the flange surface optimally. If the coil is too loose, it can lead to an over pressure or destruction of the gasket when a high surface pressure is needed.

In the laboratory the characteristic values which are the basis of the interpretation of the calculation are determined. This values/ parameters are determined with gaskets which correspond to the batch.

The user, the person who calculates and the fitter have to be sure that the parameters are not only valid for the laboratory samples but also for the batch products.

For each gasket type there are features which are important for the gasket values.

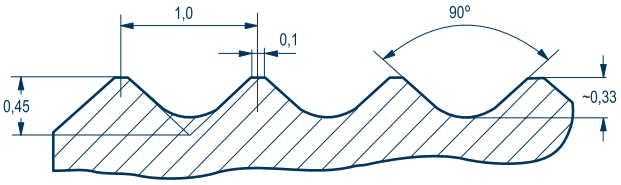
For gasket types the following features are decisive:

» Kammprofil: Shape of the combs, plane parallelism of the opposite sealing surface.

» Spiral wound gasket: Number of coil and coil tension

» Corrugated metal gasket: Shape of the waves

» Flat gasket: Material composition



Kammprofile have to be equipped with a geometrically very precise manufactured contour profile in order to ensure exact sealing.

FROM LABORATORY INTO PRACTICE

Mounting/ Assembling

According to VDI 2200 “Assembling is more than the last step in order to mount the preload forces and to realize the flange connection. It is also an important part of the quality assurance and management. As consequence to the rising requirements on the flange connection the requirements on the fitters rise as well (…)”.

Only trained staff can meet these requirements.

With the coming into force of the fourth part of the DIN EN 1591-4 the operators get a unified set of regulations for the training of fitters.

It is possible to choose the fitting staff according to individual assembling competences.

In a lot of cases it has shown that great potential is in choosing the tightening method. The optimal gasket for the concrete case of application does not help if the tightening method is inappropriate.

It is correct: The most complex the sealing problem is, the more high-grade the tightening method must be.

While it is sufficient to mount a 2" water pipe with a torque wrench, an apparatus flange with a big diameter shall be mounted with a hydraulic tightening method.

Summary

Gasket producers are, based on the parameters according to DIN EN 13555 as well as calculation according to DIN EN 1591-1 in the position to optimize the sealing material and profiles, in order to allow a low leakage in service. But not only the optimization regarding the leakage rate is targeted. It is rather the interaction of the single components and the whole process from production of the gasket to the assembling which has to be adopted.

As manufacturer/processor of the various sealing materials which are available on the market, KLINGER Kempchen offers a number of possible, best-adapted gaskets and sealing systems.

The thereby resulting testing procedure is rather enormous but it provides the possibility to choose the technically better products.

Further product developments will follow. The gasket as a component will be more intelligent, safer and most of all tighter in future.

Not only quality and choice of the gasket are essential.

We as well try to meet the needs of our customers regarding availability of the different material and composition of the gaskets with innovative logistics concepts.

An essential point of our logistics concept is to be near our customers by means of a variety of sites, like in Germany cities like Ludwigshafen, Wesseling, Leuna, Geestacht, Schwedt and last but not least Oberhausen.

At each of these sites well-trained and qualified staff is located and required machinery is available which offers higher flexibility. At each site we have individual stocks with standardized and non-standardized measurements which meet the needs of our customers.

As well our mobile standard concepts for temporary support of bigger projects, like stand still time, turnarounds or new projects have proved well in the last 15 years. Our experienced revision team ensures a high availability during the whole process time of big projects.

FROM LABORATORY INTO PRACTICE

01

In order to keep administrative processes as efficient as possible, we have supported all common IT systems and market places in recent years to optimize procurement processes. Electronic data exchange as well as the creation of electronic catalogues in different languages are our standard today.

In order to meet all quality requirements of the different branches, we continuously invest in our quality assurance systems and the improvement of single processes.

So today we have the following licenses as well as a number of product licenses:

» DIN EN ISO 9001

» DIN EN ISO 14001

» DIN EN ISO 18001

» DIN EN ISO 50001

» API 6A

» RAL for compensators

» KTA1401

KLINGER Kempchen is a member of the independent cooperations of the KLINGER Group since 2004. This gives us the possibility to widen our local support onto a worldwide net of services and distribution. Embedded in this network of competent partners, Kempchen is a strong and international partner in a worldwide working network of services.

It is our task to find:

General solutions, to have the overall view onto the sealing system regarding the given conditions of our customers as required.

SEALING CONNECTIONS

Flat gaskets

Our flat gaskets include those made from soft materials or metal, as well as those made from a combination of metal and soft material winded, layered or jacketed.

This variety in our gasket construction allows us to meet different requirements in softness, stability and price. The pressure required to be sealed is not the only factor to be considered when selecting the type of gasket and material. Medium, temperature and installation location - the type of flange, the surface texture of the seal etc. - as well as the available bolt load, all have to be taken into consideration when making the selection.

Roughness of sealing surfaces

The surface roughness of a component is frequently determinative of the efficiency of the part itself; but irregularities in shape and position can also influence this. With the regard to the terms used, there is sometimes confusion even among experts - although the definitions and basic specifications are clear.

When specifying the relevant values, care must be taken to ensure that these are meaningful and can be verified. Further difficulties arise from the application of differing regulations (standards).

For sealing connections, it is important to ensure, that the paired components fit and join correctly as well as also be seal against each other. In order to achieve satisfactory leak-tightness, the existing surface roughness must be filled with sealing material. Malleable soft materials are better at filling large valleys of roughness than metallic materials. The disadvantage of using soft materials, however, is that these have a relatively low internal strength and can be blown out more easily under high internal pressure. For this reason the thickness of the soft materials should be kept as low as possible. To achieve reproducible results, particularly with gaskets with soft-material layers, it is necessary to check the roughness of the flange sealing surfaces when determining the thickness of the layers.

With gaskets and their associated sealing surfaces, the requirements in terms of surface roughness and deviations in position and shape depend on the type of gasket in question, the materials used (gasket and sealing surface) and the operating conditions. Even the type of load, in other words, whether it is a static or dynamic load on the gasket and sealing surface, will give different values. The following remarks apply only to statically-loaded gaskets in bolted flange connections.

Surface roughness of gaskets

With soft-material gaskets and metal/soft-material gaskets (with the exception of metal jacketed gaskets), the influence of surface roughness of the gasket on the functionality of the gasket itself is negligible. Deviations in position and shape of the sealing surface can be regarded as non-critical in the gaskets currently on the market; on the other hand, deviations in position and shape in flange sealing surfaces have a significant influence on the functionality of the connection, depending on how it is being used.

In metal gaskets and metal/soft-material gaskets with metal jacket, the surface roughness and, in some cases, (depending on the type of gasket) deviations in the shape and position of the sealing surfaces, each have an influence on the behaviour of the seal. The same is true of flange sealing surfaces.

Surface roughness of flange sealing surfaces

Due to the manufacturing and production process, as well as the sealing materials and types of seals, deep surface roughness had previously been preferred. This makes sense from a technical point of view if, for example, you need to prevent a soft-material gasket from being blown out by internal pressure.

But these large valleys of roughness can actually be a disadvantage with metal/soft-materia l and metal gaskets which, due to their design and dimensions, tend only to be used with connections that are insufficiently tightened or which are being blown out by internal pressure. This can be critical, particularly in gaskets which have overlays, as the extremely large valleys of roughness are not taken into account when determining the thickness of the overlay. Tests carried out on flanges of type Form C and on grooved gaskets, with a roughness depth in the range of 70 µm < Rz < 90 µm, show that sealing behaviour improves partially with increased roughness. There are, however, no stated reproducibility criteria for the tests. The improvement in sealing behaviour can possibly be traced back to the interaction between the metal contact of the seal support and the roughness of the flange. For a roughness depth of Rz = 160 µm as allowed in DIN 2526 edition March 1979 type C not any test results are available. According to EN 1092, the roughness depth of flange sealing surfaces can fall within the range of 3,2 µm < Rz < 50 µm.

SEALING CONNECTIONS

The most important thing to note is that the inner strength of the gaskets must increase as the roughness depth decreases, in order to avoid a situation where the gasket can be easily blown out by low friction forces as a result of inadequate installation.

For soft-material gaskets, surface roughness depths in the range of 25 µm < Rz < 100 µm is proven. The maximum roughness depth of Rmax = 100 µm should only increased, it higher safety against blow out is requested. As previously mentioned, in such a case the thickness of the soft material and the roughness depth of the flange sealing surfaces must be adapted against each other.

The surface roughness depth of the flange sealing surfaces should be located within the range of 12,5 µm < Rz < 100 µm for metal/soft-material gaskets. Exact statements are contained in the sections on gaskets.

For metal gaskets the values given in the sections have to be met.

The specifications on roughness depth alone do not fully describe surface consistency, as the production process also has an effect on its behaviour. A surface with a “stock finish” has a better sealing effect at the same Rz value than a surface manufactured with a pointed cutting tool.

Determining the effective sealing width

The theoretical determination of the width of the sealing surfaces (bGe) is difficult and impossible to carry out exactly, due to the various different parameters that can influence it. Assuming that on flat gaskets the total compressed sealing area is evenly distributed, then the sealing surface width of flanges, flanges with male and female faces as well as flanges with tongue and groove faces can be represented by $b_{Ge} = (d_e - d_i)/2$, where (d_i)is the internal diameter and (d_e) is the external diameter of the gasket.

On flanges with raised face, the gasket is only compressed from the internal diameter (d_i) to the raised face diameter (d_4), so that the sealing surface width can be represented by $b_{Ge} = (d_4 - d_i) / 2$. The raised face diameter (d_4)* can be read from the following tables.

For metal/soft-material gaskets e.g. grooved or spiral wound gaskets, it is important to ensure that the gasket only has a bearing in a limited area. Only this area should be taken into account when calculating the sealing surface width.

SEALING CONNECTIONS

External diameter (d_4) in flanges with raised face in accordance with DIN(EN).

	PN											
DN	1 u. 2,5	6	10	16	25	40	63	100	160	250	320	400
10	35	35	40	40	40	40	40	40	40	40	40	40
15	40	40	45	45	45	45	45	45	45	45	45	45
20	50	50	58	58	58	58	-	-	-	-	-	-
25	60	60	68	68	68	68	68	68	68	68	68	68
32	70	70	78	78	78	78	-	-	-	-	-	-
40	80	80	88	88	88	88	88	88	88	88	88	88
50	90	90	102	102	102	102	102	102	102	102	102	102
65	110	110	122	122	122	122	122	122	122	122	122	122
80	128	128	138	138	138	138	138	138	138	138	138	138
100	148	148	158	158	162	162	162	162	162	162	162	162
125	178	178	188	188	188	188	188	188	188	188	188	188
150	202	202	212	212	218	218	218	218	218	218	218	218
175	-	-	-	242	248	260	260	260	260	-	260	-
200	258	258	268	268	278	285	285	285	285	285	285	285
250	312	312	320	320	335	345	345	345	345	345	345	-
300	365	365	370	378	395	410	410	410	410	-	-	-
350	415	415	430	438	450	465	465	465	-	-	-	-
400	465	465	482	490	505	535	535	-	-	-	-	-
500	570	570	585	610	615	615	-	-	-	-	-	-
600	670	670	685	725	720	-	-	-	-	-	-	-
700	775	775	800	795	820	-	-	-	-	-	-	-
800	880	880	905	900	930	-	-	-	-	-	-	-
900	980	980	1005	1000	1030	-	-	-	-	-	-	-
1000	1080	1080	1110	1115	1140	-	-	-	-	-	-	-

Dimensions in mm

External diameter (Øg) in flanges with raised face in accordance with ANSI/ASME 16.5

	class
NPS	150 to 2500
½	35,1
¾	42,9
1	50,8
1¼	63,5
1½	73,2
2	91,9
2½	104,6
3	127,0
3½	139,7
4	157,2
5	185,6
6	215,9
8	269,7
10	323,9
12	381,0
14	412,7
16	469,9
18	533,4
20	584,2
24	692,2

Dimensions in mm

External diameter (Øg) in flanges with raised face in accordance with ASME B16.47. Series A

	class				
NPS	150	300	400	600	900
26	749,3	749,3	749,3	749,3	749,3
28	800,1	800,1	800,1	800,1	800,1
30	857,2	857,2	857,2	857,2	857,2
32	914,4	914,4	914,4	914,4	914,4
34	965,2	965,2	965,2	965,2	965,2
36	1022,3	1022,3	1022,3	1022,3	1022,3
38	1073,1	1028,7	1035,0	1054,1	1098,5
40	1123,9	1085,8	1092,2	1111,2	1162,0
42	1193,8	1136,6	1143,0	1168,4	1212,8
44	1244,6	1193,8	1200,1	1225,5	1270,0
46	1295,4	1244,6	1257,3	1276,3	1333,5
48	1358,9	1301,1	1308,1	1333,5	1384,3
50	1409,7	1358,9	1362,0	1384,3	-
52	1460,5	1409,7	1412,8	1435,1	-
54	1511,3	1466,8	1470,0	1492,2	-
56	1574,8	1517,6	1527,1	1543,0	-
58	1625,6	1574,8	1577,9	1600,2	-
60	1676,4	1625,6	1635,1	1657,3	-

Dimensions in mm

External diameter (Øg) in flanges with raised face in accordance with ASME B16.47. Series B

	class					
NPS	75	150	300	400	600	900
26	704,9	711,2	736,6	711,2	726,9	762,6
28	755,7	762,0	787,4	762,0	784,4	819,2
30	806,5	812,8	844,6	819,2	841,2	876,3
32	857,3	863,6	901,7	873,3	895,4	927,1
34	927,1	920,8	952,5	927,1	952,5	990,6
36	992,1	971,6	1009,7	980,9	1009,7	1027,8
38	1042,9	1022,4	1060,5	-	-	-
40	1093,7	1079,5	1114,6	-	-	-
42	1144,5	1130,3	1168,4	-	-	-
44	1203,5	1181,1	1219,2	-	-	-
46	1225,6	1234,9	1270,0	-	-	-
48	1276,4	1289,1	1327,2	-	-	-
50	1327,2	1339,9	1378,0	-	-	-
52	1378,0	1390,7	1428,8	-	-	-
54	1428,8	1441,5	1479,6	-	-	-
56	1479,6	1492,3	1536,7	-	-	-
58	1536,7	1543,1	1593,8	-	-	-
60	1587,5	1600,2	1651,0	-	-	-

Dimensions in mm

In ANSI and ASME standard flanges the symbol of the raised face diameter is: g

GASKET PROFILES

02

Soft-material gaskets 03

Flat gaskets made from graphite, fibre, PTFE, elastomer

without / with rim Page 21 to 29

Profile	Cross-section
A1	 Soft material
	 RivaTherm Super with plain sheet metal (laminated)
	 RivaTherm Super with tanged sheet metal
	 RivaTherm Super Plus
	 RivaTherm HD
CA1	
F1	 Soft material
	 RivaTherm Super with plain sheet metal (laminated)
	 RivaTherm Super with tanged sheet metal
	 RivaTherm Super Plus
	 RivaTherm HD
	 Egraflex Steelflon Waveline WLP®

Flat gaskets Top Flat Gasket (TFG)

Page 27

Profile	Cross-section
TFG 9A	 Metal-Graphite

Flat gaskets made from graphite, fibre, PTFE, elastomer

without / with rim Page 21 to 29

Profile	Cross-section
F7	 Soft material

Universal flat sealing strip

PTFE/graphite Page 30 to 32

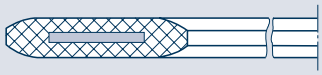
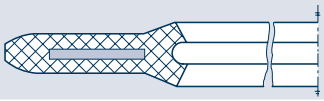
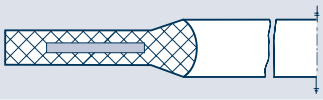
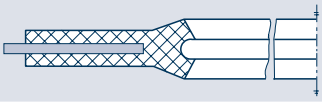
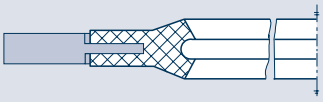
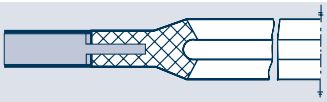
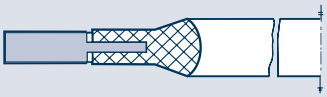
Profile	Picture
TF1	 PTFE strip
GR1	 Graphite strip

GASKET PROFILES

Metal/Soft-material gaskets 04

Rubber-steel gaskets

Page 48 to 59

Profile	Cross-section
WG	
WG2	
WG2P	
WS	
WL	
WL-HT	
KNG	

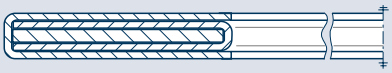
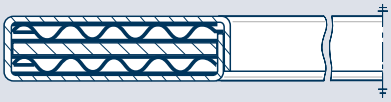
Corrugated gaskets

Page 60 to 69

Profile	Cross-section
W1A	
W1A-3	
W1A-3·F1	
W11A	
W2A	
W12A	

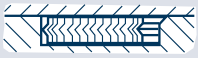
Hot furnace

Page 70

Profile	Cross-section
WAG	
W2AM	
B7M-F1	

Spiral-wound gaskets

Page 71 to 82

Profile	Cross-section
SpV1	
SpV1I	
SpV2I	
SpZ1	
SpZ2	
SpZ2I	
SpFS2I	
SpVNG	
SpZNG	
SpV2I-HT	

GASKET PROFILES

02

Metal/Soft-material gaskets 04

Grooved gaskets

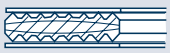
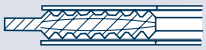
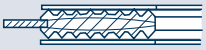
Page 83 to 93

Profile	Cross-section
B7A	
B9A	
B15A	
E7A	

Grooved gaskets

Convex grooved gaskets

Page 83 to 93

Profile	Cross-section
B27A	
B29A	
B25A	
E27A	

Metal jacketed gaskets

Page 94 to 100

Profile	Cross-section
F2	
F3	
F4	
F8	
F10	
F12	
F17	
FW3	

GASKET PROFILES

PTFE-enveloped gaskets 05

Insert: Soft material flat gaskets Page 101

Profile	Cross-section
PF2	
PF3	
PF18	
PF21	

Insert: Corrugated gaskets Page 102

Profile	Cross-section
PWA2	
PW4	
PW5	
PW21	
PW1A-3	

Insert: Grooved gaskets Page 102

Profile	Cross-section
PF7	
PF9	
PF15	
PF27	
PF29	
PF25	

GASKET PROFILES

02

Metal gaskets 06

Metal flat gaskets

Page 103

Profile	Cross-section
A1	

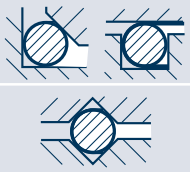
Convex gaskets

Page 103 to 106

Profile	Cross-section
A7	
H7	
H9	
H15	

Round wire gaskets

Page 107

Profile	Cross-section
A10	

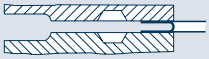
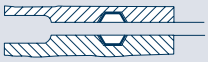
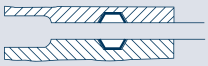
Ring joint gaskets RTJ

Page 108 to 112

Profile	Cross-section
A11	
A12	
A13	
AR13	
A14	

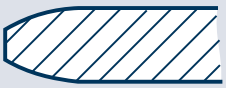
Protective gaskets / compensating caps

Page 109

Profile	Cross-section
F22	
AK11	
AK12	
AK13	
AK14	

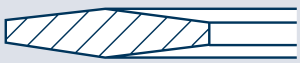
Lens gaskets

Page 113 to 115

Profile	Cross-section
A5	
A5S	
A5BS	

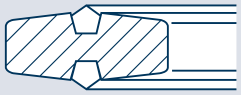
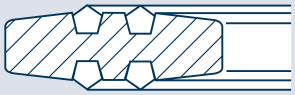
Diamond gaskets

Page 116

Profile	Cross-section
B2	
B3	

H-gaskets

Page 116 to 117

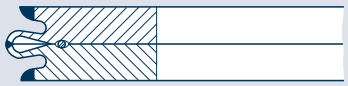
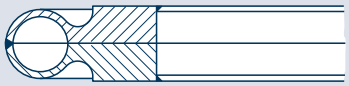
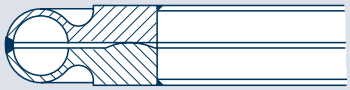
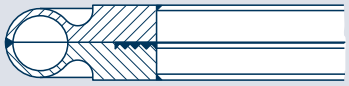
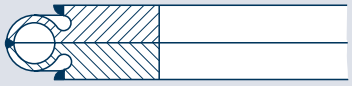
Profile	Cross-section
H5-2 H5-2,5 H5-3	
H5-D2 H5-D2,5 H5-d3	

GASKET PROFILES

Metal gaskets 06

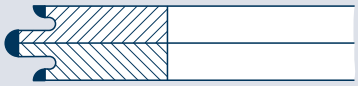
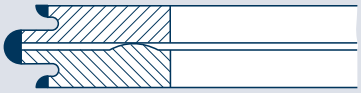
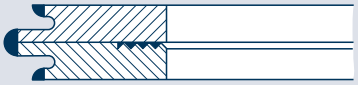
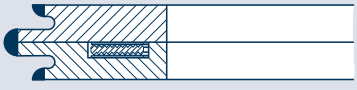
Weld ring gaskets with hollow lip

Page 118 to 130

Profile	Cross-section
A23	
A24	
A24H	
A24K	
A25	

Weld ring gaskets

Page 118 to 130

Profile	Cross-section
A22	
A22H	
A22K	
A22KVR	
A22N	

Weld ring gaskets

Membranes

Page 118 to 130

Profile	Cross-section
A21	

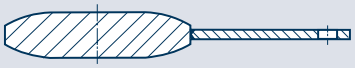
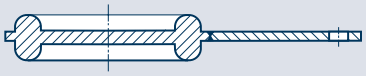
Blind gaskets

Page 131

Profile	Cross-section
A1S	
B7S	
B9S	

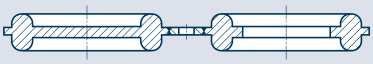
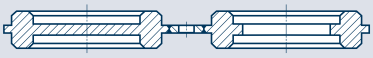
Blind gaskets

Page 131

Profile	Cross-section
A5S	
A11S	
A13S	

Blind spectacle gaskets

Page 131

Profile	Cross-section
A5BS	
A11BS	
A13BS	

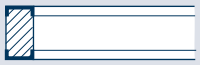
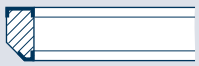
GASKET PROFILES

02

Cover gaskets 07

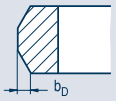
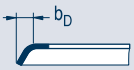
Cover plate gaskets

Page 132 to 133

Profile	Cross-section
P71	
P71K	
P74	
P74K	
P75	
P75K	

Double-cone gaskets

Page 134

Profile	Cross-section
A16	
AR16	
A19	

Delta gaskets

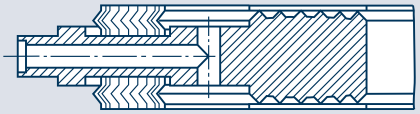
Page 135

Profile	Cross-section
A15	

Special gaskets 08

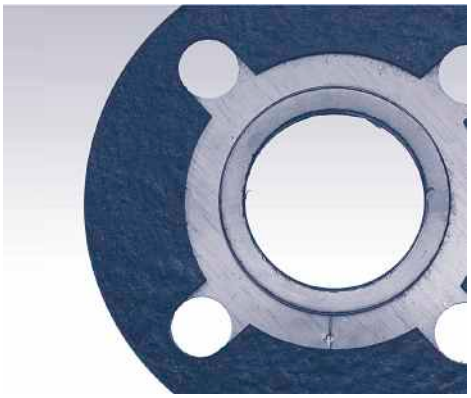
Double sealing system

Page 136 to 139

Profile	Cross-section
HN21A	
HN21H	
HN22A	
HN222A	

Fire Protection

Page 147

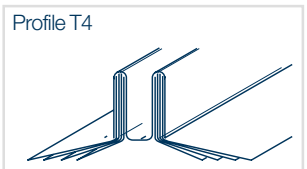


Splatter-shield strip

Page 140 to 141

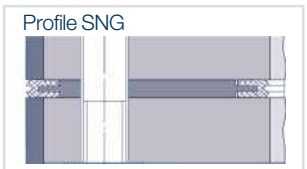
Baffle seals

Page 142 to 143



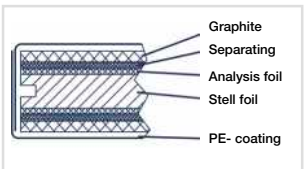
Static Neutral Gasket

Page 144



KemAnalysis

Page 145 to 146



FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Soft-material gaskets are universal sealing elements with a large range of application in all branches of industry. They can be used within a temperature range of - 200 °C up to a maximum of + 550 °C. A suitable material should be selected depending on the medium, medium concentration, temperature and type of flange being used.

We produce flat gaskets in all commonly-used soft materials. See also the section **"Materials commonly used"**. As a general rule, thin gaskets are preferred to thicker ones.

The usual thickness of gaskets is 1; 1.5; 2 and 3 mm. PTFE gaskets should be used in the thinnest size possible due to cold flow.

The surface finish and evenness of the flange should determine the gasket thickness to be used. The better the flange surface, the thinner the gasket can be. Soft-material gaskets require only low seating surface pressure av, but can be more easily overloaded than metal gaskets or metal/soft-material gaskets, especially at narrower gasket widths.

In order to avoid collapse, the sealing surface pressure must be between σ_V and σ_ϑ and the following width/height relationships must be complied with:

Width / height relationships:

Material	$b_G/h_G >$
Graphite with reinforcement	8
Graphite without reinforcement	12
Fibre sheet	10
PTFE	20

If smaller relationships arise due to design considerations, the gaskets must be encased, e.g. using tongue and groove or male/female face flanges. When calculating the assembly bolt load, the reduced stability due to the reduction of the σ_V value must be taken into consideration. The σ_ϑ value is not affected.

Flat gaskets made from soft material are available in ring shape, as frames, as oval gaskets and practically any other special kind of shape. To close the porous interfaces in fibre sheet gaskets (FA) or in expanded flexible graphite or RivaTherm Super, gaskets are rimmed on the inside with a thin metal band.

Gaskets with outer rim made of a thin metal band are used where the media wear comes from the outside. This is the case, for example, with self-sealing manholes, head access hole locks or even in construction apparatus, if internal fixtures need to be sealed. So as to avoid misunderstandings, it must be noted that this gasket profile is not a gasket with a reinforced outer ring, as mentioned in the applicable regulations under "blowout proof gasket with metal outer ring".

Bordering with a thin inner and outer metal band can be useful in preventing the extrusion of the soft sealing material into gaps, as can happen for example when used in flange connections with male and female faces.

It must be taken into account, that the characteristic of gaskets for tongue and groove-according to DIN, EN resp. ANSI standard-with inner and/or outer rim corresponds with a metal jacketed gasket.

» **Profile A1** Flat gasket made of soft material with a rectangular cross-section

» **Profile F1** internal with a thin metal band rim

» **Profile F7** with an internal and external rim of thin metal

Gasket limiting values

Profile			A1	A1	A1	A1	A1	F1	A1	A1	A1	A1
Materials			FA 1 mm	FA 1,5 mm	FA 2 mm	PTFE	Rubber	FA / 1.4541	RivaTherm-Superplain sheet metal	RivaTherm-Super tanged sheet metal	RivaTherm-Super-Plus	RivaTherm-HD
Recommended max. roughness of flange surface	µm	from	50	50	50	50	50	25	50	50	50	50
		to	100	100	100	100	100	50	100	100	100	100
Surface pressure limits for 20 °C	N/mm²	σ_v	40	35	30	15	2	35	10	20	20	20
		σ_ϑ	100	80	60	90	15	60	120	140	160*	290*
Surface pressure limits for 300 °C	N/mm²	σ_v	-	-	-	-	-	-	10	20	20	20
		σ_ϑ	-	-	-	-	-	-	110	120	140*	260*

* Values measured in accordance with DIN EN 13555 at a 20 mm gasket width

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

03

Gasket profiles

with / without rim

Profile	cross-section
A1	 Soft material
	 RivaTherm Super with plain sheet metal (laminated)
	 RivaTherm Super with tanged sheet metal
	 RivaTherm-Super-Plus
	 RivaTherm-HD
CA1	
F1	 Soft material
	 RivaTherm Super with plain sheet metal (laminated)
	 RivaTherm Super with tanged sheet metal
	 RivaTherm-Super-Plus
	 RivaTherm-HD
	 Egraflex Steelflon Waveline-WLP
F7	 Soft material
TFG 9A	 Metal-graphite

RivaTherm products

Gaskets made from RivaTherm Super have a wide range of application. They can be used as pipeline or cover gaskets with corrosive media and at high temperatures. Further they can be used to fit tanks, steam pipelines, existing systems, heating systems, systems with heat transfer oil and non-oxidising melting and exhaust gaskets.

RivaTherm Super laminated, made from expanded graphite and generally having several metal sheet in layers. The lamination is provided by a low chloride and sulphide reaction polymer in a sandwich joint. The joint is free from all cyan and furan bonds. Because of its many layers, the laminate can withstand very high pressures. This is perfectly suited to non-standard gaskets.

Approved for application in the gas industry by the German Association for Gas and Water (DVGW) and with oxygen installations by the Federal Institute for Materials Research and Testing (Manufacturer certificate on the basis of a BAM test report).

» Purity C > 99 % or > 99.85 %

» Low chloride Cl- < 25 ppm or < 20 ppm

» Temperature range - 200 °C to + 550 °C

RivaTherm Super with tanged sheet metal reinforcement and impregnation is a glue-free graphite sheet which is impregnated so as to render the surface completely impervious to damage. The impregnation of RivaTherm Super leads to a significant increase in stability. There is a very low level of lateral deformation. Using impregnated sheet, the leak rate can be reduced by up to two orders of magnitude.

» Graphite purity 99 %

» Low chloride Cl- < 25 ppm

» Temperature range - 200 °C to 550 °C

Approvals and test reports from PAS.

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

RivaTherm Super Plus Type RSP 2S2075-I is a modern sealing sheet. It fulfils all leak-proof requirements in accordance with VDI 2440 and in terms of gasket characteristic values is regarded as a high-value gasket in terms of the TA Luft. The structure of this sealing sheet is based on a glue-free sandwich construction with two modified tanged sheet metal overlays made from stainless steel with alternating arrangements of graphite sheets.

The thickness of the stainless steel inlayer has been reduced by 0.05 mm. As a result the punching and cutting properties of the sealing sheet have been improved. The RivaTherm Super Plus sealing sheet represents a significant further development of the proven range of impregnated RivaTherm Super Type RS 2S110-I.

The adjustment from RivaTherm Super Type RS 2S110-I to RivaTherm Super Plus Type RSP 2S2075-I is made easy by the retention of She gasket characteristic values.

» Graphite purity 99 %

» Low chloride < 25 ppm

» Temperature range - 200 °C to 550 °C

Approvals and test reports:

» TA-Luft

» BAM

» DVGW

» Blow out resistance

» Fire safe

RivaTherm-HD Type RHD 2S3075-I is Kempchen's premium graphite sealing sheet. This impregnated sealing sheet has excellent mechanical properties. Besides its classification as high-value by TA Luft, RivaTherm HD has extremely high stability under load. All the leak-proofing requirements of VDI 2440 are fulfilled.

The thickness of the stainless steel inlayer has been reduced by 0.05 mm. As a result the punching and cutting properties of the sealing sheet have been improved.

Gaskets made from this impregnated sealing sheet fulfil the highest possible demands of system security with regard to pressure, temperature and leak-proof properties.

The structure of the high-strength RivaTherm HD sealing sheet is based on a glue-free sandwich construction with three modified tanged sheet metal inlayers made from stainless steel with alternating arrangements of graphite sheets.

» Graphite purity 99 %

» Low chloride < 25 ppm

» Temperature range - 200 °C to 550 °C

Approvals and test reports:

» TA-Luft

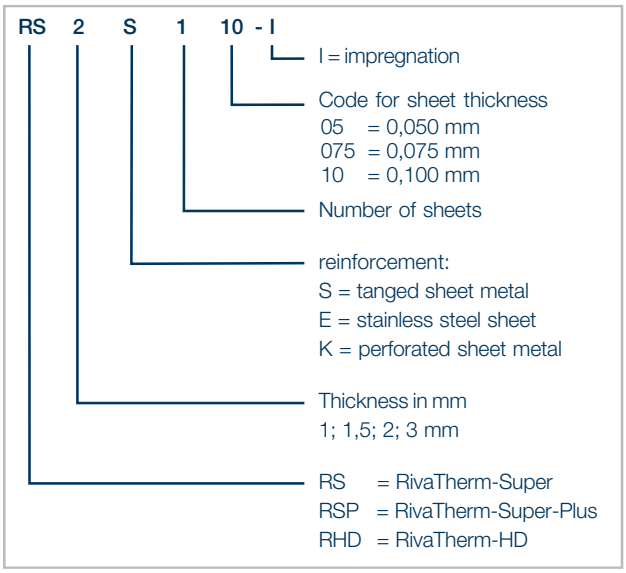
» BAM

» DVGW

» Blow out resistance

» Fire safe

The RivaTherm Super sheet description broadly corresponds with the actual composition of the sheets. The combination of letters and numbers stands for the following:



FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

03

Fibre sheets

The overwhelming majority of fibre sheets (FA) have an operating range limited to 150 °C up to 180 °C. High-quality examples can also be used at higher temperatures.

The sheets are usually made of a natural rubber matrix into which aramide, glass, carbon and/or calcium sulphate fibres are embedded. A wide range of different types are available. All of these different types are designated with "FA" in accordance with DIN 28091-2.

Due to the high demands that are placed on security of the sealing connections as well as the requirements for the lowest leakage rates, it is necessary to select and install the correct fibre sheet gasket using the correct know-how.

We supply gaskets from all fibre sheet materials currently on the market (e.g. Klingersil).

PTFE flat gaskets

In flange connections where there are high levels of chemical attack, PTFE flat gaskets are increasingly being used. Due to the cold flow tendencies of unfilled PTFE, the gaskets should be as thin as possible in order to limit the cold flow. Filled or modified PTFE has a higher resistance to compressive strength. However, due to the materials used to fill PTFE and the proportion of filler present, the universal media resistances of filled PTFE are limited.

Rubber flat gaskets

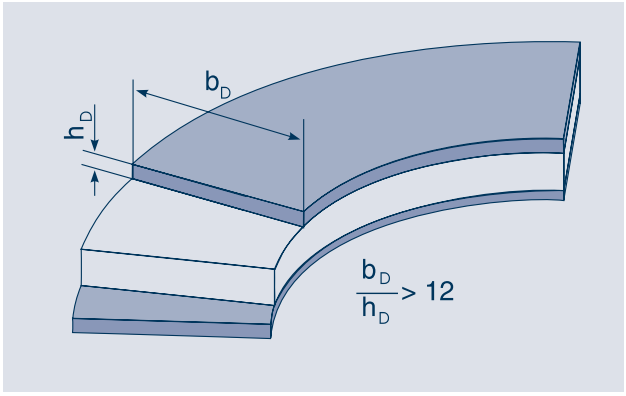
In sealing technology, rubber flat gaskets have a wide range of application. Wherever an inexpensive sealing of media at low temperatures and pressures is required, rubber gaskets provide an optimal solution. For each area of application there is a wide selection of rubber qualities available such as NR, NBR, EPDM and FKM.

We offer lines of rubber gaskets that have been punched or cut by water jet. In addition, we supply vulcanised extrudates and moulds in various rubber qualities.

Meter and fitting gaskets

For fittings in the gas and water industry, we stock a range of gaskets in NBR, EPDM and fibre materials with the necessary certification. The rubber bolt gaskets are punched from sheets or manufactured as tube rings. Our gaskets can be used in single and double pipe fittings.

RIVATHERM-COMPACT



RivaTherm-Compact consists of a stainless steel sheet as carrier material and a 0.5 mm graphite foil glued on both sides as sealing material. All common stainless steel qualities are available. Sheet metal carriers made of other metallic materials with a smooth, scale-free surface are also possible.

Due to the low temperature resistance of soft material sheets, carrier materials made of soft material sheets for reinforcing graphite foils are only suitable for certain areas of application.

Larger seals can be handled particularly well with 2 mm or 3 mm thick carrier sheets. Sheet and support thickness can be freely selected. However, a thicker sheet metal insert does not increase the resilience of the seal.

The surface pressure for pre-forming is very low at σ_V = 10 N/mm². The acceptable surface pressure with a graphite layer of 0.5 mm and 1.0 mm with a width/height ratio of the layers is bD/hD < 12 for 20 °C up to and including 200 °C σ_V = 120 N/mm²; for 300 °C σ_V = 110 N/mm²; 400 °C and 500 °C σ_V = 100 N/mm².

For graphite supports thicker than 1 mm, the maximum bearable surface pressures are lower than those mentioned above and the linings can be pushed out more easily by the internal pressure if not installed properly.

The leakage flow that may then occur, causes the sheet metal base to vibrate which can lead to fatigue fracture after a short time. To avoid this, the minimum surface pressure in the operating state should be σBU = 1.5 * p (N/mm²) – but at least 10 N/mm².

Forms of supply

RivaTherm-Compact can only be processed with special tools. Therefore, only finished seals are delivered. The seals can be made either round or in the form of frames. Seals with holes or retaining straps are also possible.

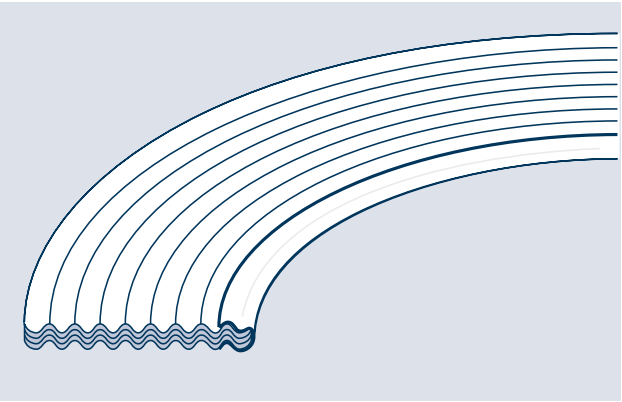
The dimensions can be up to several meters and only transport possibilities are a limitation.

1 mm thick stainless steel sheet 1.4541 is used as standard, on which 0.5 mm graphite is glued on both sides. On request, the carrier ring can also be coated on both sides with high-purity 99.85 % C nuclear graphite with a chloride content of < 20 ppm. If the carbon content is not specified, graphite layers in industrial quality 98 % C, with a chloride content of < 50 ppm, are bonded.

Min. surface pressure:	10 N/mm²
Min. surface pressure:	100 N/mm²
Min. temperature:	-200 °C
Max. temperature:	500 °C

WAVELINE WLP® FLAT GASKETS

03



Waveline WLP® flat gaskets Profile F1

made from Egraflex Steelflon with inner eyelet made from 1.4571 stainless steel

The Waveline WLP Egraflex Steelflon gasket Profile 1 with inner eyelet has a corrugated cross-section which is under high pressure due to the corrugated stress. The sealing material is a sandwich design of pure graphite and metal sheets. The internal design consists of several 0.5 mm thick layers of high-quality graphite sheets and 0.05 mm of plain stainless steel sheet foils.

The surface consists of a stainless steel foil with a 0.05 mm thick covering layer of PTFE. The internal eyelet is made of 0.15 mm thick metal sheeting made from 1.4571 stainless steel and finished using the Waveline® process. The entire bond is glue-free.

Due to the pre-compression using the Waveline® process, the cross-section density is improved so that the "flange deforming work" is partly done. Any bolt load applied affects the tips of the waves first. This allows the gasket to even itself out particularly well, even at low flange bearings, which helps it to adapt to the surfaces to be sealed.

The inner eyelet is pre-compressed using the Waveline® process and reduces the diffusion of the medium through the seal. This produces very low leakage rates, even under normal operating conditions. The Waveline WLP® Profile F1 with inner eyelet fulfils the requirements of TA Luft in accordance with the VDI Guidelines 2440.

The metal reinforcements and the stable 0.15 mm thick inner eyelet, combined with the corrugated pre-compression, ensure that the gasket is inherently stable and easy to handle.

Gasket limiting values

Min surface pressure N/mm²:	σ_V	20
Max. surface pressure N/mm²:	σ_ϑ	120
Min. temperature:	°C	-200
Max. temperature:	°C	+300

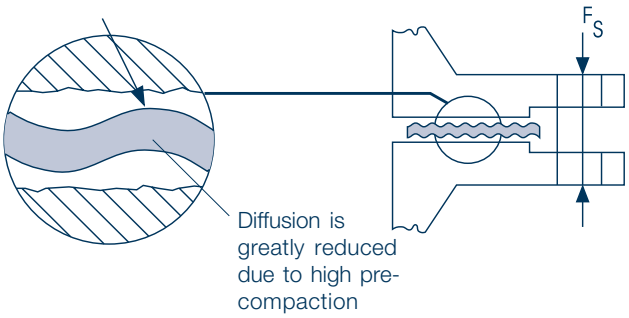
The inner eyelet

» protects the medium and the seal from impurities

» reduces cross-section leakage

» increases the buckling stability and improves handling.

Reduces surface leakage by increasing the surface pressure.



The advantages:

» meets the leakage requirements of the VDI Guidelines 2440 and TA Luft.

» media resistance of 1.4571 steel and PTFE

» wide range of application

» no measurable creep properties

» blow out proof

» easily replaceable, as the gaskets do not stick to the sealing surface.

» no contamination of the medium by the gasket

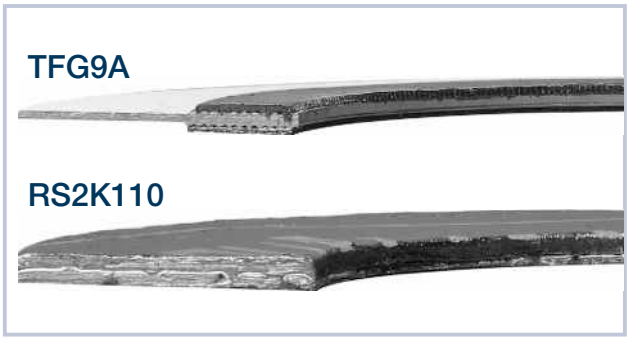
» easier handling due to the Waveline WLP® process

TOP FLAT GASKET (TFG)

A generation of flat gaskets

The requirements for the entire sealing system are high as defined by the VDI Guidelines 2290. We have developed a new type of gasket for leakage requirements < 1•10-2 mg/sm. This gasket meets the required tightness class under specific basic conditions.

It was important that the usual thickness does not exceed 2 mm to eliminate any additional complex adjustments to the flange distances to match a new gasket type.



Based on our many years of experience, we devised an innovative type of gasket with a total thickness of 2 mm to solve this problem. This new seal is a metal/soft-material gasket, type designation **TFG9A**. The feature of this gasket consists of a very fine profile with both sides coated with high-purity graphite or a PTFE film.

The high stability of the carrier material made it possible to reduce the effective sealing surface. The reduced sealing surface is supported by a centered medium-sized inner sealing diameter. This results in a 60 percent increase in surface pressure with the same bolt force in contrast to the simple geometry of flat gaskets.

This higher surface pressure allows for a much smaller tightness class and less leaks occur even with weak flanges.

Due to the high stability under pressure of the carrier material, the type **TFG9A** gasket has significantly less relaxation compared to conventional soft material gaskets.

The use of unreinforced PTFE as a layer material is possible because the carrier material (the metal core) prevents relaxation/creep relaxation.

It is also noteworthy that the gasket type **TFG9A** compared to conventional flat gaskets can be used with higher pressures as well due to the stable metal core.

See for yourself with a calculation by the use of our online calculation program Kemproof at

kemproof.klinger-kempchen.de.

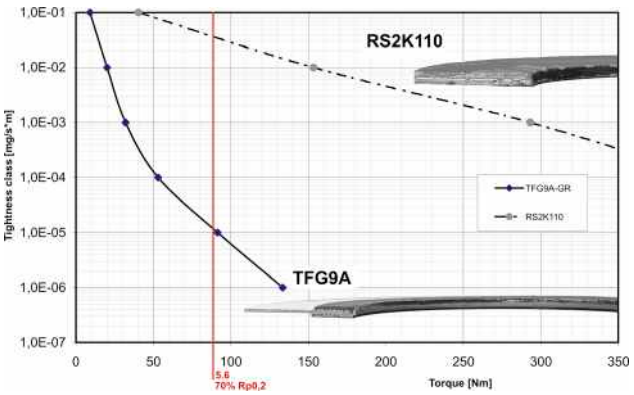
The gasket **TFG9A** has been listed there for a calculation.

The diagram shows clearly the advantages of the new gasket type from a sealing technology point of view, here in comparison with a graphite perforated sheet gasket. Excellent tightness classes can be achieved already with low torques.

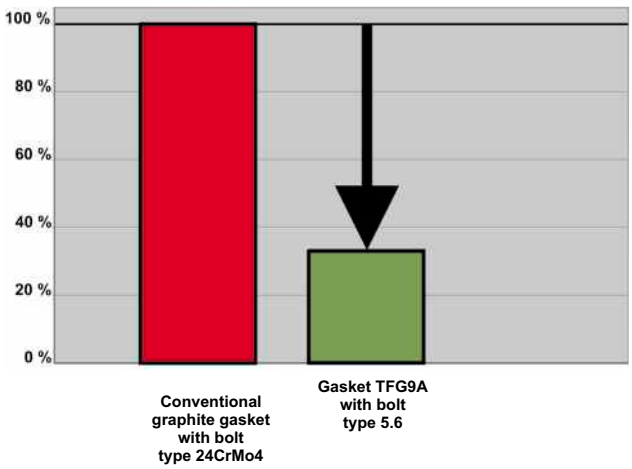
The flat gasket type **TFG9A** shows clear advantages not only in the technical overall assessment of the system but also in the economic evaluation.

The **TFG9A** type of gasket also meets the requirements of VDI 2290 with 5.6 grade bolts across all nominal sizes. Traditional gaskets meet the requirements of VDI 2290, for critical nominal sizes, only with higher grade bolts.

Required torques to achieve a tightness class at DN 40 / PN 40 - Flange P245GH / 150 °C with 5.6 M16 bolts



Cost savings by not investing in high-strength bolt materials



FLAT GASKETS FROM KLINGER®TOP-CHEM

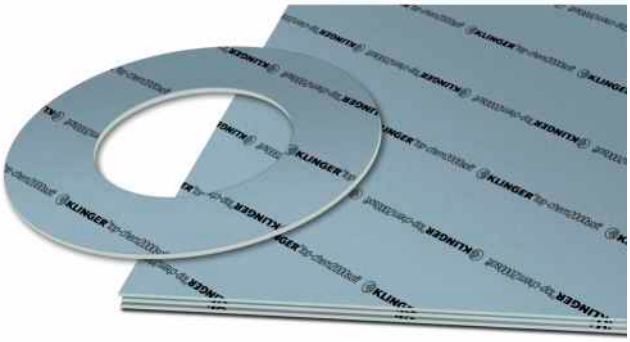
03

Soft material flat gaskets from KLINGER®top-chem

With the superb quality of the series, you have all of the advantages of PTFE gaskets without the usual disadvantages. With KLINGER®top-chem you can really push the boundaries of what's possible. You'll save productive time and gain greater system security.

With our seamless coverage of all applications and hugely detailed description of the performance features of each product, you can avoid any gaps in security.

The following brief descriptions of the three different materials will give you an overview and make your choice easier:



KLINGER®top-chem 2000soft

- PTFE sealing material filled with silicon carbide
- Colour: grey
- Excellent compressibility with best mechanical properties
- High adaptability and tightness
- Outstanding chemical resistance in applications with strong acids and alkalis
- High-quality sealing material for many areas of application

Approvals and test reports:

FDA, TA-Luft

KLINGER®top-chem 2003

- PTFE sealing material with inorganic fillers
- Colour: white
- Highly compressible - very good sealing properties even at low surface stresses
- pH 0 - 14
- can be used with all chemicals, except for alkaline solutions, liquid or gaseous fluorine and hydrofluoric acid

Approvals and test reports:

DVGW, FDA, BAM (liquid oxygen), TA Luft, DNV GL

FLAT GASKETS FROM KLINGER®TOP-CHEM

KLINGER® top-chem 2005

- PTFE sealing material with inorganic fillers
- Colour: red
- Very good chemical resistance to strong acids
- Good mechanical properties
- pH 0 - 14
- can be used with all chemicals, except for alkaline solutions, liquid or gaseous fluorine and hydrofluoric acid

Certification:

DVGW, KTW, FDA, BAM, TA Luft, DNV GL, WRAS

KLINGER® top-chem 2006

- Barium sulphide filled PTFE material
- Colour: white
- Very good chemical resistance to strong alkaline applications and liquid acids
- Good mechanical properties
- pH 0 - 14
- can be used with all chemicals, except for alkaline solutions, gaseous fluorine and liquid sulphuric acid.

Approvals and test reports:

DVGW, KTW, FDA, BAM, TA Luft, DNV GL

Technical data

		KLINGER®top-chem			
		2000soft	2003	2005	2006
Reference thickness	mm	2,0	1,5	1,5	1,5
Density	g/cm³	2,1	1,7	2,2	3,0
Compressibility ASTM F36J	%	15	18	3	4
Recovery ASTM F36J	% min	20	30	40	45
Leak-tightness DIN 28090-2	mg/s*m	0,05	0,01	0,02	0,01
Compression Stability DIN 52913 30 MPa 16h 150 °C according to KLINGER	MPa	25	13	25	18
Thickness decrease					
23 °C / 50 MPa	%	17	9	6	10
260 °C / 25 MPa	%	20	38	30	40
Thickness / weight increase					
H_2SO_4 100 % 18 h / 23 °C	%	1/1	1/1	1/1	-
HNO_3 100 % 18 h / 23 °C	%	½	0/5	½	½
NaOH 33 % 72 h / 110 °C	%	2/3	1/5	-	1/1
H_2O 5h / 100 °C		1/1	-	-	-

UNIVERSAL PTFE FLAT SEALING STRIP PROFILE TF1

03

The Kempchen PTFE flat sealing strip Profile TF1 has proven to be excellent for sealing flanges on machines, tanks, housings, pumps, gearbox covers, water level valves, etc.

Despite its high level of breaking and tensile strength, the gasket remains soft and supple and is perfect for smoothing out uneven areas on the sealing surface.

The strip is stretched using a special technique that allows the material to retain its individual properties.

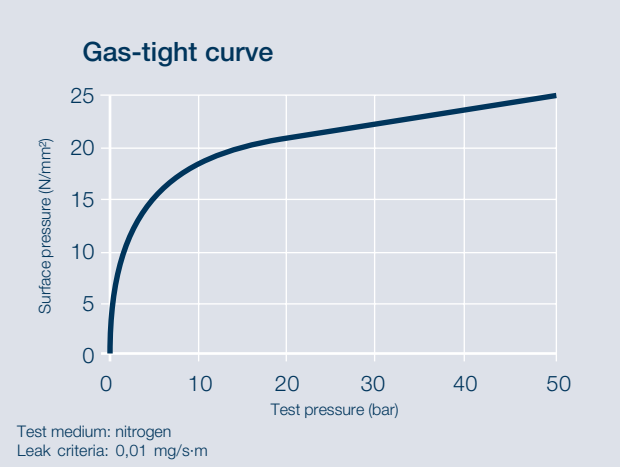
The glue strips attached to one side serve as aids for easy fitting of the strip during installation.

» **DVGW VP 403**
Suitable for gas supply
pressure up to 16 bar and
temperatures of -10 °C to +50 °C

» **BAM-test report for use with oxygen**
(Manufacturer certificate on the basis of a BAM test report)

» **General purpose**
Temperature range - 200 °C to 150 °C

The use of the PTFE strip as a permanent replacement for flat gaskets, such as those required by DIN 2690, is not recommended.



Installation is easy and inexpensive with the secure handling offered by the glue strips.

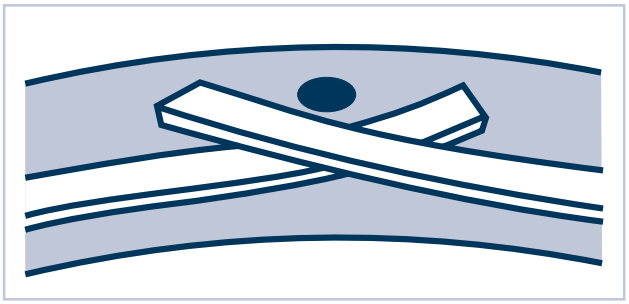
Installation instructions:

» Clean the sealing surfaces. The sealing surfaces must be dry and free from grease.

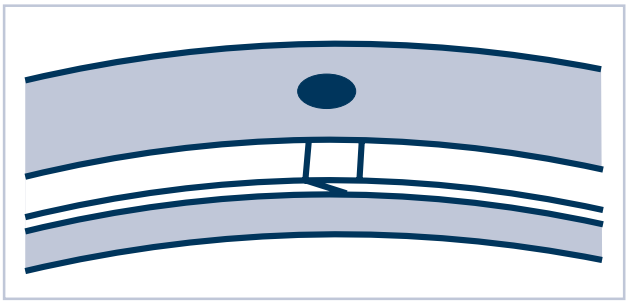
» Select a flat sealing strip of the appropriate size.

» Remove the protective strips and stick the flat sealing strip on.

» Place the PTFE sealing strip inside the pitch circle beginning with a bolt hole. Overlap the ends by about 2 cm and cut off (retrieve any cuttings).



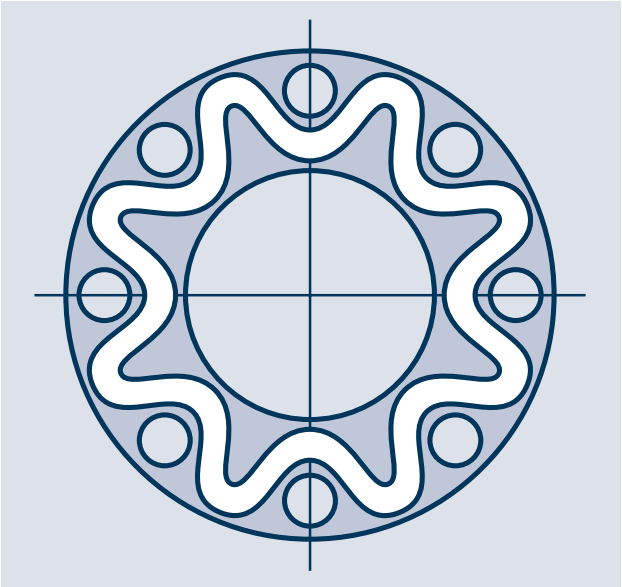
» The band should be fitted to stress-sensitive components with a bevel cut. To do this, create a scarf joint at each end to a length of approx. 1.5 times the sealing width and fit together. This method of joining can also be used in any place where only a light pressing force can be applied. The joint should be located in the area of a bolt hole.



UNIVERSAL PTFE FLAT SEALING STRIP PROFILE TF1

» In order to avoid bending of the flange, as can sometimes occur with thin flanges, it is recommended to position the sealing strip in a "serpentine line" (see illustration).

» Bolt the sealing connection over cross.



If there is considerable unevenness or damage to the sealing surface, thicker strips should be used. Due to the greater width that thicker strips have, a corresponding increase in the bolt load is required.

In our terms of delivery we guarantee an expert finish to our products.

All technical information and advice is based on our previous experience and is stated to the best of our knowledge. However, we accept no responsibility as a result of any of the foregoing. Specifications and values must always be checked by the client, as the client will only be in a position to accurately judge the effectiveness of a flat sealing strip by assessing all the data available at its location himself.

Supplied as:
rolls in lengths of 10 and 25 m.

Width mm	1	3	5	7	10	12	14	17	20	22	28	40
Thickness approx. mm	1*	1,5	2,0	2,5	3,0	4,0	5,0	6,0	7,0	5,0	5,0	5,0

* no glue strips

UNIVERSAL GRAPHITE FLAT SEALING STRIP

03

Flat sealing strips made from pure graphite are available at 98 % carbon quality and at nuclear quality of 99.85 % carbon. They can be supplied in a smooth or corrugated roll. The strips are manufactured with an adhesive backing.

The width of the strips ranges from 6 mm to 70 mm. The usual lengths are 10; 12; 15, 47 and 50 meters. Other lengths are available on request.

Depending on the circumference, the strips are delivered in plastic cans, in cartons or skin-packed onto cardboard.

The thickness of the pure graphite strips is 0.38 mm; 0.5 mm; and 1 mm. The density of the 0.5 mm and 1 mm strips is 1.0 g/cm^3. The strip with a thickness of 0.38 mm has a density of 1.1 g/cm^3.

Pure graphite strips have excellent gliding properties, a chloride content of less than 50 ppm and are self-lubricating. They also have outstanding heat-conducting properties and contain no adhesive agent or filler. Pure graphite strips are physiologically harmless.

Self-sticking pure graphite strips are useful when fitting strips on hard-to-reach positions.

If a punched pure graphite gasket is not available as a cladding for metallic gaskets, e.g. grooved gaskets, then a self-adhesive pure graphite strip can be used. Depending on the width of the strip, the corrugated strip can also be used for small radiuses.

Pure graphite strips can also be used to seal spindles. For this, the strip is wound around the stem, so that it can then be pressed into the gland area by the gland flange.

We also supply pure graphite strips as pre-compressed rings. Seethe section entitled "Packings", RivaTherm Packing K80.

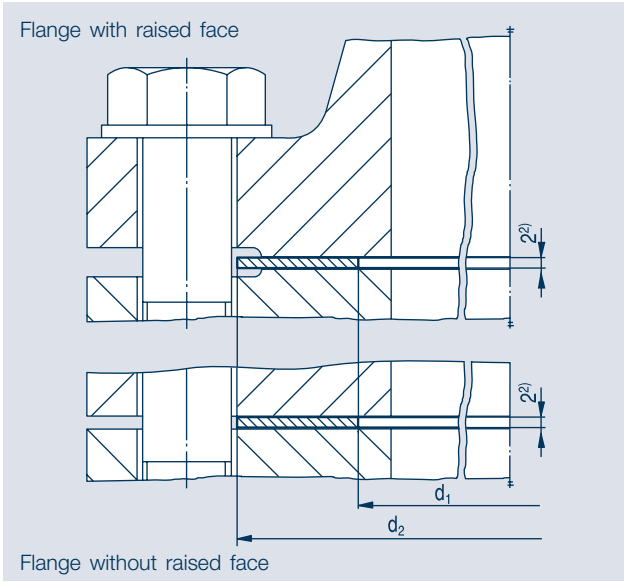
not self-adhesive

self-adhesive

self-adhesive

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form IBC gaskets for flanges with and without raised face



Ordering example for a flat gasket, Form IBC, Profile A1, DN 100, PN 16, made of ...[1]:

Flat gasket IBC, A1, DN 100, PN 16, EN 1514-4,1, RHD*

Ordering example for a flat gasket with inner eyelet, Form IBC, Profile F1, DN 100, PN 16, made of ...[1]:

Flat gasket IBC, F1, DN 100, PN 16, EN 1514-4, 1, RSP*/ 1.4571

Conforming to EN 1514-1 Form IBC

		PN d_2
DN	d_1	63
10	18	56
15	21	61
20	25	72
25	30	82
32	41	88
40	47	103
50	59	113
60	68	123
65	73	138
80	86	148
100	110	174
125	135	210
150	163	247
175	185	277
200	210	309
250	264	364
300	314	424
350	360	486
400	415	543

Dimensions in mm

Conforming to EN 1514-1 Form IBC

		PN d_2					
DN	d_1	2,5	6	10	16	25	40
10	18		39				46
15	22		44				51
20	27		54				61
25	34		64				71
32	43		76				82
40	49		86	Use PN 40	Use PN 40	Use PN 40	92
50	61		96				107
60	72		106				117
65	77		116				127
80	89		132				142
100	115		152		162		168
125	141		182	Use 16	192		194
150	169	Use PN 6	207		218		224
200	220		262		273	284	290
250	273		317	328	329	340	352
300	324		373	378	384	400	417
350	356		423	438	444	457	474
400	407		473	489	495	514	546
450	458		528	539	555	564	571
500	508		578	594	617	624	628
600	610		679	695	734	731	747
700	712		784	810	804	833	-
800	813		890	917	911	942	-
900	915		990	1017	1011	1042	-
1000	1016		1090	1124	1128	1154	-
1100	1120	-	-	1231	1228	1254	-
1200	1220	1290	1307	1341	1342	1364	-
1400	1420	1490	1524	1548	1542	1578	-
1500	1520	-	-	1658	1654	1688	-
1600	1620	1700	1724	1772	1764	1798	-
1800	1820	1900	1931	1972	1964	2000	-
2000	2020	2100	2138	2182	2168	2230	-
2200	2220	2307	2348	2384	-	-	-
2400	2420	2507	2558	2594	-	-	-
2600	2620	2707	2762	2794	-	-	-
2800	2820	2924	2972	3014	-	-	-
3000	3020	3124	3172	3228	-	-	-
3200	3220	3324	3382	-	-	-	-
3400	3420	3524	3592	-	-	-	-
3600	3620	3734	3804	-	*	-	-
3800	3820	3931	-	-	-	-	-
4000	4020	4131	-	-	-	-	-

- Flanges compliant with the standard not available

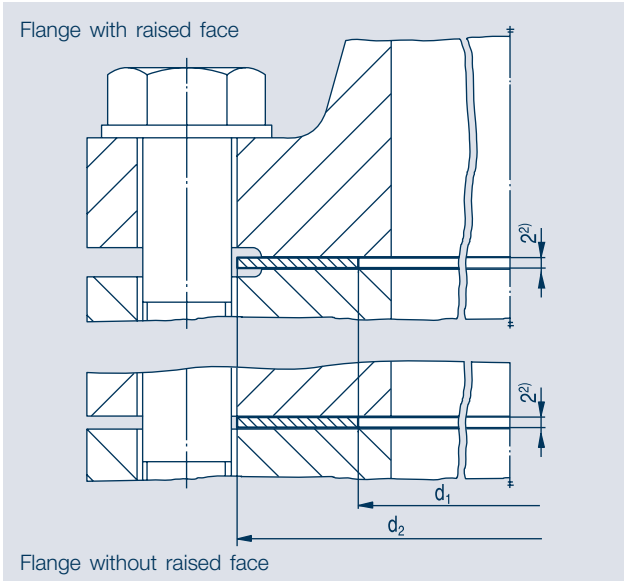
Dimensions in mm

* RHD = RivaTherm HD;
RSP = RivaTherm Super Plus

[1] Specify material when placing order
[2] Please arrange other thicknesses when ordering

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form IBC gaskets for flanges with and without raised face



Ordering example for a flat gasket, Form IBC, Profile A1, NPS 5, Class 300, made of ...[1]:
Flat gasket IBC, A1, NPS 5, Class 300, EN 12560-1, RHD*

Ordering example for a flat gasket with inner eyelet, Form IBC, Profile FA1, NPS 5, Class 300, made of ...[1]:
Flat gasket IBC, F1, NPS 5, Class 300, EN 12560-1, RSP*/ 1.4571

Conforming to EN 12560-1 Form IBC

NPS	d_1	Class 150	d_2 300	d_2 600	d_2 900
½	22	47,5		54,0	63,5
¾	27	57,0		66,5	69,5
1	34	66,5	Use Class 600	73,0	79,0
1¼	43	76,0		82,5	89,0
1½	49	85,5		95,0	98,0
2	61	104,5		111,0	142,5
2½	73	124,0		130,0	165,0
3	89	136,5		149,0	168,0
4	115	174,5	181,0	193,5	206,0
5	141	196,5	216,0	241,0	247,5
6	169	222,0	251,0	266,5	289,0
8	220	279,0	308,0	320,5	358,5
10	273	339,5	362,0	400,0	435,0
12	324	409,5	422,0	457,0	498,5
14	356	450,5	485,5	492,0	520,5
16	407	514,0	539,5	565,0	574,5
18	458	549,0	597,0	612,5	638,0
20	508	606,5	654,0	682,5	698,5
24	610	717,5	774,5	790,5	838,0

Dimensions in mm

Ordering example for a flat gasket, Form IBC, Profile A1, DN 100, PN 16, made of ...[1]:
Flat gasket IBC, A1, DN 100, PN 16, DIN 2690, RHD*

Ordering example for a flat gasket with inner eyelet, Form IBC, Profile F1, DN 100, PN 16, made of ...[1]:
Flat gasket IBC, F1, DN 100, PN 16, EN 2690, RSP*/1.4571

Conforming to EN 2690** Form IBC

DN	d_1	PN d_2 1 u.2,5	6	10	16	25	40
4	6		-	-	-	30	-
6	10		28				38
8	14		33				43
10	18		38				45
15	22		43				50
20	28		53	Use PN 40	Use PN 40	Use PN 40	60
25	35		63				70
32	43		75				82
40	49		85				92
50	61		95				107
65	77		115				127
80	90		132				142
100	115		152	Use PN 16	162		168
125	141		182		192		195
150	169	Use PN 6	207		218		225
(175)	195		237		248	255	267
200	220		262		273	285	292
250	274		318	328	330	342	353
300	325		373	378	385	402	418
350	368		423	438	445	458	475
400	420		473	490	497	515	547
(450)	470		528	540	557	565	572
500	520		578	595	618	625	628
600	620		680	695	735	730	745
700	720		785	810	805	830	850
800	820		890	915	910	940	970
900	920		990	1015	1010	1040	1080
1000	1020		1090	1120	1125	1150	1190
1200	1220	1290	1305	1340	1340	1360	1395
1400	1420	1490	1520	1545	1540	1575	1615
1600	1620	1700	1720	1770	1760	1795	1830
1800	1820	1900	1930	1970	1960	2000	-
2000	2020	2100	2135	2180	2165	2230	-
2200	2220	2305	2345	2380	2375	-	-
2400	2420	2505	2555	2590	2585	-	-
2600	2620	2705	2760	2790	2785	-	-
2800	2820	2920	2970	3010			
3000	3020	3120	3170	3225			
3200	3220	3320	3380	-			
3400	3420	3520	3590	-			
3600	3620	3730	3800	-			
3800	3820	3930	-	-			
4000	4020	4130	-	-			

- Flanges compliant with the standard not available

Dimensions in mm

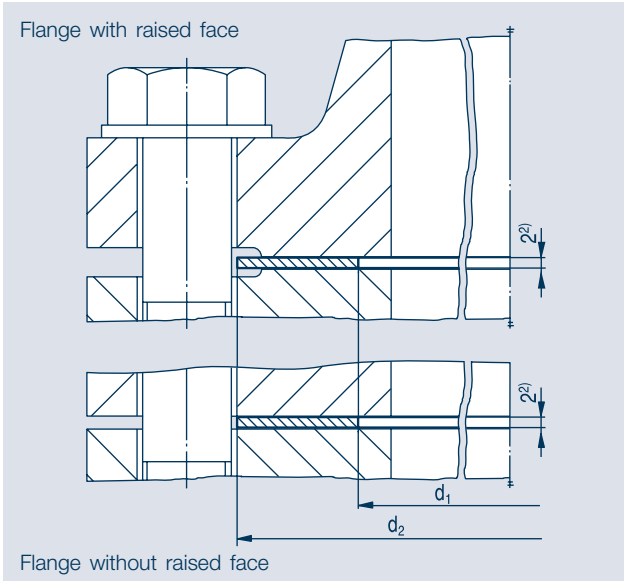
* RHD = RivaTherm HD;
RSP = RivaTherm Super Plus

[1] Specify material when placing order
[2] Please arrange other thicknesses when ordering

** DIN 2690 has been replaced by DIN EN 1514-1

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form IBC gaskets for flanges with and without raised face



Ordering example for a flat gasket, Form IBC, Profile A1, NPS 5, Class 400, made of ...[1]:
Flat gasket IBC, A1, NPS 5, Class 400, ASME B16.21, RHD*

Ordering example for a flat gasket with inner eyelet, Form IBC, Profile F1, NPS 5, Class 400, made of ...[1]:
Flat gasket IBC, F1, NPS 5, Class 400, ASME B16.21, RSP*/ 1.4571

In accordance with ANSI B 16.21 for flanges in accordance with ASME/ANSI B16.5

		Class		d_2		
NPS	d_1	150	300	400	600	900
½	21	48	54	54	54	64
¾	27	57	67	67	67	70
1	33	67	73	73	73	79
1¼	42	76	83	83	83	89
1½	49	86	95	95	95	99
2	60	105	111	111	111	143
2½	73	124	130	130	130	165
3	89	137	149	149	149	168
3½	102	162	165	162	162	-
4	114	175	181	178	194	206
5	141	197	216	213	241	248
6	168	222	251	248	267	289
8	219	279	308	305	321	359
10	273	340	362	359	400	435
12	324	410	422	419	457	498
14	356	451	486	483	492	521
16	406	514	540	536	565	575
18	457	549	597	594	613	638
20	508	607	654	648	683	699
24	610	718	775	768	790	838

Dimensions in mm

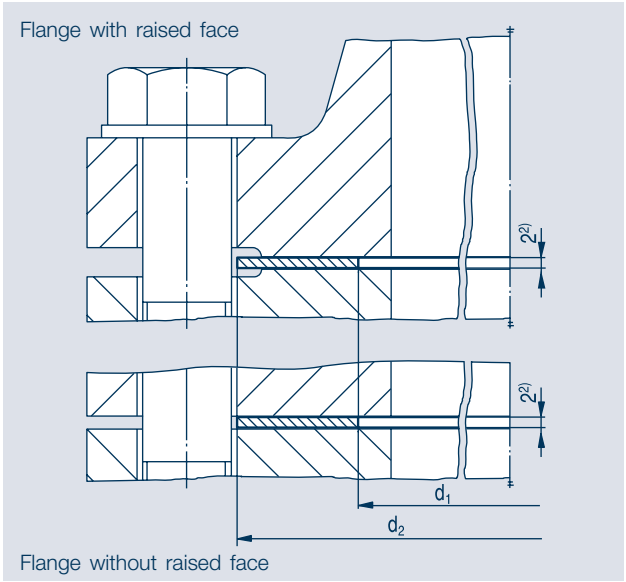
The basis for these tables is ASME B16.21 of 1992 with measurements in inches. The measurements in mm have been rounded off to whole numbers. We draw to your attention the fact that the measurements in millimetres and those in inches will deviate slightly from each other.

* RHD = RivaTherm HD;
RSP = RivaTherm Super Plus

[1] Specify material when placing order
[2] Please arrange other thicknesses when ordering

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form IBC gaskets for flanges with and without raised face



The basis for these tables is ASME B16.21 of 1992 with measurements in inches. The measurements in mm have been rounded off to whole numbers. We draw to your attention the fact that the measurements in millimetres and those in inches will deviate slightly from each other.

Ordering example for a flat gasket, Form IBC, Profile A1 , NPS 26, Class 400, made of ...[1]:
Flat gasket IBC, A1, NPS 26, Class 400, ASME B16.21 / ASME B16.47 Series A, RHD*

Ordering example for a flat gasket with inner eyelet, Form IBC, Profile FA1, NPS 26, Class 400, made of ...[1]:
Flat gasket IBC, F1, NPS 26, Class 400, ASME B16.21 /ASME B16.47 Series A, RSP*/1.4571

Ordering example for a flat gasket, Form IBC, Profile A1, NPS 26, Class 300, made of ...[1]:
Flat gasket IBC, A1, NPS 26, Class 300, ASME B16.21 / ASME B16.47 Series B, RHD*

Ordering example for a flat gasket with inner eyelet, Form IBC, Profile FA1, NPS 26, Class 300, made of ...[1]:
Flat gasket IBC, A1, NPS 26, Class 300, ASME B16.21 / ASME B16.47 Series B, RSP*/1.4571

In accordance with ASME B16.21 for flanges in accordance with ASME B16.47 Series A

		Class	d_2		
NPS	d_1	150	300	400	600
26	660	775	835	832	867
28	711	832	899	892	914
30	762	883	953	946	972
32	813	940	1006	1003	1022
34	864	991	1057	1054	1073
36	914	1048	1118	1118	1130
38	965	1111	1054	1073	1105
40	1016	1162	1115	1132	1156
42	1067	1219	1165	1178	1219
44	1118	1276	1219	1232	1270
46	1168	1326	1273	1289	1327
48	1219	1384	1324	1346	1391
50	1270	1435	1378	1403	1448
52	1321	1492	1429	1454	1499
54	1372	1549	1492	1518	1556
56	1422	1607	1543	1568	1613
58	1473	1664	1594	1619	1664
60	1524	1715	1645	1683	1721

Dimensions in mm

In accordance with ASME B16.21 for flanges in accordance with ASME B16.47 Series B

		Class	d_2			
NPS	d_1	75	150	300	400	600
26	660	708	725	772	746	765
28	711	759	776	826	800	819
30	762	810	827	886	857	879
32	813	861	881	940	911	933
34	864	911	935	994	962	997
36	914	973	988	1048	1022	1048
38	965	1024	1044	1099	-	-
40	1016	1075	1095	1149	-	-
42	1067	1125	1146	1200	-	-
44	1118	1181	1197	1251	-	-
46	1168	1232	1256	1318	-	-
48	1219	1283	1307	1369	-	-
50	1270	1334	1357	1419	-	-
52	1321	1387	1408	1470	-	-
54	1372	1438	1464	1556	-	-
56	1422	1496	1514	1594	-	-
58	1473	1546	1580	1656	-	-
60	1524	1597	1630	1705	-	-

- Flanges compliant with the standard not available

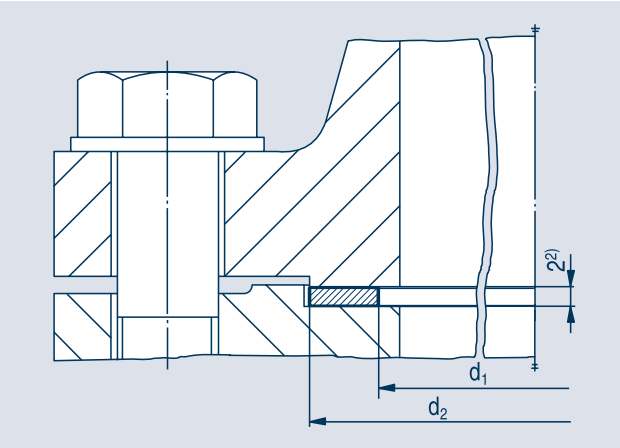
Dimensions in mm

* RHD = RivaTherm HD;
RSP = RivaTherm Super Plus

1) Specify material when placing order
2) Please arrange other thicknesses when ordering

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form S gaskets for flanges with male and female



Ordering example for a flat gasket, Form SR, Profile A1, DN 100, made of ...[1]:
Flat gasket SR, A1, DN 100, EN 1514-1, RHD*
Ordering example for a flat gasket with inner eyelet, Form SR, Profile F1, DN level 100, made of ...[1]:
Flat gasket SR, F1, DN 100, EN 1514-1, RSP*/1.4571

Ordering example for a flat gasket, Form SR, Profile A1, NPS 5, made of ...[1]:
Flat gasket SR, A1, NPS 5, EN 12560-1, RHD*
Ordering example for a flat gasket with inner eyelet, Form SR, Profile F1, NPS 5, made of ...[1]:
Flat gasket SR, F1, NPS 5, EN 12560-1, RSP*/1.4571

Conforming to EN 1514-1 Form SR

DN	d_1	PN d_2 10 - 40	DN	d_1	PN d_2 10 - 25
10	18	34	**700**	712	777
15	22	39	**800**	813	882
20	27	50	**900**	915	987
25	34	57	**1000**	1016	1092
32	43	65			
40	49	75			
50	61	87			
60	-	-			
65	77	109			
80	89	120			
100	115	149			
125	141	175			
150	169	203			
200	220	259			
250	273	312			
300	324	363			
350	356	421			
400	407	473			
450	458	523			
500	508	575			
600	610	675			

Dimensions in mm

Conforming to EN 12560-1 Form SR

NPS	d_1	Class d_2 300 - 900
½	22	35,0
¾	27	43,0
1	34	51,0
1¼	43	64,0
1½	49	73,0
2	61	92,0
2½	73	105,0
3	89	127,0
4	115	157,0
5	141	186,0
6	169	216,0
8	220	270,0
10	273	324,0
12	324	381,0
14	356	413,0
16	407	470,0
18	458	533,0
20	508	584,0
24	610	692,0

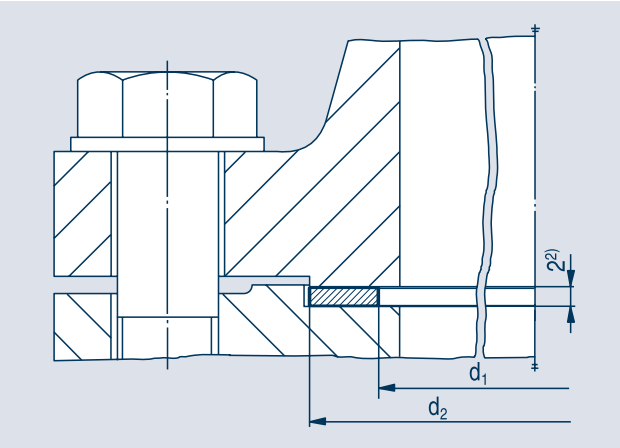
Dimensions in mm

* RHD = RivaTherm HD;
RSP = RivaTherm Super Plus

[1] Specify material when placing order.
[2] The gasket thickness is always less than the female face depth. Please arrange other thicknesses when ordering.

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form SR gaskets for flanges with male and female



The basis for these tables is ASME B16.5 of 1988 with measurements in inches. The measurements in mm have been rounded off to whole numbers. We draw to your attention the fact that the measurements in millimetres and those in inches will deviate slightly from each other.

Ordering example for a flat gasket, Form SR, Profile A1, DN 100, made of ...[1]:
Flat gasket SR, A1, DN 100, EN 2692, RHD*

Ordering example for a flat gasket with inner eyelet, Form SR, Profile F1, DN 100, made of ...[1]:
Flat gasket SR, F1, DN 100, EN 2692, RSP*/1.4571

Ordering example for a flat gasket, FormSR, Profile A1, NPS5, wide model, made of ...[1]:
Flat gasket SR, A1, NPS 5, ASME/ANSI B16.5, wide, RHD*

Ordering example for a flat gasket with inner eyelet, Form SR, Profile F1, NPS 5, wide model, made of ...[1]:
Flat gasket SR, F1, NPS 5, ASME/ANSI B16.5, wide, RSP*/1.4571

Conforms to DIN 2692** (PN 10 to PN 100)

DN	d_1	d_2
10	18	34
15	22	39
20	28	50
25	35	57
32	43	65
40	49	75
50	61	87
65	77	109
80	90	120
100	115	149
125	141	175
150	169	203
175	195	233
200	220	259
250	274	312
300	325	363
350	368	421
400	420	473
500	520	575
600	620	675
700	720	777
800	820	882
900	920	987
1000	1020	1091

Dimensions in mm

Conforms to ANSI/ASME B 16.5 (Class 150 to Class 1500)

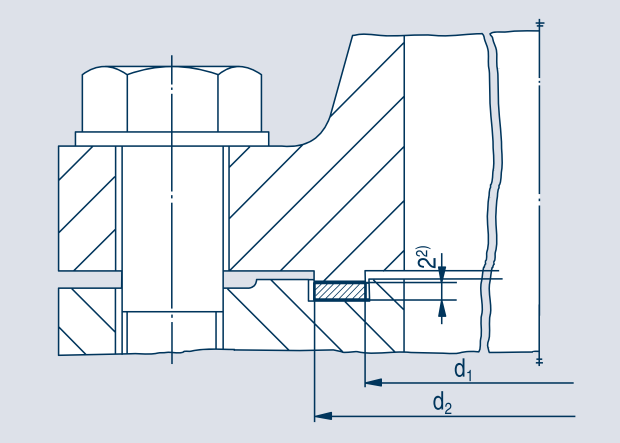
	narrow		wide	
NPS	d_1	d_2	d_1	d_2
½	To be specified by the customer	18	21	35
¾		24	27	43
1		30	34	51
1¼		38	42	64
1½		44	48	73
2		57	60	92
2½		68	73	105
3		84	89	127
3½		97	102	140
4		109	114	157
5		137	141	186
6		162	168	216
8		213	219	270
10		267	273	324
12		318	324	381
14		349	356	413
16		400	406	470
18		451	457	533
20		502	508	584
24		603	610	692

Dimensions in mm

* RHD = RivaTherm HD; RSP = RivaTherm Super Plus
[1] Specify material when placing order.
[2] The gasket thickness is always less than the female face depth. Please arrange other thicknesses when ordering.
** DIN 2692 has been replaced by DIN EN 1514-1

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form TG gaskets for flanges with tongue and groove



Ordering example for a flat gasket, Form TG, Profile A1, EN 1514-1, DN 100, made of ...[1)]:
Flat gasket TG, A1, DN 100, EN 1541-1, RHD*

Ordering example for a flat gasket, Form TG, Profile A1, NPS 5, EN 12560-1, made of ...[1)]:
Flat gasket TG, A1, NPS 5, EN 12560-1, RHD*

Conforming to EN 1514-1 Form TG[3)]

DN	d_1	PN d_2 10 - 40
10	24	34
15	29	39
20	36	50
25	43	57
32	51	65
40	61	75
50	73	87
60	-	-
65	95	109
80	106	120
100	129	149
125	155	175
150	183	203
200	239	259
250	292	312
300	343	363
350	395	421
400	447	473
450	497	523
500	549	575
600	649	675

DN	d_1	PN d_2 10 - 25
700	751	777
800	856	882
900	961	987
1000	1062	1092

Dimensions in mm

Conforming to EN 12560-1 Form TG

NPS	d_1	Class d_2 300 - 900
½	25,5	35,0
¾	33,5	43,0
1	38,0	51,0
1¼	47,5	64,0
1½	54,0	73,0
2	73,0	92,0
2½	85,5	105,0
3	108,0	127,0
4	132,0	157,0
5	160,5	186,0
6	190,5	216,0
8	238,0	270,0
10	286,0	324,0
12	343,0	381,0
14	374,5	413,0
16	425,5	470,0
18	489,0	533,0
20	533,5	584,0
24	641,5	692,0

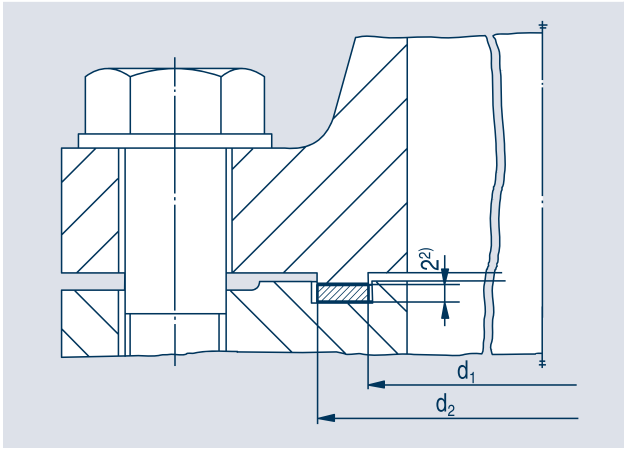
Dimensions in mm

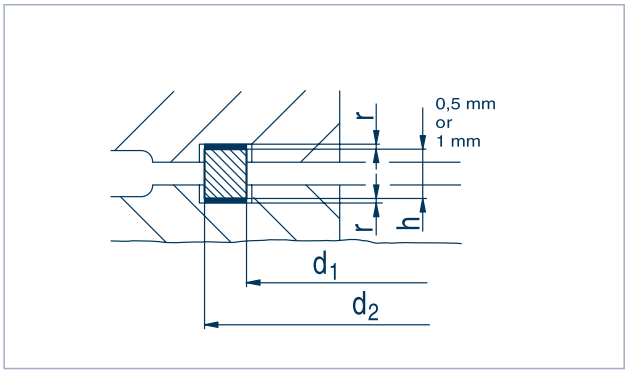
* RHD = RivaTherm HD;

1) Specify material when placing order
2) Please arrange other thicknesses when ordering
3) Formerly DIN 2691

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form TG gaskets for flanges with tongue and groove





Ordering example for a flat gasket, Form TG, Profile A1, DN 100, made of ...[1)]:

Flat gasket TG, A1, DN 100, DIN 2691, RSP*

Spacer rings for flange connections groove on groove in accordance with 2512

Ordering example for a spacer ring with associated RSP gaskets for groove flanges, DN 65, made of ...[1)]:

Spacer ring, DN 65, DIN 2512,1.4541/RSP*

Conforms to DIN 2691 for flanges in accordance with DIN 2512 (PN 10 PN 160)**

DN	d_1	d_2	for Spacer ring h^{+1}
4-6	20	30	10
8	22	32	10
10	24	34	10
15	29	39	10
20	36	50	10
25	43	57	10
32	51	65	10
40	61	75	10
50	73	87	10
65	95	109	10
80	106	120	10
100	129	149	12
125	155	175	12
150	183	203	12
175	213	233	12
200	239	259	12
250	292	312	12
300	343	363	12
350	395	421	14
400	447	473	14
500	549	575	14
600	649	675	14
700	751	777	14
800	856	882	14
900	961	987	14
1000	1062[2)]	1092[2)]	16

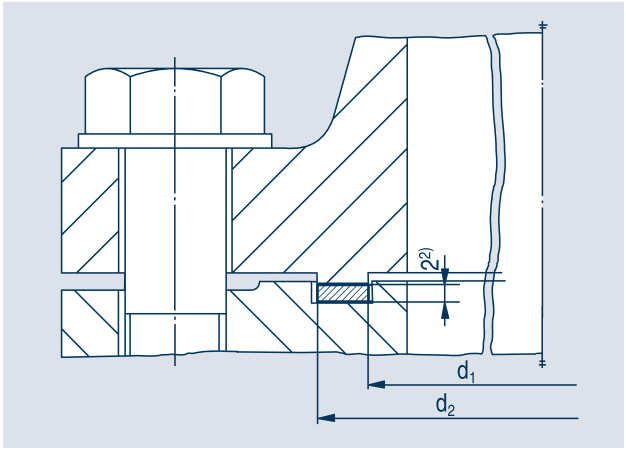
Dimensions in mm

* RSP = RivaTherm Super Plus
** DIN 2691 has been replaced by DIN EN 1514-1

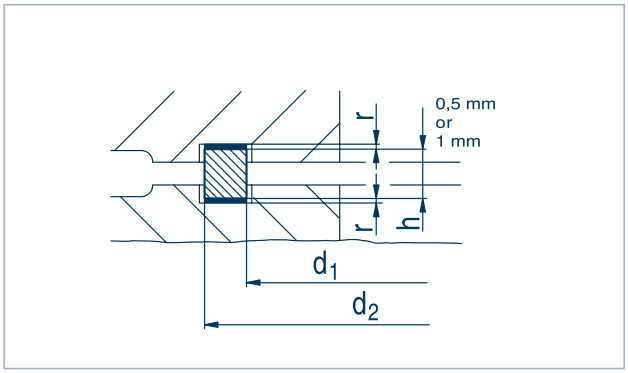
[1)] Specify material when placing order.
[2)] Measurements in accordance with DIN 2512

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form TG gaskets for flanges with tongue and groove



Ordering example for a flat gasket, Form TG, Profile A1, NPS 5, wide model, made of ...[1]:
Flat gasket TG, A1, NPS 5, ASME/ANSI B16.5, wide, tongue and groove, RSP*



Works standard 133
Spacer rings for flanges in accordance with ANSI B 16.5, groove to groove flange connection.

Ordering example for a spacer ring with associated RSP gaskets for groove flanges, NPS 5, narrow model, made of ...[1]:
Spacer ring, NPS 5, WN 133, narrow, 1.4541/RSP*

Conforms to ANSI/ASME B 16.5 (Class 150 to Class 1500) for flanges in accordance with ASME/ANSI B 16.5

DN	narrow d1	narrow d2	wide d2	for Spacer ring[3] h+1
½	25	35	35	12
¾	33	43	43	12
1	38	48	51	12
1¼	48	57	64	12
1½	54	64	73	12
2	73	83	92	12
2½	86	95	105	12
3	108	117	127	14
3½	121	130	140	14
4	132	145	157	14
5	160	173	186	14
6	191	203	216	14
8	238	254	270	14
10	286	305	324	14
12	343	362	381	14
14	375	394	413	16
16	425	448	470	16
18	489	511	533	16
20	533	559	584	16
24	641	667	692	16

Dimensions in mm

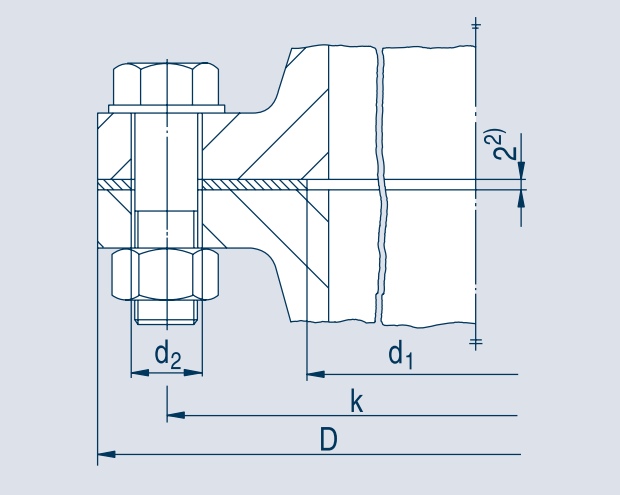
The basis for these tables is ASME B16.5 of 1988 with measurements in inches. The measurements in mm have been rounded off to whole numbers. We draw to your attention the fact that the measurements in millimetres and those in inches will deviate slightly from each other.

* RSP = RivaTherm Super Plus

1) Specify material when placing order
2) Please arrange other thicknesses when ordering
3) The measurements for the height are given in works standard 133. The height “h” applies to the spacer ring.

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form FF gaskets with bolt holes for flat face flanges



Ordering example for a flat gasket, Form FF, DN 100, PN 16, DIN 86071, made of ...[1]:

Flat gasket FF, DN 100, PN 16, DIN 86071, RSP*

Conforming to DIN 86071 Form FF

DN	d_1	PN 6				PN 10				PN 16				PN 25			
		D	k	d_2	Number of holes	D	k	d_2	Number of holes	D	k	d_2	Number of holes	D	k	d_2	Number of holes
20	29	90	65	11	4	105	75	14	4	105	75	14	4	105	75	14	4
25	36	100	75	11	4	115	85	14	4	115	85	14	4	115	85	14	4
32	47	120	90	14	4	140	100	18	4	140	100	18	4	140	100	18	4
40	53	130	100	14	4	150	110	18	4	150	110	18	4	150	110	18	4
50	65	140	110	14	4	165	125	18	4	165	125	18	4	165	125	18	4
65	81	160	130	14	4	185	145	18	4	185	145	18	4	185	145	18	8
80	93	190	150	18	4	200	160	18	8	200	160	18	8	200	160	18	8
100	120	210	170	18	4	220	180	18	8	220	180	18	8	235	190	22	8
125	146	240	200	18	8	250	210	18	8	250	210	18	8	270	220	26	8
150	172	265	225	18	8	285	240	22	8	285	240	22	8	300	250	26	8
175	200	295	255	18	8	315	270	22	8	315	270	22	8	330	280	26	12
200	225	320	280	18	8	340	295	22	8	340	295	22	12	360	310	26	12
250	282	375	335	18	12	395	350	22	12	405	355	26	12	425	370	30	12
300	332	440	395	22	12	445	400	22	12	460	410	26	12	485	430	30	16
350	363	490	445	22	12	505	460	22	16	520	470	26	16	555	490	33	16
400	415	540	495	22	16	565	515	26	16	580	525	30	16	620	550	36	16
450	467	595	550	22	16	615	565	26	20	640	585	30	20	-	-	-	-
500	520	645	600	22	20	670	620	26	20	715	650	33	20	730	660	36	20
600	620	755	705	26	20	780	725	30	20	840	770	36	20	845	770	39	20
700	723	860	810	36	24	895	840	30	24	910	840	36	24	960	875	42	24
800	825	975	920	30	24	1015	950	33	24	1025	950	39	24	1085	990	48	24
900	928	-	-	-	-	1115	1050	33	28	1125	1050	39	28	1185	1090	48	28
1000	1032	-	-	-	-	1230	1160	36	28	1255	1170	42	28	1320	1210	56	28
1200	1220	-	-	-	-	1455	1380	39	32	1485	1390	48	32	-	-	-	-
1400	1420	-	-	-	-	1675	1590	42	35	1685	1590	48	36	-	-	-	-
1600	1620	-	-	-	-	1915	1820	48	40	1930	1820	56	40	-	-	-	-
1800	1820	-	-	-	-	2115	2020	48	44	2130	2020	56	44	-	-	-	-
2000	2020	-	-	-	-	2325	2230	48	48	2345	2230	62	48	-	-	-	-

- Flanges compliant with the standard not available

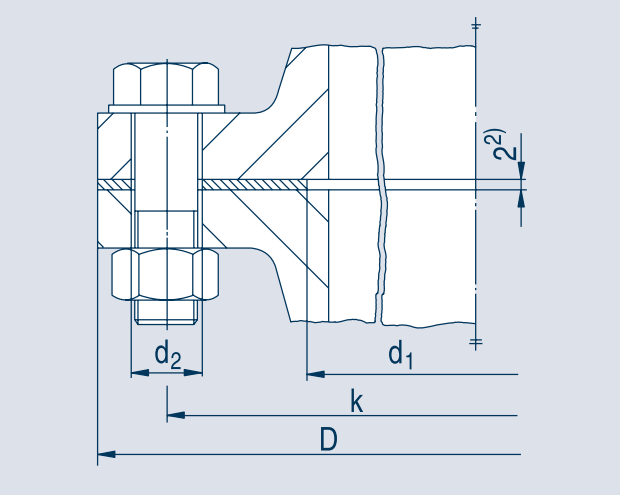
Dimensions in mm

* RSP = RivaTherm Super Plus
1) Specify material when placing order
2) Please arrange other thicknesses when ordering

Tolerances: a) for sizes up to 120 mm = ± 0,3 mm
b) for sizes over 120 mm the following applies: General tolerance: DIN 7168-m

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form FF gaskets with bolt holes for flat face flanges



Ordering example for a flat gasket, Form FF, DN 100, PN 16, conforming to EN 1514-1, made of ...[1]:
Flat gasket FF, DN 100, PN 16, EN 1514-1, RSP*

Conforming to EN 1514-1 Form FF

DN	d_1	PN 10				PN 16				PN 25				PN 40			
		D	k	d_2	Number of holes	D	k	d_2	Number of holes	D	k	d_2	Number of holes	D	k	d_2	Number of holes
10	18	90	60	14	4	90	60	14	4	90	60	14	4	90	60	14	4
15	22	95	65	14	4	95	65	14	4	95	65	14	4	95	65	14	4
20	27	105	75	14	4	105	75	14	4	105	75	14	4	105	75	14	4
25	34	115	85	14	4	115	85	14	4	115	85	14	4	115	85	14	4
32	43	140	100	18	4	140	100	18	4	140	100	18	4	140	100	18	4
40	49	150	110	18	4	150	110	18	4	150	110	18	4	150	110	18	4
50	61	165	125	18	4	165	125	18	4	165	125	18	4	165	125	18	4
60	72	175	135	18	8	175	135	18	8	175	135	18	8	175	135	18	8
65	77	185	145	18	8	185	145	18	8	185	145	18	8	185	145	18	8
80	89	200	160	18	8	200	160	18	8	200	160	18	8	200	160	18	8
100	115	220	180	18	8	220	180	18	8	235	190	22	8	235	190	22	8
125	141	250	210	18	8	250	210	18	8	270	220	26	8	270	220	26	8
150	169	285	240	22	8	285	240	22	8	300	250	26	8	300	250	26	8
200	220	340	295	22	8	340	295	22	12	360	310	26	12	375	320	30	12
250	273	395	350	22	12	405	355	26	12	425	370	30	12	450	385	33	12
300	324	445	400	22	12	460	410	26	12	485	430	30	16	515	450	33	16
350	356	505	460	22	16	520	470	26	16	555	490	33	16	580	510	36	16
400	407	565	515	26	16	580	525	30	16	620	550	36	16	660	585	39	16
450	458	615	565	26	20	640	585	30	20	670	600	36	20	685	610	39	20
500	508	670	620	26	20	715	650	33	20	730	660	36	20	755	670	42	20
600	610	780	725	30	20	840	770	36	20	845	770	39	20	890	795	48	20
700	712	895	840	30	24	910	840	36	24	960	875	42	24	-	-	-	-
800	813	1015	950	33	24	1025	950	39	24	1085	990	48	24	-	-	-	-
900	915	1115	1050	33	28	1125	1050	39	28	1185	1090	48	28	-	-	-	-
1000	1016	1230	1160	36	28	1255	1170	42	28	1320	1210	56	28	-	-	-	-
1100	1120	1340	1270	39	32	1355	1270	42	32	1420	1310	56	32	-	-	-	-
1200	1220	1455	1380	39	32	1485	1390	48	32	1530	1420	56	32	-	-	-	-
1400	1420	1675	1590	42	36	1685	1590	48	36	1755	1640	62	36	-	-	-	-
1500	1520	1785	1700	42	36	1820	1710	56	36	1865	1750	62	36	-	-	-	-
1600	1620	1915	1820	48	40	1930	1820	56	40	1975	1860	62	40	-	-	-	-
1800	1820	2115	2020	48	44	2130	2020	56	44	2195	2070	70	44	-	-	-	-
2000	2020	2325	2230	48	48	2345	2230	62	48	2425	2300	70	48	-	-	-	-

- Flanges compliant with the standard not available

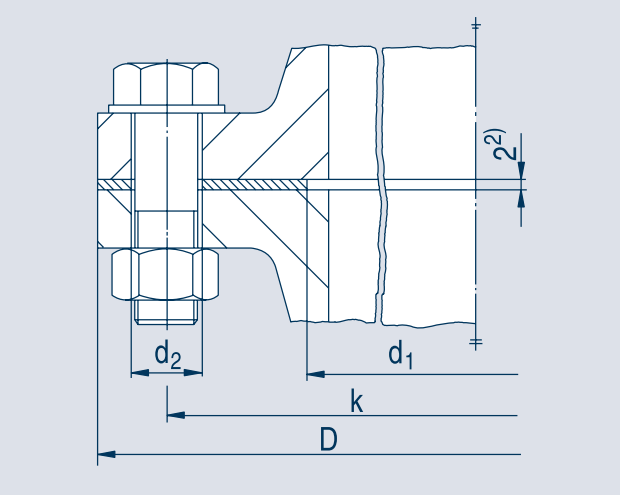
Dimensions in mm

* RSP = RivaTherm Super Plus

1) Specify material when placing order
2) Please arrange other thicknesses when ordering

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form FF gaskets with bolt holes for flat face flanges



Ordering example for a flat gasket, Form FF, Series 1, DN level 500, made of ...[1]:

Flat gasket FF, DN 82331 -1, DN 500, elastomer conforming to DIN 86076

Conforms to DIN 82331 for flanges in accordance with DIN 82330

		Series 1			
DN	d_1	D	k	d_2	Number of bolt holes
250	250	340	315	12	8
280	290	370	345	12	12
315	325	405	380	12	12
355	370	445	420	12	12
400	415	490	465	12	12
450	465	540	615	12	16
500	515	590	565	12	16
560	580	670	640	14,5	16
630	650	740	710	14,5	16
710	730	820	720	14,5	20
800	820	915	880	14,5	20
900	920	1015	980	14,5	24
1000	1020	1115	1080	14,5	24
1120	1145	1260	1220	18,5	24
1250	1280	1390	1350	18,5	28
1400	1430	1540	1500	18,5	28
1600	1630	1745	1700	18,5	32
1800	1830	1945	1900	18,5	36

Dimensions in mm

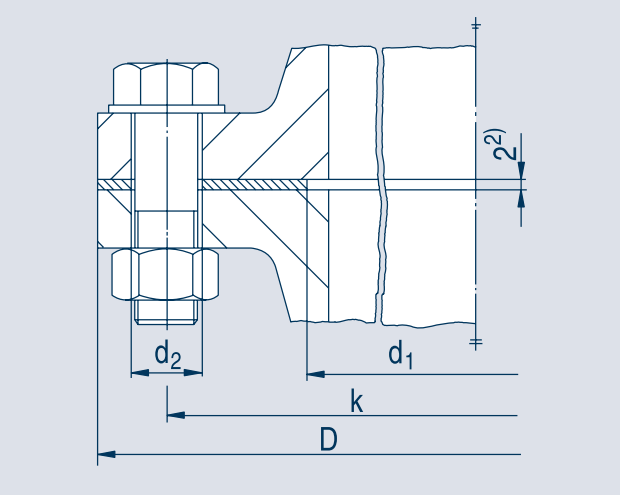
		Series 2			
DN	d_1	D	k	d_2	Number of bolt holes
250	275	355	325	14,5	12
280	305	385	355	14,5	12
315	340	420	390	14,5	12
355	380	460	430	14,5	16
400	425	505	475	14,5	16
450	480	555	525	14,5	20
500	530	605	575	14,5	20
560	590	690	650	18,5	20
630	660	760	720	18,5	20
710	740	840	800	18,5	20
800	830	930	890	18,5	24
900	930	1030	990	18,5	24
1000	1035	1130	1090	18,5	28
1120	1155	1275	1230	24	28
1260	1285	1405	1360	24	28
1400	1435	1555	1510	24	32
1600	1635	1755	1710	24	36
1800	1840	1955	1910	24	40

Dimensions in mm

[1] Specify material when placing order
[2] Please arrange other thicknesses when ordering

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form FF gaskets with bolt holes for flat face flanges



Ordering example for a flat gasket, Form FF, DN 1000, made of ...[1]:

Flat gasket FF, DN 1000, DIN 86072, RSP*

Conforms to DIN 86072

DN	d_1	D	k	d_2	Number of bolt holes
550	565	703	650	22	20
600	616	754	700	22	20
650	668	805	750	22	20
700	718	856	800	22	24
750	770	907	860	22	24
800	820	958	900	22	24
850	872	1010	950	22	28
900	922	1060	1010	22	28
950	972	1110	1060	22	28
1000	1024	1162	1110	22	32
1100	1128	1266	1210	22	32
1200	1228	1366	1310	22	36
1300	1328	1466	1410	22	40
1400	1428	1566	1510	22	40
1500	1528	1666	1610	22	44

Dimensions in mm

DN	d_1	D	k	d_2	Number of bolt holes
1600	1628	1766	1710	22	48
1700	1728	1866	1810	22	48
1800	1828	1966	1910	22	52
1900	1928	2066	2010	22	56
2000	2028	2166	2110	22	56
2100	2128	2266	2210	22	60
2200	2228	2366	2310	22	64
2300	2328	2466	2410	22	64
2400	2428	2566	2510	22	68
2500	2528	2666	2610	22	72
2600	2628	2766	2710	22	72
2700	2728	2866	2810	22	76
2800	2828	2966	2910	22	80
2900	2928	3066	3010	22	80
3000	3028	3166	3110	22	84

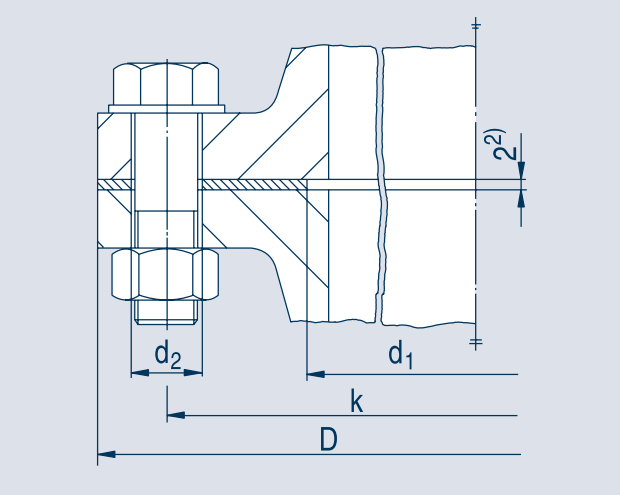
Dimensions in mm

* RSP = RivaTherm Super Plus

1) Specify material when placing order
2) Please arrange other thicknesses when ordering

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Form FF gaskets with bolt holes for flat face flanges



The basis for these tables is ASME B16.21 of 1992 with measurements in inches. The measurements in mm have been rounded off to whole numbers. We draw to your attention the fact that the measurements in millimetres and those in inches will deviate slightly from each other.

Ordering example for flat gasket with bolt holes, NPS 8, for FF flanges ASME B 16.5, Class 150 made of ...[1]:
Flat gasket FF with bolt holes, NPS 8, Class 150, ASME B16.21.RSP*

In accordance with ANSI B 16.21 for flanges in accordance with ASME/ANSI B16.5

		Class 150				Class 300			
NPS	d_1	D	k	d_2	Number of bolt holes	D	k	d_2	Number of bolt holes
½	21	89	60	16	4	95	67	16	4
¾	27	99	70	16	4	117	83	19	4
1	33	108	79	16	4	124	89	19	4
1¼	42	117	89	16	4	133	99	19	4
1½	49	127	99	16	4	155	114	22	4
2	60	152	121	19	4	165	127	19	8
2½	73	178	140	19	4	191	149	22	8
3	89	191	152	19	4	210	168	22	8
3½	102	216	178	19	8	229	184	22	8
4	114	229	191	19	8	254	200	22	8
5	141	254	216	22	8	279	235	22	8
6	168	279	241	22	8	318	270	22	12
8	219	343	298	22	8	381	330	25	12
10	273	406	362	25	12	-	-	-	-
12	324	483	432	25	12	-	-	-	-
14	356	533	476	28	12	-	-	-	-
16	406	597	540	28	16	-	-	-	-
18	457	635	578	32	16	-	-	-	-
20	508	699	635	32	20	-	-	-	-
24	610	813	749	35	20	-	-	-	-

- Flanges compliant with the standard not available

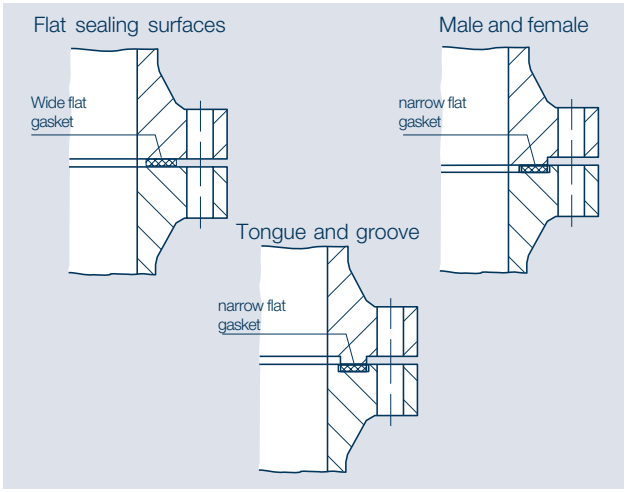
Dimensions in mm

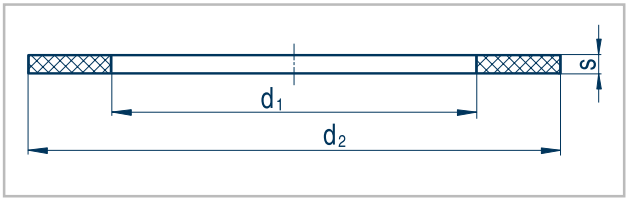
* RSP = RivaTherm Super Plus

1) Specify material when placing order
2) Please arrange other thicknesses when ordering

FLAT GASKETS MADE FROM GRAPHITE, FIBRE, PTFE, ELASTOMER

Gaskets for apparatus flange connections





Ordering example for a flat gasket of d1 = 1000 mm and d_2 = 1050 mm x 4 mm thick, made of ...[1]:
Flat gasket 1000 x 1050 x 4, DIN 28040, RSP*

Conforms to DIN 28040 for flanges in accordance with DIN 28031, 28032, 28034, 28036, 28038

DN	d_1	d_2 on bolts with screw threads									
		M 16		M 20		M 24		M 27		M 30	
		narrow	wide	narrow	wide	narrow	wide	narrow	wide	narrow	wide
150[1]	159	179	189	179	195	185	199	-	-	-	-
200[1]	219	239	249	239	255	245	259	-	-	-	-
250[1]	257	287	297	287	303	293	307	-	-	-	-
300	324	344	354	344	360	350	364	-	-	-	-
350	368	388	398	388	404	394	408	-	-	-	-
400	419	439	449	439	455	445	459	-	-	-	-
450[1]	457	477	487	477	493	483	497	-	-	-	-
500	508	528	538	528	544	534	548	540	558	-	-
600	600	626	640	626	640	632	650	632	655	636	660
700	700	726	740	726	740	732	750	732	755	736	765
800	800	826	840	826	840	832	850	832	855	836	865
900	900	-	940	926	940	932	950	932	955	936	965
1000	1000	-	1040	1026	1040	1032	1050	1032	1060	1036	1065
1100	1100	-	1140	1126	1140	1132	1150	1132	1160	1136	1165
1200	1200	-	1250	1226	1240	1232	1250	1232	1260	1236	1265
(1300)	1300	-	1350	1326	1340	1332	1350	1332	1360	1336	1365
1400	1400	-	1450	1426	1440	1432	1450	1432	1460	1436	1465
(1500)	1500	-	1550	1526	1540	1532	1550	1532	1565	1536	1570
1600	1600	-	1650	1626	1640	1632	1650	1632	1665	1636	1670
(1700)	1700	-	1750	1726	1740	1732	1750	1732	1765	1736	1770
1800	1800	-	-	1826	1840	1832	1855	1832	1865	1836	1870
1900[1]	1900	-	-	1926	1940	1932	1955	1932	1970	1936	1975
2000	2000	-	-	2026	2040	2032	2055	2032	2070	2036	2075
2100[1]	2100	-	-	2126	2140	2132	2155	2132	2170	2136	2180
2200	2200	-	-	2226	2240	2232	2255	2232	2270	2236	2280
2300[1]	2300	-	-	2326	2340	2332	2355	2332	2370	2336	2380
2400	2400	-	-	2426	2445	2432	2455	2432	2475	2436	2480
2600	2600	-	-	2626	2645	2632	2660	2632	2675	2636	2680
2800	2800	-	-	2826	2845	2832	2865	2832	2875	2836	2880
3000	3000	-	-	3026	3045	3032	3065	3032	3080	3036	3080
3200	3200	-	-	3226	3245	3232	3265	3232	3280	3236	3280
3400	3400	-	-	-	3460	-	-	-	-	-	-
3600	3600	-	-	-	3660	-	-	-	-	-	-
3800	3800	-	-	-	3860	-	-	-	-	-	-
4000	4000	-	-	-	4060	-	-	-	-	-	-

Dimensions in mm

Nominal diameter on bolts with screw threads		S	3	4	5
	Wide flat gasket (FB)	M 16	300 to 1100	1200 to 1700	-
		M 20	300 to 2200	2400 to 4000	-
		M 24	300 to 500	600 to 2600	2800 to 3200
		M 27	-	500 to 1400	1500 to 3200
		M 30	-	600	700 to 3200
	narrow flat gasket (FS)	M 16 to M 30	300 to 3200	–	

* RSP = RivaTherm Super Plus
[1] No longer contained in DIN edition 2.89. Avoid nominal diameters in brackets if at all possible.

RUBBER-STEEL GASKETS

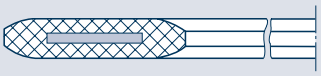
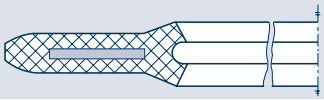
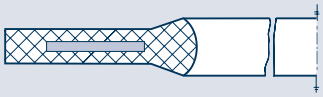
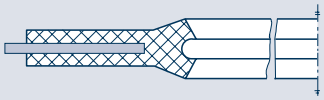
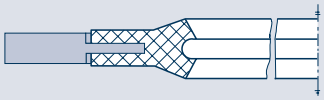
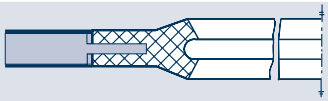
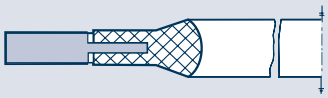
04

Rubber-steel gaskets have amassed a wide range of applications in sealing technology. Wherever the secure sealing of media with an exceptionally low leak rate, as well as low bolt loads at relatively low temperatures is required, rubber-steel gaskets provide the optimal solution.

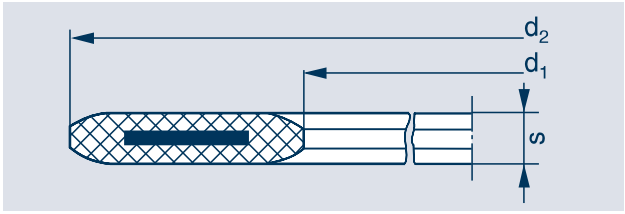
The steel support ring prevents a blow out of the gasket and increases stability, allowing the rubber-steel gasket to be handled easily, even in difficult fitting conditions.

The rubber sealing material ensures a secure seal is created, even in uneven locations, as it has an excellent ability to adapt to sealing surfaces. In conforming to the maximum allowable installation surface pressure, rubber-steel gaskets fulfil the requirements of the TA Luft having regard to clause 3.3.1.4 of the VDI Guidelines 2440.

Gasket profiles

Profile	Cross-section
WG	
WG2	
WG2P	
WS	
WL	
WL-HT	
KNG	

RUBBER-STEEL GASKETS



Rubber-steel gaskets Profile WG

Main load gasket

The rubber-steel gasket Profile WG consists of a steel ring (1.0330) which is surrounded on all sides by rubber. The steel ring is therefore protected from corrosion and media. Vulcanisation guarantees a high level of adhesive strength between the rubber and the steel ring.

EN 1514-1 flanges to EN 1092-1

For DIN/EN flanges

DN	d_1	d_2 PN6	PN10	PN16	PN25	PN40	s
15	22	-	51	51	51	51	3
20	27	-	61	61	61	61	3
25	34	-	71	71	71	71	3
32	43	-	82	82	82	82	3
40	49	-	92	92	92	92	3
50	61	-	107	107	107	107	4
65	77	-	127	127	127	127	4
80	89	-	142	142	142	142	4
100	115	-	162	162	168	168	5
125	141	-	192	192	-	-	5
150	169	-	218	218	224	224	5
175	195	-	248	248	-	-	5
200	220	-	273	273	284	-	6
250	273	-	328	329	340	-	6
300	324	-	378	384	400	417	6
350	356	423	438	444	457	474	7
400	407	473	489	495	517	-	7
450	458	-	539	-	-	-	7
500	508	578	594	617	-	-	7
600	610	-	695	734	-	-	7
700	712	785	810	-	-	-	8
800	813	890	917	911	-	-	8
900	915	-	1017	1011	-	-	8
1000	1016	-	1124	1128	-	-	8
1200	1220	-	1341	1342	-	-	8
1400	1422	-	1548	1542	-	-	8
1600	1620	-	1772	1754	-	-	8
1800	1820	-	1972	1964	-	-	8

Dimensions in mm

Features:

- high level of security against slippage or blow out provided by the steel reinforcement
- simple, secure and cost-effective installation due to its stability, compared to non-reinforced rubber gaskets
- exceptionally low leakage rate due to the homogeneous rubber casing, making it particularly suitable for pipeline systems carrying media harmful to the environment
- low demand on the flange surface due to the soft, flexible sealing surface, seals can even be created with slightly damaged flanges

Typical field of application:

- gas and water supply
- chemical industries where aggressive and environmentally-harmful media are used
- flue gas cleaning systems and power plant cooling circuits
- wastewater systems
- pipeline construction with vacuum-operated pipelines
- pipeline systems with all-rubber flange sealing surfaces
- with enamel pipelines and apparatus flanges.

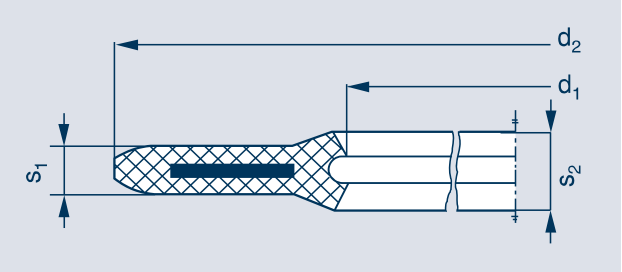
For ANSI/ASME B16.5 flanges*

NPS	d_1	d_2 class 150	class 300	s
½	18	46	-	3
¾	27	54	-	3
1	33	64	70	3
1¼	42	73	-	3
1½	48	83	-	3
2	60	102	108	4
2½	73	121	-	4
3	89	134	-	4
3½	102	159	-	4
4	115	172	-	4
5	141	194	-	5
6	168	220	-	5
8	219	277	-	6
10	273	337	-	6
12	324	407	-	6
14	356	448	-	7
16	406	512	-	7
18	457	547	-	7
20	508	604	-	7
22	560	658	-	7
24	610	715	-	7

* currently only available in NBR 50219.0

Dimensions in mm

RUBBER-STEEL GASKETS



Rubber-steel gaskets Profile WG2

Main load gasket

The rubber-steel gasket Profile WG2 has two stable sealing lips on its internal sealing diameter and the same design as rubber-steel gasket Profile WG on its external diameter.

Conforms to DIN 2690* (PN 10 to PN 40)

Ordering example:
Profile WG2, NBR quality, DN 300, PN 10, DIN 2690

Features:

» Leak-proof even at the lowest tightening torques, making the rubber-steel gasket Profile WG2P particularly suitable for plastic flange connections where no high forces can be exerted.

» Optimum smoothing of flange unevennesses by the flexible sealing lips, particularly when an all-over sealing cannot always be guaranteed, as with GRP flanges.

Typical fields of application:

» Plastic and GRP flange connections

» Sealing of vacuum-operated pipeline systems in the chemical industry

» Gas and drinking water supply

» Sealings of highly-flexible flanges

For DIN/EN flanges

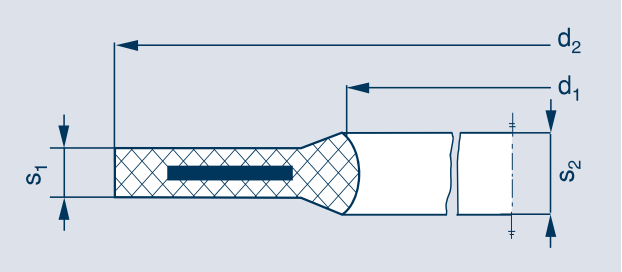
		d_2					
DN	d_1	**PN 10**	**PN 16**	**PN 25**	**PN 40**	s_1	s_2
25	35	70	70	70	70	4	6
32	43	82	82	82	82	4	6
40	49	92	92	92	92	4	6
50	61	107	107	107	107	4	6
65	77	127	127	127	127	4	6
80	90	142	142	142	142	4	6
100	115	162	162	168	168	5	7,5
125	141	192	192	-	-	5	7,5
150	169	218	218	225	225	5	7,5
175	195	248	248	-	-	5	7,5
200	220	273	273	285	292	6	9
250	274	328	330	342	353	6	9
300	325	378	385	402	418	6	9
350	368	438	445	-	-	7	11
400	420	490	-	-	-	7	11
450	470	540	-	-	-	7	11
500	520	595	-	-	-	7	11
600	620	695	735	-	-	7	11
700	720	810	-	-	-	8	12

Other sizes available on request

Dimensions in mm

*DIN 2690 has been replaced by DIN EN 1514-1.

RUBBER-STEEL GASKETS



Rubber-steel gaskets Profile WG2P

Main load gasket

The WG2P rubber-steel gasket is a main load gasket. On the internal diameter it has a profile sealing lip and in the gasket diameter it has a steel core, similar to the WG rubber-steel gasket.

The rubber-steel gasket Profile WG2P consists of a steel ring (1.0330) which is surrounded on all sides by rubber. The steel ring is therefore protected from corrosion and media. Vulcanisation guarantees a high level of adhesive strength between the rubber and the steel ring.

Features:

» Leak-proof even at the lowest tightening torques, making the rubber-steel gasket Profile WG2P particularly suitable for plastic flange connections where no high forces can be exerted.

» Optimum smoothing of flange unevennesses by the flexible sealing lips, particularly when an all-over sealing cannot always be guaranteed, as with GRP flanges.

Typical fields of application:

» Plastic and GRP flange connections

» Sealing of vacuum-operated pipeline systems in the chemical industry

» Gas and drinking water supply

» Sealings of highly-flexible flanges

For ANSI/ASME B16.5 flanges

NPS	d_1	d_2 class 150	d_2 class 300	s_1	s_2
½	18	45	51	3	4
¾	27	54	64	3	4
1	34	64	70	3	4
1¼	42	74	81	3	4
1½	48	85	92	3	4
2	60	102	108	4	5
2½	73	121	127	4	5
3	89	134	146	4	5
3½	102	159	162	4	5
4	114	172	178	5	6,5
5	141	194	213	5	6,5
6	168	220	247	5	6,5
8	219	277	305	6	8
10	273	338	359	6	8
12	324	407	419	6	8
14	356	448	482	7	10
16	406	512	537	7	10
18	457	547	594	7	10
20	508	604	651	7	10
24	610	715	772	7	10

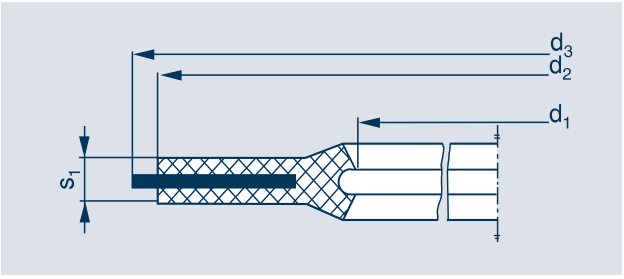
Other sizes available on request. Dimensions in mm

RUBBER-STEEL GASKETS

Rubber-steel gaskets Profile WS

Main load gasket

The rubber-steel gasket Profile WS consists of a central support ring and a rubber sealing ring with integrally moulded sealing lips. The central support ring is available in galvanised and chromated carbon steel, stainless steel or plastic.



Works standard 182 for DIN/EN flanges (PN 10 PN 25)

Ordering example:
Profile WS, NBR/1.4541, DN 300, PN 10,
Works standard 182

Works standard 183 for flanges in accordance with ANSI/ASME B16.5 (Class 150 to Class 300)

Ordering example:
Profile WS, NBR/1.4541, NPS 1, Class 150

For DIN/EN flanges

DN	d_1	d_2	d_3 PN 10	d_3 PN 16	d_3 PN 25	s_1
10	18	45	45	45	45	4
15	22	50	50	50	50	4
20	28	60	60	60	60	4
25	35	70	70	70	70	4
32	43	82	82	82	82	4
40	49	92	92	92	92	4
50	61	102	107	107	107	4
65	77	121	127	127	127	4
80	90	134	142	142	142	4
100	115	162	162	162	168	4
125	141	192	192	192	195	4
150	169	218	218	218	225	4
175	195	248	248	248	255	4
200	220	273	273	273	285	4
250	274	328	328	330	342	4
300	325	378	378	385	402	4
350	368	438	438	445	458	4
400	420	490	490	497	515	4
450	470	540	540	557	565	8
500	520	590	595	618	625	8
600	620	690	695	735	730	8
700	720	800	810	805	830	8
800	820	900	915	910	940	8
900	920	1010	1015	1010	1040	8
1000	1020	1110	1120	1125	1150	8
1200	1220	1310	1340	1340	1360	8
1400	1420	1510	1545	1540	1575	8
1600	1620	1710	1770	1760	1795	8
1800	1820	1910	1970	1960	2000	8
2000	2020	2110	2180	2165	2230	8
2200	2220	2310	2380	2375	-	8
2400	2420	2510	2590	2585	-	8
2600	2620	2710	2790	2785	-	8
2800	2820	2910	3010	-	-	8
3000	3020	3110	3225	-	-	8

Other sizes available on request.
Gaskets for PN6 flanges available on request.

Dimensions in mm

For ANSI/ASME B16.5 flanges

NPS	d_1	d_2	d_3 class 150	d_3 class 300	s_1
½	18	45	45	51	4
¾	22	50	54	64	4
1	28	60	64	70	4
1¼	35	70	73	82	4
1½	43	82	83	93	4
2	61	102	102	108	4
2½	77	121	121	127	4
3	90	134	134	146	4
3½	102	159	159	162	4
4	115	162	172	178	4
5	141	192	194	213	4
6	169	218	220	248	4
8	220	273	277	305	4
10	274	328	337	359	4
12	325	378	407	419	4
14	368	438	448	483	4
16	420	490	512	537	4
18	470	540	547	594	8
20	520	590	604	651	8
22	560	630	658	702	8
24	620	690	715	772	8

Dimensions in mm

RUBBER-STEEL GASKETS

Works standard 184 for flanges in accordance with ASM E B16.47 Series A[1] (Class 150 to Class 300)

Injection-moulded gasket, vulcanised

Ordering example:
Profile WS, NBR/1.4541, NPS 26, Class 150,

Works standard 185 for flanges in accordance with ASM E B16.47 Series B[2] (Class 150 to Class 300)

Injection-moulded sealing ring, vulcanised

Ordering example:
Profile WS, NBR/1.4541, NPS 26, Class 150,

For ASME B16.47 Series A flanges

NPS	d_1	d_2	d_3 class 150	d_3 class 300	s_1
26	665	745	771	832	8
28	720	800	829	895	8
30	770	850	880	949	8
32	820	900	937	1003	8
34	865	945	987	1054	8
36	920	1010	1045	1114	8
38	965	1045	1108	1051	8
40	1020	1110	1159	1111	8
42	1070	1160	1216	1162	8
44	1120	1210	1273	1216	8
46	1170	1260	1324	1270	8
48	1220	1310	1381	1321	8
50	1270	1360	1432	1375	8
52	1320	1410	1489	1425	8
54	1370	1460	1546	1489	8
56	1430	1520	1603	1540	8
58	1475	1565	1660	1590	8
60	1530	1620	1711	1641	8

[1] Previously MSS SP-44

Dimensions in mm

For ASME B16.47 Series B flanges

NPS	d_1	d_2	d_3 class 150	d_3 class 300	s_1
26	650	720	722	768	8
28	700	770	773	822	8
30	745	815	824	883	8
32	795	875	878	937	8
34	850	930	932	991	8
36	900	980	984	1045	8
38	950	1040	1041	1095	8
40	1000	1090	1092	1146	8
42	1050	1140	1143	1197	8
44	1100	1190	1194	1248	8
46	1150	1240	1252	1314	8
48	1200	1290	1303	1365	8
50	1250	1340	1354	1416	8
52	1300	1390	1405	1467	8
54	1350	1440	1460	1527	8
56	1400	1490	1511	1591	8
58	1450	1540	1576	1653	8
60	1500	1590	1627	1703	8

[2] Previously API 605
Other sizes available on request

Dimensions in mm

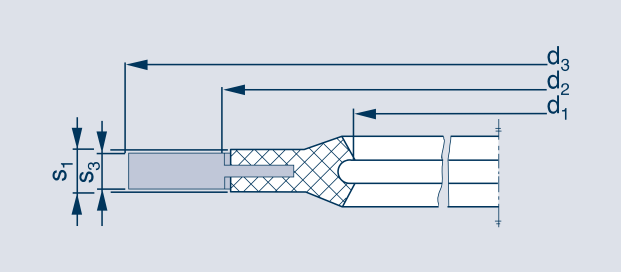
Features:

- Easy to replace the rubber sealing rings, meaning the rubber-steel gasket Profile WS can be reused again and again
- Safe to use and easy to handle the rubber sealing material, even at large nominal sizes
- Special sizes can be produced without incurring additional costs, from an internal diameter of approx. 400 mm.

Typical field of application:

- Sealing tank flange connections
- Sealing special flanges
- Sealing cooling and condensate pipelines in power plants

RUBBER-STEEL GASKETS



Rubber-steel gaskets Profile WL

Metal-to-metal contact gasket

The rubber-steel gasket Profile WL in its standard form consists of a galvanised and chromated metal support ring and a rubber sealing ring with integrally moulded sealing lips. The support ring is also available in stainless steel or plastic. In contrast to traditional gaskets, the rubber sealing ring in the rubber-steel gasket Profile WL is in off load contact. This means that any forces that are too high for the rubber sealing ring are borne by the support ring.

Another advantage is that the rubber sealing ring is chambered outwards by the support ring. With the creation of a metal-to-metal seal, very high internal pressures and additional forces from the pipeline system can be permitted. The rubber-steel gasket Profile WL combines all the advantages of a rubber gasket with those of a metal gasket.

Features:

» impossible to over load the rubber sealing ring

» seal is secure, even with large fluctuations or surges in pressure

» impervious to additional pipelines forces

easy and safe installation, reduces the risk of installation errors caused by applying too high or uneven bolt tightening torques (the most common reason for the failure of a rubber-steel gasket)

» simple replacement of the rubber sealing ring, making it reusable

» Special sizes can be produced without incurring additional costs, from an internal diameter of approx. 400 mm.

» can be used for a range of applications due to the very large range of surface pressure limits.

Typical field of application:

» High pressure lines such as e.g. gas distribution pipelines, gas pressure control systems

» Pipeline construction such as e.g. in underground pipelines

» flue gas cleaning systems and power plant cooling circuits

» Pipeline and apparatus construction with partly-rubber flange sealing surfaces.

In order to determine the flange recess required for the rubber coating we would be happy to provide our design recommendations.

RUBBER-STEEL GASKETS

Works standard 178 for DIN/EN flanges (PN 10 to PN 160)

Ordering example:
Profile WL, NBR/carbon steel galvanised and chromated,
DN 200, PN 63, Works standard 178

Works standard 179 for flanges in accordance with ANSI/ ASME B 16.5 (Class 150 to Class 2500)

Ordering example:
Profile WL, NBR/1.4541, NPS 5, Class 150,
Works standard 179

For DIN/EN flanges

			PN			d_3					
DN	d_1	d_2	10	16	25	40	63	100	160	s_1	s_3
10	18	37	45	45	45	45	56	56	56	4	3
15	22	39	50	50	50	50	61	61	61	4	3
20	28	45	60	60	60	60	-	-	-	4	3
25	35	55	70	70	70	70	82	82	82	4	3
32	43	63	82	82	82	82	-	-	-	4	3
40	49	75	92	92	92	92	103	103	103	4	3
50	61	82	107	107	107	107	113	119	119	4	3
65	77	97	127	127	127	127	137	143	143	4	3
80	90	115	142	142	142	142	148	154	154	4	3
100	115	149	162	162	168	168	174	180	180	4	3
125	141	175	192	192	195	195	210	217	217	4	3
150	169	205	218	218	225	225	247	257	257	4	3
175	195	235	248	248	255	267	277	287	284	4	3
200	220	260	273	273	285	292	309	-	324	4	3
250	274	309	328	330	342	353	364	391	388	4	3
300	325	360	378	385	402	418	424	458	458	4	3
350	368	400	438	445	458	475	486	512	-	4	3
400	420	460	490	497	515	547	543	572	-	4	3
450	470	515	540	557	565	572	-	-	-	8	6
500	520	565	595	618	625	628	657	704	-	8	6
600	620	665	695	735	730	745	764	813	-	8	6
700	720	775	810	805	830	850	879	950	-	8	6
800	820	875	915	910	940	970	988	-	-	8	6
900	920	985	1015	1010	1040	1080	1108	-	-	8	6
1000	1020	1085	1120	1125	1150	1190	1220	-	-	8	6
1200	1220	1295	1340	1340	1360	1395	1452	-	-	8	6
1400	1420	1495	1545	1540	1575	1615	-	-	-	8	6
1600	1620	1705	1770	1760	1795	1830	-	-	-	8	6
1800	1820	1905	1970	1960	2000	-	-	-	-	8	6
2000	2020	2105	2180	2165	2230	-	-	-	-	8	6
2200	2220	2305	2380	2375	-	-	-	-	-	8	6
2400	2420	2505	2590	2585	-	-	-	-	-	8	6
2600	2620	2705	2790	2785	-	-	-	-	-	8	6
2800	2820	2905	3010	-	-	-	-	-	-	8	6
3000	3020	3105	3225	-	-	-	-	-	-	8	6

Gaskets for PN6 flanges available on request

Dimensions in mm

For ANSI/ASME B16.5 flanges

			class d_3								
NPS	d_1	d_2	150	300	400	600	900	1500	2500	s_1	s_3
½	16	32	45	51	51	51	61	61	67	4	3
¾	22	39	54	64	64	64	67	67	73	4	3
1	28	45	64	70	70	70	76	76	83	4	3
1¼	35	55	73	80	80	80	86	86	102	4	3
1½	43	63	83	93	93	93	95	95	114	4	3
2	61	82	102	108	108	108	140	140	143	4	3
2½	77	97	121	127	127	127	162	162	165	4	3
3	90	115	134	146	146	146	165	172	194	4	3
3½	102	128	159	162	159	159	-	-	-	4	3
4	115	149	172	178	175	191	203	207	232	4	3
5	141	175	194	213	210	238	245	251	276	4	3
6	169	205	220	248	245	264	286	280	314	4	3
8	220	260	277	305	302	318	356	349	384	4	3
10	274	309	337	359	356	397	432	432	473	4	3
12	325	360	407	419	416	454	496	518	546	4	3
14	368	400	448	483	480	489	518	575	-	4	3
16	420	460	512	537	534	562	572	638	-	4	3
18	470	515	547	594	591	610	635	702	-	8	6
20	520	565	604	651	645	680	696	753	-	8	6
22	560	605	658	702	-	730	-	-	-	8	6
24	620	665	715	772	766	788	835	899	-	8	6

Dimensions in mm

RUBBER-STEEL GASKETS

04

Works standard 180 for flanges in accordance with ASME B16.47 Series A[1] (Class 150 to Class 900)

Ordering example:
Profile WL, NBR/1.4541, NPS 26, class 150,
Works standard 180

For ASME B16.47 Series A flanges

			class		d_3				
NPS	d_1	d_2	150	300	400	600	900	s_1	s_3
26	665	720	771	832	829	864	880	8	6
28	720	775	829	895	889	911	943	8	6
30	770	825	880	949	943	968	1006	8	6
32	820	875	937	1003	1000	1019	1070	8	6
34	865	920	987	1054	1051	1070	1133	8	6
36	920	975	1045	1114	1114	1127	1197	8	6
38	965	1020	1108	1051	1070	1102	1197	8	6
40	1020	1075	1159	1111	1124	1152	1248	8	6
42	1070	1125	1216	1162	1175	1216	1298	8	6
44	1120	1175	1273	1216	1229	1267	1365	8	6
46	1170	1225	1324	1270	1286	1324	1432	8	6
48	1220	1275	1381	1321	1343	1387	1483	8	6
50	1270	1325	1432	1375	1400	1445	-	8	6
52	1320	1375	1489	1425	1451	1495	-	8	6
54	1370	1425	1546	1489	1515	1552	-	8	6
56	1430	1485	1603	1540	1565	1610	-	8	6
58	1475	1530	1660	1590	1616	1660	-	8	6
60	1530	1585	1711	1641	1680	1730	-	8	6

[1] Previously MSS SP-44

Dimensions in mm

Works standard 181 for flanges in accordance with ASME B16.47 Series B[2] (Class 150 to Class 900)

Ordering example:
Profile WL, NBR/1.4541, NPS 26, class 150,
Works standard 181

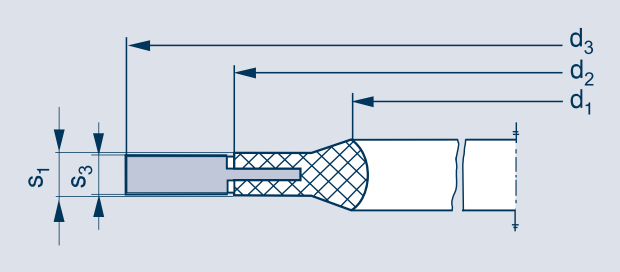
For ASME B16.47 Series B flanges

			class		d_3				
NPS	d_1	d_2	150	300	400	600	900	s_1	s_3
26	650	695	722	768	743	762	835	8	6
28	700	745	773	822	797	816	899	8	6
30	745	790	824	883	854	876	956	8	6
32	795	840	878	937	908	930	1013	8	6
34	850	895	932	991	959	994	1070	8	6
36	900	945	984	1045	1019	1045	1121	8	6
38	950	1000	1041	1095	1070	1102	1197	8	6
40	1000	1050	1092	1146	1124	1152	1248	8	6
42	1050	1100	1143	1197	1175	1216	1298	8	6
44	1100	1150	1194	1248	1229	1267	1365	8	6
46	1150	1205	1252	1314	1286	1324	1432	8	6
48	1200	1255	1303	1365	1343	1387	1483	8	6
50	1250	1305	1354	1416	1400	1445	-	8	6
52	1300	1355	1405	1467	1451	1495	-	8	6
54	1350	1405	1460	1527	1515	1552	-	8	6
56	1400	1455	1511	1591	1565	1604	-	8	6
58	1450	1515	1576	1653	1616	1660	-	8	6
60	1500	1565	1627	1703	1680	1730	-	8	6

[2] Previously API 605

Dimensions in mm

RUBBER-STEEL GASKETS



The rubber-steel gasket with an elastomer gasket ring in the force shunt version in accordance with DIN 30690-1.

Rubber-steel gaskets profile KNG

– Elastomer sealing element in force shunt –

The KNG rubber-steel gasket profile is comprised of a NBR rubber gasket ring and a supporting ring made of coated steel. The KNG profile functions according to the principle of the force shunt. All of the forces that are too high for the rubber gasket ring are absorbed by the supporting ring in the force shunt. This makes it possible to apply high surface pressures which allows secure sealing of high inner pressures. An overload of the NBR rubber gasket ring due to inadmissible additional pipe forces is prevented.

The design complies with the specifications of DIN 30690-1 for use in the gas area and has the required labelling. The gasket is delivered with labelling in conformity with the standards, showing the manufacturer, manufacturer designation, material, nominal pressure, nominal width and manufacturing date of the elastomer.

Special features:

- complies the DIN 30690-1
- certification in accordance with DIN EN 102014 3.1 for the support and in accordance with DIN 10204 2.2 for the sealing lip
- impossible to over load the rubber sealing ring
- impervious to additional pipelines forces
- easy and safe installation, reduces the risk of installation errors caused by applying too high or uneven bolt tightening torques (the most common reason for the failure of a rubber-steel gasket)
- coating in RAL1003 in conformity with DIN 2403

For DIN/EN flanges

DN	d_1	d_2	PN / d_3 10	16	25	40	63	100	160	S_1	S_3
10	18	36	46	46	46	46	-	-	-	4,75	4
15	22	40	51	51	51	51	-	-	-	4,75	4
20	27	45	61	61	61	61	-	-	-	4,75	4
25	34	57	71	71	71	71	-	-	-	4,75	4
32	43	66	82	82	82	82	-	-	-	4,75	4
40	49	75	92	92	92	92	-	-	-	4,75	4
50	61	87	107	107	107	107	-	-	-	4,75	4
65	77	103	127	127	127	127	-	-	-	4,75	4
80	89	115	142	142	142	142	-	-	-	4,75	4
100	115	147	162	162	168	168	-	-	-	4,75	4
125	141	173	192	192	194	194	-	-	-	4,75	4
150	169	201	218	218	224	224	-	-	-	4,75	4
200	220	253	273	273	284	290	-	-	-	4,75	4
250	273	306	328	329	340	352	-	-	-	4,75	4
300	324	357	378	384	400	417	-	-	-	4,75	4
350	356	399	438	444	457	474	-	-	-	4,75	4
400	407	450	489	495	514	546	-	-	-	4,75	4

Sizes acc. to EN DIN 1514-1.
Other sizes available on request.
Also available for flanges acc. to ASME DIN EN 1759-1.

Area of application:

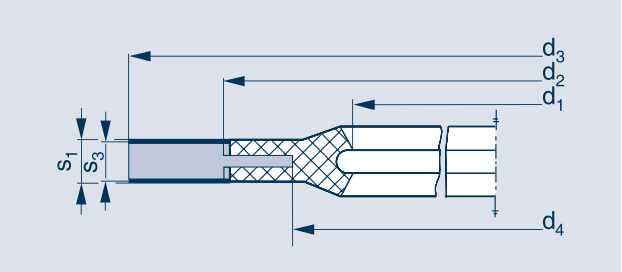
- for design pressures DP up to 100 bar (in accordance with DIN 30690-1)
- higher DP possible

Typical field of application:

- High pressure lines such as e.g. gas distribution pipelines, gas pressure control systems
- underground pipelines

DVGW CERT

RUBBER-STEEL GASKETS



Rubber-steel gaskets Profile WL-HT

Metal-to-metal gasket, HTB (high thermal load) tested

The rubber-steel gasket Profile WL-HT is essentially designed in the same way as the gasket Profile WL, except that the support ring is made with layers of graphite. The rubber sealing lip is made of NBR 50219.0 and the support ring is made of galvanised and chromated metal. In normal use the rubber sealing lip forms the primary seal. Under extreme thermal loads, such as during a fire, the support ring with graphite layers provides the seal.

Features:

» certified and tested under high thermal loads at 650 °C, 30 minutes by the DVGW research centre, Karlsruhe for flange connections in accordance with DIN EN 1092-1.

» has all the features of the rubber-steel gasket Profile WL

» Easy to replace the rubber sealing rings and graphite layers, meaning the rubber-steel gasket Profile WLHT can be reused again and again

Typical field of application:

» Domestic gas supplies with flanged house connection combinations, pressure regulators and gas metres

» Gas stations

For DIN/EN flanges

			d_3				
DN	d_1	d_2	PN16	PN40	d_4	S_1	S_3
25	35	57	70	70	44	4,7	3,7
32	43	68	82	82	52	4,7	3,7
40	49	75	92	92	58	4,7	3,7
50	61	90	107	107	71	4,7	3,7
80	90	121	142	142	100	4,7	3,7
100	111	142	162	168	124	4,7	3,7
150	163	195	218	225	176	4,7	3,7
200	212	248	273	-	225	4,7	3,7

Other sizes available on request. Dimensions in mm

RUBBER-STEEL GASKETS

Gasket characteristic values, calculations, rubber qualities

Main load gaskets:

Profile	Material	Description	Unit	Temp. ϑ in the gasket area 20 °C	100 °C
WG WG2 WG2P WS	FKM	σ_v	N/mm²	2	2
		σ_ϑ	N/mm²	15	7
WG WG2 WG2P WS	NBR, EPDM NR*	σ_v	N/mm²	2	2
		σ_ϑ	N/mm²	15	6

* only up to 80 °C

Rubber qualities for rubber-steel gaskets:

Quality		Temperature range in °C		
NBR	50219.5*	-30	to	100
NR	Natural rubber	-50	to	80
EPDM	e.g. Buna AP	-40	to	110
EPDM	Peroxide vulcanisation**	-40	to	130
FKM	e.g. Viton	-20	to	200

The thermal resistance relates to air.

* NBR 50219.5 is certified for use with gas and drinking water

Certified in accordance with:

» DVGW-DIN/EN 682 (Gas supply distribution pipelines)

** EPDM 50324.1 Peroxide is certified for use with drinking water supplies

Certified in accordance with:

» the elastomeric guidline

» DVGW Worksheet W270 (microbiological test)

All approval and tests can be found at www.klinger-kempchen.de

For the steel part in the main-load, range d_2 and d_3

Profile	Material	Description	Unit	Temp. ϑ in the gasket area	
WL	carbon steel	σ_V	N/mm²	12	12
		σ_ϑ	N/mm²	450	450
WL-HT	carbon steel / graphite	σ_V	N/mm²	12	12
		σ_ϑ	N/mm²	120	120
KNG	carbon steel	σ_V	N/mm²	12	12
		σ_ϑ	N/mm²	120	120

For the rubber part in the off-load, range d_4 and d_2

Profile	Material	Description	Unit	Temp. ϑ in the gasket area	
WL WL-HT KNG	NBR, EPDM	σ_V	N/mm²	12	12

CORRUGATED GASKETS

04

Corrugated gaskets are universally applicable sealing elements. Due to the wide range of shapes that they can be produced in - including rings, ovals, elongated ovals or frames, with or without dividers, holes and retaining plates -they continue to be used in new areas. The gaskets can be fully or partially coated. Corrugated gaskets with torque support have proven excellent when used with inflexible flanges.

Even with unmachined flanges, a satisfactory seal can be achieved with the use of suitable soft-material layers. The gaskets can be produced in all the usual sizes up to 6000 mm.

The corrugation on the carrier hold the layers in place. The gaskets are also suitable for use with vacuums.

Gaskets of the **Profile W1A** consist of a carrier ring W1 with layers on both sides - PTFE for use at temperatures of up to 250 °C, or graphite for temperatures of approx. 500 °C with atmospheric oxygen influx. When fitted, the soft plastic layers are pressed into the corrugation. This creates an extremely elastic sealing element with a low leakage rate.

In pieces with large diameters and sealing widths, or where there are bumps on the existing flange, it is particularly useful to have layers of RivaTherm Super on both sides. This provides the seal with better stability and evenness. RivaTherm Super layers are made from expanded graphite with a stainless steel sheet metal insert. The 1 mm product is designated RS1E1 and the 2 mm product is RS2E1. The layer width for RivaTherm Super should be at least 15 mm. The type of layer required should be specified in each case.

Gaskets with an unlined central edge are marked as **Profile W11A**. For large sealing diameters above DN 1200 we recommend that gaskets of either **Profile W2A** or **Profile W12A** be used. These gaskets are fitted with a stabilising ring as well as a W1A seal on both sides, making them very inherently stable with a greater ability to conform to the surface of the flange.

The gaskets can also be provided with an F1 external eyelet, such as in e.g. **Profile W1A-3F1**.

Gasket profiles

Profile	Cross-section
W1A	
W1A-3	
W1A-3·F1	
W11A	
W2A	
W12A	

Gasket limiting values

Profiles			W1A, W11A		W1A-3	
Materials			1.4541 graphite	1.4541 PTFE	1.4571 graphite	1.4571 PTFE
Recommended max. roughness of the flange surfaces	µm	from	25	50	25	50
		to	50	100	50	100
Surface pressure limits for 20 °C	N/mm²	σ_v	15	15	15	15
		σ_ϑ	180	180	200	200
Surface pressure limits for 300 °C	N/mm²	σ_v	20	-	20	-
		σ_ϑ	150	-	150	-

You can find gasket characteristic values in accordance with EN13555 on our homepage at www.klinger-kempchen.de

CORRUGATED GASKETS

Corrugated ring gasket W1A-RS 2E2 for manhole covers on steam boiler systems in accordance with TRD 401

(Expired on 1st January 2013.)

Steam drums in energy producing and recycling plants use oval manhole covers with internal caps at pressures of up to 250 bar and temperatures of up to 450 °C. For applications such as these we recommend the use of metal/soft-material gaskets. For manhole covers on steam boiler systems operating in accordance with **TRD 401** with pressure of up to **40 bar** and temperatures of up to **250 °C**, and frequently in excess of that, the corrugated ring gaskets **W1A** with RivaTherm Super layers on both sides RS2E2 in the 2 mm size have proven to be extremely useful.

The **W1A** gaskets with layers of RS2E2 have been tested by the South German TUV for compliance with TRD 401 and as a result of the tests have received the TUV approval mark. The approval mark was granted in compliance with the associated TUV technical specification sheet Gasket 100 and TRD 401 Appendix 1, and highest class “Test Class d“ was awarded.

With appropriate dimensioning of the gasket with regard to measurements, it can withstand pressures of up to 400 bar and temperatures of up to 500 °C.

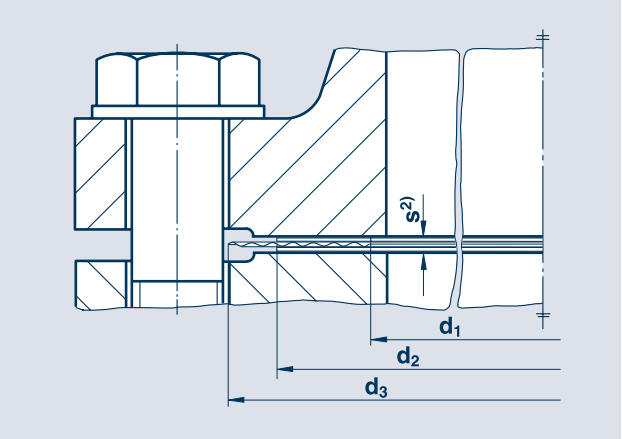
The following table contains the surface pressure limits for the temperature range from 20 °C to 500 °C.

Gasket limiting values

Description		20 °C	100 °C	200 °C	300 °C	400 °C	500 °C
W1A-RS2E2	σ_v [N/mm²]	15	16	17	20	22	25
1.4571/graphite	σ_ϑ [N/mm²]	180	170	160	150	140	130

CORRUGATED GASKETS

for flanges with raised face



Conforms to works standard 157 (PN 1 to PN 400)

Ordering example for a corrugated gasket with layers, Profile W11A, DN 100, PN 100, works standard 15L, made of ...[1]:

Corrugated gasket, W11A, DN 100, PN 100, WN 157, 1.4541 /g raphite

For DIN flanges

DN	d_1	d_2	PN / d_3											
			1 u. 2,5	6	10	16	25	40	63	100	160	250	320	400
10	18	34	38	38	46	46	46	46	56	56	56	67	67	67
15	22	39	43	43	51	51	51	51	61	61	61	72	72	78
20	28	50	53	53	60	60	60	60	-	-	-	-	-	-
25	35	57	63	63	70	70	70	70	82	82	82	83	92	104
32	43	65	75	75	82	82	82	82	-	-	-	-	-	-
40	49	75	85	85	92	92	92	92	103	103	103	109	119	135
50	61	87	95	95	107	107	107	107	113	119	119	124	134	150
65	77	109	115	115	127	127	127	127	137	143	143	153	170	192
80	90	120	132	132	142	142	142	142	148	154	154	170	190	207
100	115	149	152	152	162	162	168	168	174	180	180	202	229	256
125	141	175	182	182	192	192	194	194	210	217	217	242	274	301
150	169	203	207	207	218	218	224	224	247	257	257	284	311	348
175	195	233	237	237	247	247	254	265	277	287	284	316	358	402
200	220	259	262	262	272	272	284	290	309	324	324	358	398	442
250	274	312	318	318	327	328	340	352	364	391	388	442	488	-
300	325	363	373	373	377	383	400	417	424	458	458	536	-	-
350	368	421	423	423	437	443	457	474	486	512	-	-	-	-
400	420	473	473	473	489	495	514	546	543	572	-	-	-	-
450	470	524	528	528	539	555	-	571	-	-	-	-	-	-
500	520	575	578	578	594	617	624	628	657	704	-	-	-	-
600	620	675	680	680	695	734	731	747	764	813	-	-	-	-
700	720	777	785	785	810	804	833	852	879	950	-	-	-	-
800	820	882	890	890	917	911	942	974	988	-	-	-	-	-
900	920	987	990	990	1017	1011	1042	1084	1108	-	-	-	-	-
1000	1020	1091	-	-	1124	1128	1154	1194	1220	-	-	-	-	-
1200	1240	1320	-	-	1341	1342	1364	1398	1452	-	-	-	-	-
1400	1440	1520	-	-	1548	1542	1578	1618	-	-	-	-	-	-
1600	1640	1740	-	-	1772	1764	1798	1830	-	-	-	-	-	-
1800	1840	1940	-	-	1972	1964	2000	-	-	-	-	-	-	-
2000	2040	2140	-	-	2182	2168	2230	-	-	-	-	-	-	-
2200	2240	2340	-	-	2384	2378	-	-	-	-	-	-	-	-
2400	2440	2540	-	-	2594	-	-	-	-	-	-	-	-	-
2600	2650	2750	-	-	2794	-	-	-	-	-	-	-	-	-
2800	2870	2970	-	-	3014	-	-	-	-	-	-	-	-	-
3000	3080	3180	-	-	3228	-	-	-	-	-	-	-	-	-

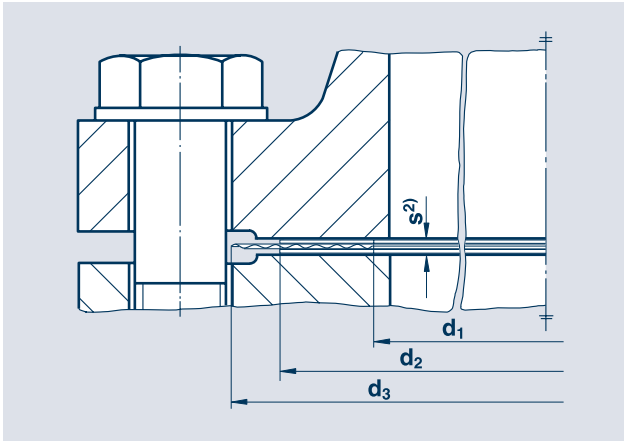
- Flanges compliant with the standard not available

Dimensions in mm

1) Specify material when placing order
2) The thickness of the metal ring is approx. 1.5 mm at d_3 < 150mm, otherwise approx. 1.2 mm

CORRUGATED GASKETS

for flanges with raised face



Conforms to works standard 158 (Class 150 to Class 2500)

Ordering example for a corrugated gasket with layers, Profile W11A, NPS 5 for ANSI flanges, Class 600, works standard 158, made of ...[1]:

Corrugated gasket, W11A, NPS 5, Class 600, WN 158, 1.4541 / PTFE,

For flanges in accordance with ANSI B16.5

NPS	d_1	d_2	Class 150	d_3 300	400	600	900	1500	2500
½	21	35	44,4	50,8	50,8	50,8	60,3	60,3	66,7
¾	27	43	53,9	63,5	63,5	63,5	66,7	66,7	73,0
1	33	51	63,5	69,8	69,8	69,8	76,3	76,3	82,5
1¼	42	64	73,0	79,4	79,4	79,4	85,7	85,7	101,6
1½	48	73	82,5	92,1	92,1	92,1	95,2	95,2	114,3
2	60	92	101,6	108,0	108,0	108,0	139,7	139,7	142,8
2½	73	105	120,6	127,0	127,0	127,0	161,9	161,9	165,1
3	89	127	133,4	146,1	146,1	146,1	165,1	174,5	193,7
3½	102	140	158,8	161,9	158,7	158,7	-	-	-
4	114	157	171,5	177,8	174,6	190,5	203,2	206,4	231,7
5	141	186	193,7	212,7	209,5	238,1	244,5	250,8	276,2
6	168	216	219,1	247,7	244,5	263,5	285,8	297,4	314,3
8	219	270	276,2	304,8	301,6	317,5	355,6	349,3	384,1
10	273	324	336,5	358,8	355,6	396,9	431,8	431,8	473,0
12	324	381	406,4	419,1	415,9	454,0	495,3	517,5	546,1
14	356	413	447,7	482,6	479,4	488,9	517,5	574,7	-
16	406	470	511,2	536,6	533,4	561,9	571,5	638,1	-
18	457	535	546,1	593,7	590,5	609,6	636,0	701,7	-
20	510	585	603,2	650,9	644,5	679,5	695,3	752,4	-
22	559	641	657,2	701,7	698,5	730,3	-	-	-
24	610	690	714,4	771,5	765,2	787,4	835,0	898,5	-

- Flanges compliant with the standard not available

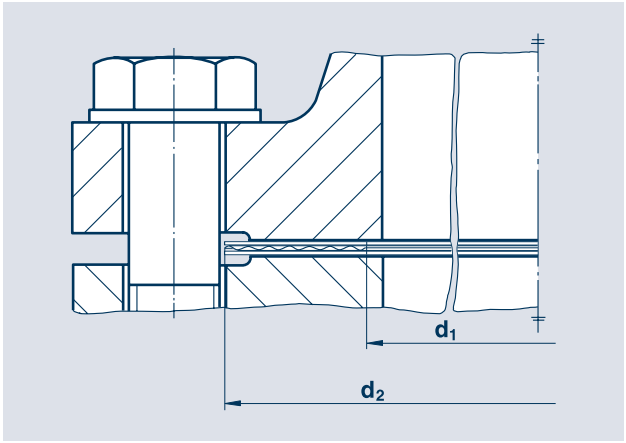
Dimensions in mm

1) Specify material when placing order

2) The thickness of the metal ring is approx. 1.5 mm at d_3 < 150mm, otherwise approx. 1.2 mm

CORRUGATED GASKETS

for flanges with raised face



Conforms to EN 1514-4 (PN 10 to PN 100)

Ordering example for a corrugated gasket with layers, Profile W1A, DN 100, PN 100, EN 1514-4, made of ...[1]:

Corrugated gasket, W1A, DN 100, PN 100, EN 1514-4, 1.4571 / graphite

Conforms to EN 1514-4 for DIN flanges

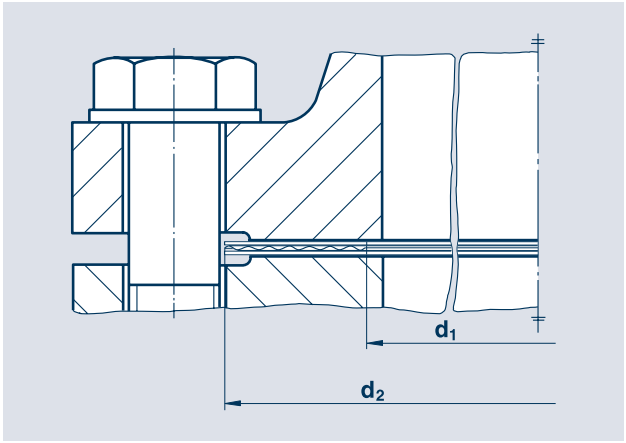
DN	d_1	PN 10	PN 16	PN 25	PN 40	d_3 PN 63	d_3 PN 100
10	18	48	48	48	48	58	58
15	22	53	53	53	53	63	63
20	27	63	63	63	63	74	74
25	34	73	73	73	73	84	84
32	43	84	84	84	84	90	90
40	49	94	94	94	94	105	105
50	61	109	109	109	109	115	121
65	77	129	129	129	129	140	146
80	89	144	144	144	144	150	156
100	115	164	164	170	170	176	183
125	141	194	194	196	196	213	220
150	169	220	220	226	226	250	260
200	220	275	275	286	293	312	327
250	273	330	331	343	355	367	394
300	324	380	386	403	420	427	461
350	356	440	446	460	477	489	515
400	407	491	498	517	549	546	575
450	458	541	558	567	574	-	-
500	508	596	620	627	631	660	708
600	610	698	737	734	750	768	819
700	712	813	807	836	-	883	956
800	813	920	914	945	-	994	-
900	915	1020	1014	1045	-	1114	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order

CORRUGATED GASKETS



Conforms EN 12560-4 (Class 150 to Class 2500)

Ordering example for a corrugated gasket with layers, Profile W1A, NPS 5, for ANSI flanges, Class 600, EN 12560-4, made of ...[1]:

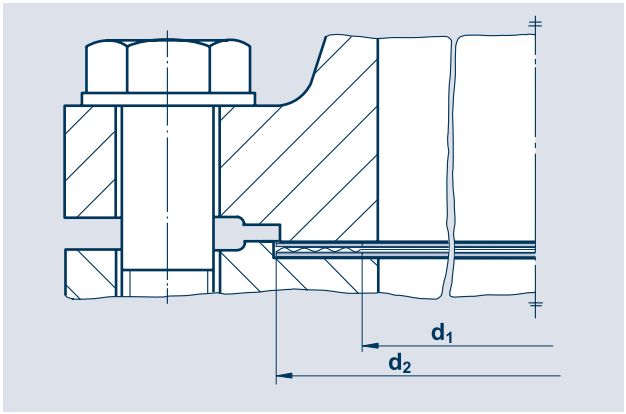
Corrugated gasket, W1A, NPS 5, Class 600, EN 12560-4, 1.4541 / PTFE

Conforms to EN 12560-4 for flanges in accordance with ANSI B 16.5

NPS	d_1	Class	d_2				
		150	300	600	900	1500	2500
½	22	47,6	54,0	54,0	63,5	63,5	69,9
¾	27	57,2	66,7	66,7	69,9	69,9	76,2
1	34	66,7	73,0	73,0	79,4	79,4	85,7
1¼	43	76,2	82,6	82,6	88,9	88,9	104,8
1½	49	85,7	95,3	95,3	98,4	98,4	117,5
2	61	104,8	111,1	111,1	142,9	142,9	146,1
2½	73	123,8	130,2	130,2	165,1	165,1	168,3
3	89	136,5	149,2	149,2	168,3	174,6	196,9
4	115	174,6	181,0	193,7	206,4	209,6	235,0
5	141	196,9	215,9	241,3	247,7	254,0	279,4
6	169	222,3	250,8	266,7	288,9	282,6	317,5
8	220	279,4	308,0	320,7	358,8	352,4	387,4
10	273	339,7	362,0	400,1	435,0	435,0	476,3
12	324	409,6	422,3	457,2	498,5	520,7	549,2
14	356	450,9	485,8	492,1	520,7	577,9	-
16	407	514,4	539,8	565,2	574,7	641,4	-
18	458	549,3	596,9	612,8	638,2	704,9	-
20	508	606,4	654,1	682,6	698,5	755,7	-
24	610	717,6	774,7	790,6	838,2	901,7	-

Dimensions in mm

For flanges with male and female faces



Conforms to DIN 2692 (PN 10 to PN 100)

For dimensions, see the section 3 “flat gaskets“.
Ordering example for a corrugated gasket with layers, Profile W1A, DN100, made of ...[1]:

Corrugated gasket, W1A, DN 100, DIN 2692,1.4541/PTFE

In accordance with ANSI B16.21 (Class 150 to 1500)

For dimensions, see the section 3 “flat gaskets“.
Ordering example for a corrugated gasket with layers, Profile W1 A, DN 5, NPS 5, wide finish, made of ...[1]:

Corrugated gasket, W1A, NPS 5, ANSI B16.21 wide, male and female face, 1.4541/graphite

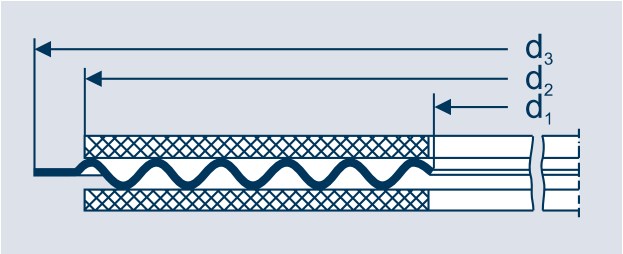
[1] Specify material when placing order

CORRUGATED GASKETS

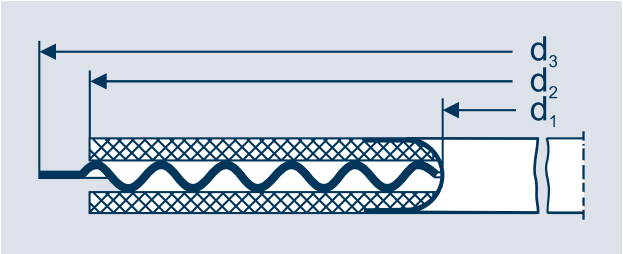
04

Corrugated TA-Luft gasket Profile W1A-3
with layers of soft material on both sides and an optimised corrugated ring carrier.

Profile: W1A-3



Profile: W1A-3·F1



TA-Luft gaskets such as Profile W1A-3 consist of an optimised corrugated ring carrier W1-3 made of 1.4571 with graphite layers on both sides. The 0.8 mm thick layers have a purity of C >= 99 %, a density of p = 1.0 g/cm³ and a chloride content of <= 25 ppm. The graphite layers do not contain filler or adhesives.

The total thickness of a gasket with graphite layers as delivered is approx. 2.9 mm, made up of the 1.3 mm thick corrugated ring carrier and both 0.8 mm graphite layers.

0.5 mm layers of unsintered PTFE are also used.

The total thickness of a gasket with PTFE layers as delivered is approx. 2.3 mm, made up of the 1.3 mm thick corrugated ring carrier and both 0.5 mm PTFE layers.

When a surface pressure of 30 MPa is applied, the gasket thickness is reduced by approximately 50 %.

This means that in a pressurised condition, the gasket has the same thickness as a soft-material flat gasket with a starting thickness of 2 mm. The W1A-3 gasket can also be used with flanges conforming to DIN 2526 Form C.

In order to avoid contact between the medium and the graphite layers, the corrugated ring gasket is also available with an eyelet ring made of 1.4571, Profile W1A-3-F1.

Gaskets that conform to works standard 188 and/or works standard 189 in accordance with DIN 2690 have an external parallel centre ring onto which the corrugated ring material, the nominal width, the nominal pressure and the manufacturer's mark are impressed.

As the external diameter of the layers is approx. 8 mm smaller than the corrugated carrier, this identification area is always visible.

Due to their soft plastic layers, these gaskets conform easily to flange sealing surfaces.

Once fitted, the layers are pressed into the corrugation and are chambered there, resulting in the creation of an extremely elastic sealing element due to the pressure, with a leak rate that is significantly lower than with traditional graphite flat gaskets.

Profile W1A-3 has been tested in accordance with VDI 2440 and fulfils the criteria of the TA-Luft type test.

The blow out security of Profile W1A-3 was tested, demonstrated and documented by the Amtec Institute on specimens at a temperature of 400 °C. The geometry of the corrugated ring gasket ensures high stability in the seal, making it particularly easy to handle.

Fulfilment of the Tire Safe" requirements of ISO 10497 has been demonstrated by tests in accordance with API 607 and is confirmed with the relevant certificate.

CORRUGATED GASKETS

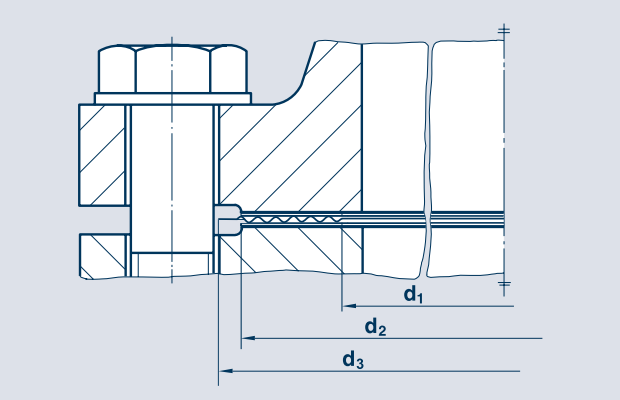
Gasket limiting values

Layer		Graphite	PTFE
Min. surface pressure N/mm² at 20 °C:	σ_v	15	15
Max. surface pressure N/mm² at 20 °C:	σ_ϑ	200	200
Min. temperature:	°C	-200	-200
Max. temperature:*	°C	+550	+250

* From a continuous temperature of 450 °C our technical department must be consulted.

You can find gasket characteristic values in accordance with EN13555 on our homepage at www.klinger-kempchen.de

CORRUGATED GASKETS



Ordering example for a corrugated ring gasket, Profile W1A-3, DN 100, PN 16, works standard 210, with a corrugated ring carrier made of 1.4571 steel with a graphite layer.

Corrugated ring gasket, W1A-3, DN 100, PN 16, works standard 210, 1.4571 / graphite

Works standard 210
For smooth flanges and flanges with raised face as per DIN and/or EN

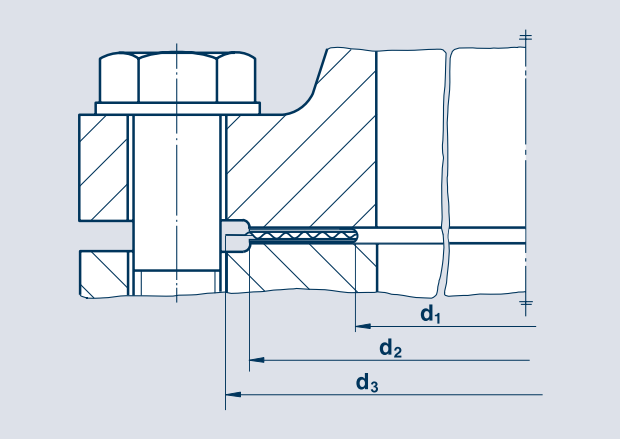
DN	d_1	PN 10		PN 16		PN 25		PN 40		PN 63*		PN 100*	
		d_2	d_3	d_2	d_3	d_2	d_3	d_2	d_3	d_2	d_3	d_2	d_3
10	18	38	46	38	46	38	46	38	46				
15	22	43	51	43	51	43	51	43	51				
20	27	53	61	53	61	53	61	53	61				
25	34	63	71	63	71	63	71	63	71				
32	43	74	82	74	82	74	82	74	82				
40	49	84	92	84	92	84	92	84	92				
50	61	99	107	99	107	99	107	99	107				
65	77	119	127	119	127	119	127	119	127				
80	89	134	142	134	142	134	142	134	142				
100	115	154	162	154	162	160	168	160	168				
125	141	184	192	184	192	186	194	186	194				
150	169	210	218	210	218	216	224	216	224				
200	220	265	273	265	273	276	284	282	290				
250	273	320	328	321	329	332	340	344	352				
300	324	370	378	376	384	392	400	409	417				
350	356	430	438	436	444	449	457	466	474				
400	407	481	489	487	495	506	514	538	546				
450	458	531	539	547	555	556	564	563	571				
500	508	586	594	609	617	616	624	**620**	**628**				
600	610	678	695	726	734	723	731	**739**	**747**			-	-
700	712	802	810	**796**	**804**	**825**	**833**					-	-
800	813	909	917	**903**	**911**	**934**	**942**					-	-
900	915	1009	1017									-	-

- Flanges compliant with the standard not available. *Sizes available on request.

Dimensions in mm

Figures in bold:
For flanges with raised face, the surface pressure must be recalculated and if necessary re-evaluated.
In some cases the gasket will not bear the installation tightening torque required by the internal pressure.

CORRUGATED GASKETS



Ordering example for a corrugated ring gasket,
Profile W1A-3 · F1, NPS 4, Class 15, works standard 189,
with a corrugated ring carrier and a eyelet
made of 1.4571 steel with a graphite layer.

Corrugated ring gasket, W1A-3 · F1, NPS 4, Class 150, works standard 189, 1.4571 / graphite

Works standard 189
For smooth flanges and flanges with raised face as per ANSI / ASME B16.5 and EN 1759

			Class 150		Class 300		Class 600		Class 900	
DN	NPS	d_1	d_2	d_3	d_2	d_3	d_2	d_3	d_2	d_3
15	**½**	22	40	47,5	46	54,0	46	54,0	56	63,5
20	**¾**	27	49	57,0	59	66,5	59	66,5	62	70,0
25	**1**	34	59	66,5	65	73,0	65	73,0	72	79,5
32	**1¼**	43	68	76,0	75	82,5	75	82,5	81	89,0
40	**1½**	49	78	85,5	88	95,5	88	95,5	91	98,5
50	**2**	61	97	105,0	103	111,0	103	111,0	135	143,0
65	**2½**	73	116	124,0	122	130,0	122	130,0	157	165,0
80	**3**	89	129	136,5	141	149,0	141	149,0	161	168,5
100	**4**	115	167	174,5	173	181,0	186	193,5	199	206,5
125	**5**	141	189	197,0	208	216,0	234	241,5	240	247,5
150	**6**	169	215	222,5	243	251,0	259	266,5	**281**	**289,0**
200	**8**	220	272	279,5	300	308,0	313	320,5	**351**	**359,0**
250	**10**	273	332	339,5	354	362,0	**392**	**400,0**	**427**	**435,0**
300	**12**	324	402	409,5	415	422,5	**449**	**457,0**	**491**	**498,5**
350	**14**	356	443	451,0	478	486,0	**484**	**492,0**	**513**	**520,5**
400	**16**	407	507	514,5	532	540,0	**557**	**565,0**	**567**	**574,5**
450	**18**	458	542	549,5	589	597,0	**605**	**613,0**	**630**	**638,0**
500	**20**	508	599	606,5	646	654,0	**675**	**682,5**	**691**	**698,5**
600	**24**	610	710	717,5	767	774,5	**783**	**790,5**	**830**	**838,0**

Dimensions in mm

Figures in bold:
For flanges with nubbins, the surface pressure must be recalculated and if necessary re-evaluated.
In some cases the gasket will not bear the installation tightening torque required by the internal pressure.

HOT-GAS AND HOT-BLAST GASKETS

KLINGER Kempchen's hot-gas and hot-blast gaskets have proven themselves over many years of use in the iron and steel industry. Hot-gas and hot-blast gaskets are primarily used with dry gases and with high, dry heat. They are very suitable for the harsh conditions in hot-gas and hot-blast lines which also generally have low pressure. Depending on the leak-tightness required and the flange temperature, there are a number of models available.

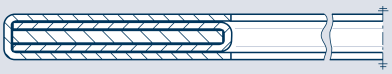
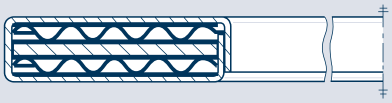
Most gaskets can withstand the demands made of a gasket when used in hot-gas or hot-blast lines. The gaskets can withstand high temperatures, are non-flammable and chemically resistant against dry, hot gases. They are used at high temperatures and at pressures of up to 10 bars. Gaskets with graphite inlays can be used at temperatures up to 550 °C.

The gaskets are available as circular or oval sealing rings or as frames. In their standard form they consist of a 3 mm thick core of unalloyed steel and a coating of fibreglass impregnated with graphite.

We can produce frame gaskets with welded plates or in some cases with holes directly from client drawings. If requested, we can also supply these gaskets with a different steel core, for example 1.4541 or 1.5414.

The **WAG Profile** consists of a steel ring with two U-shaped fibreglass envelope. The first (inner) envelope has an opening facing outwards, the second (outer) envelope has an opening facing inwards. This design helps to prevent the casing being ripped off when fitted in difficult conditions, by packing the gasket into a narrow sealing gap. The gaskets are generally impregnated.

Gasket profiles

Profile	Cross-section
WAG	
W2AM	
B7M-F1-CKP	

In **Profile W2AM** gaskets, the inner steel ring is layered with corrugated gaskets with graphite layers and then coated with fibreglass. The gaskets are generally impregnated.

Profile B7M-F1-CKP gaskets consist of a grooved gasket coated with fibreglass and an inner eyelet and are impregnated with CKP. This design produces comparatively thin gaskets. These gaskets fulfil the need for a fast compression set, particularly when fitting flanges with hydraulic or pneumatic screwing tools or even by hydraulic tension (bolt tensioning). The gasket is certified in accordance with TA-Luft and ca be used with other smelting gases.

Corrugated and metal jacketed gaskets can also be used for hot-gas applications.

Gasket limiting values

Profile			WAG	W2AM	B7M-F1 -CKP
Materials			Steel fibreglass	fibreglass fibreglass	Steel fibreglass
Recomm. max. roughness of the flange surfaces	µm	from	50	50	50
		to	100	100	100
Surface pressure limits for 20 °C	N/mm²	σ_v	45	45	30
		σ_ϑ	120	150	350
Surface pressure limits for 300 °C	N/mm²	σ_v	60	60	25
		σ_ϑ	100	125	210

SPIROFLEX SPIRAL-WOUND GASKETS

Spiral-wound gaskets have long been used as sealing elements in refineries, chemical plants, gas installations, water treatment plants and in general pipeline construction.

Spiroflex gaskets SpV retain the same filler strip throughout. Common filler materials include graphite, sintered or unsintered PTFE and mica. Spiroflex gaskets SpV are only suitable for flange connections below PN 25 where there are sufficiently high bolt loads available.

BAM test report: Profile SpV with graphite for liquid and gaseous oxygen 350 °C, 250 bar (Manufacturer certificate on the basis of a BAM test report).

Spiroflex gaskets with sealing zone Profile SpZ have the same filler strip inside and outside and a PTFE filler strip in the middle area. They have a number of distinct technical advantages:

- Lower seating stress required with higher leak-tightness, as the surface pressure is concentrated on the middle area of the sealing zone of unsintered PTFE. This allows Profile SpZ gaskets to be used from PN 10. The minimum surface pressure is 30 N/mm² as opposed to the 50 N/mm² otherwise required.
- The surface pressure creates smaller radial forces than for example gaskets that are filled entirely with PTFE. There is therefore no need to support the spiral with an inner ring at smaller nominal diameters up to max. DN 200 and at low sealing pressures of approx. 60 N/mm². High pressure and/or frequent load changes require a high sealing pressure, in this case the spirals should be supported with an appropriate flange design or additional rings.
- As the PTFE sealing zone is protected by areas filled with graphite, it can withstand extreme operational conditions.
- Using a helium leak detector, leak rates of 10^{-8} mbar l s^{-1} m^{-1} have been measured on SpZ gaskets DN 150 with PTFE sealing zone.

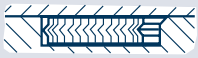
Spiroflex gaskets SpFS in the “Firesafe“ range have unsintered PTFE filler strips on the inside and graphite filler strips on the outside. They are suitable for applications where the product may not come into contact with the graphite and in an operating temperature range below 250 °C. At temperatures above 250 °C which require to be “Firesafe“, Spiroflex gaskets SpV with graphite filler band can be used

Application limits

Spiroflex gaskets can be produced in all sizes from DN 10 to a diameter of four metres. However, from a sealing technology point of view, grooved gaskets are recommended for use at diameters above 1000 mm.

We also produce oval-shaped spiral-wound gaskets for the valve and apparatus construction industries, e.g. as valve cover gaskets or manhole covers. Oval-shaped inner and/or outer rings are also possible.

Gasket profiles

Profile	Cross-section
SpV1	
SpV1I	
SpV2I	
SpZ1	
SpZ2	
SpZ2I	
SpFS2I	
SpVNG	
SpZNG	
SpV2I-HT	

Materials for the metal strip

For DIN areas: 1.4541
For ASME areas: 316L (1.4404)
Other materials available on request.

Materials for the sealing filler strip

Graphite up to 550 °C, unsintered PTFE as the sealing zone or sintered PTFE for all the filling up to 260 °C, other materials available on request.

Materials for the outer ring

The standard model has an outer ring of galvanised sheet steel or a bichromatised ring.

Materials for the inner ring

Generally the material for the inner ring is the same as that used for the metal strip.

SPIROFLEX SPIRAL-WOUND GASKETS

Gasket limiting values

Profiles			SpV1, SpV2			SpV1I, SpV2I			SpZ1, SpZ2	SpZ1I; SpZ2I
Materials			1.4541 Graphite	1.4571 PTFE	1.4571 PTFE sintered	1.4541 Graphite	1.4571 PTFE	1.4571 PTFE sintered	1.4571 PTFE/Graphite	1.4571 PTFE/Graphite
Recommended max. roughness of the flange surfaces	µm	from	12,5	25	25	12,5	25	25	25	25
		to	50	50	50	50	50	50	50	50
Surface pressure limits for 20 °C	N/mm²	σ_v	50	50	50	50	50	50	30	30
		σ_ϑ	150	150	150	300	300	300	150	300
Surface pressure limits for 300 °C	N/mm²	σ_v	60	*	*	60	*	*	45*	45*
		σ_ϑ	120	*	*	220	*	*	120*	220*

* For PTFE, these surface pressures apply at 250 °C.
You can find gasket characteristic values in accordance with EN13555 on our homepage at www.klinger-kempchen.de

Profile design and gasket thickness

Profile design		single corrugated SpV	single corrugated with zone SpZ	For flange type	Gasket thickness SpV or SpZ to DN 80	300	900	1200	1800	≥2000
1	without inner and outer ring	SpV1*	SpZ1*	Tongue and groove Male and female face	2,5	3,0	3,5	4,5	5,5	6,5
1I	with inner ring 1)	SpV1I*	SpZ1I	Male and female face	2,5	3,0	3,5	4,5	5,5	6,5
1I	with inner ring 2)	SpV1I	SpZ1I	specially-produced male and female face **	4,5	4,5	4,5	4,5	5,5	6,5
2	with outer ring 2)	SpV2	SpZ2*	raised face	4,5	4,5	4,5	4,5	5,5	6,5
2I	with inner and outer ring 2)	SpV2I*	SpZ2I*	raised face	4,5	4,5	4,5	4,5	5,5	6,5
				1) Thickness	1,5	1,5	2,0	3,0	3,0	4,0
				2) Thickness	3,0	3,0	3,0	3,0	3,0	4,0

* Shown in cross-section.
** The groove and/or female face depth at 4.5 mm = 6 mm, at 5.5 mm = 7 mm and at 6.5 mm = 8 mm.

Dimensions in mm

Production tolerances

Production tolerances for spiral-wound gaskets “SPIROFLEX” and filler material projection (thickness tolerance)

Works standard 127

Sectional steel strip s $^{+0,3}$ mm
Projection of the filler material strip on each side:

s	minimum	maximum
2,5 to 4,5	+ 0,10	+ 0,20
5,5	+ 0,15	+ 0,30
6,5	+ 0,20	+ 0,40
7,2	+ 0,40	+ 0,80

Works standard 104		Tolerances in mm	ASME B16.20	Tolerances in mm
d1	DN ≤ 100	± 0,4	NPS ≤ 3	±0,8
	100 < DN ≤ 400	± 0,6	3 < NPS ≤ 24	±1,5
	400 < DN ≤ 800	± 0,8	24 < NPS ≤ 60	±3,0
	800 < DN ≤ 1600	± 1,2		
	1600 < DN ≤ 2000	± 1,5		
d4	DN ≤ 800	± 0,8	NPS ≤ 60	±0,8
	800 < DN ≤ 1600	± 1,5		
	1600 < DN ≤ 2000	± 2,0		

SPIROFLEX SPIRAL-WOUND GASKETS

Metal-to-metal spiral gaskets (KNS)

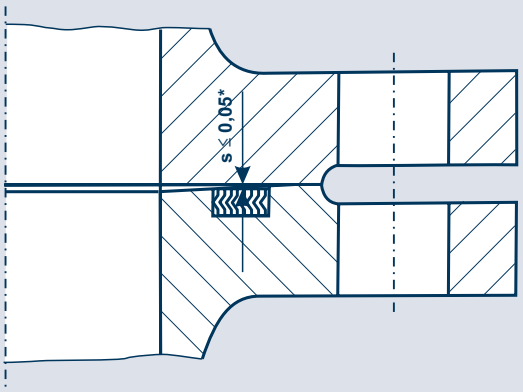
This type of gasket has proven itself in many applications as well in valve construction for power plants. The gasket is in a groove and the flanges are tensioned against each other in such a way as to achieve metal-to-metal contact. The gasket is therefore in metal-to-metal contact. Full contact must be ensured under all operating conditions.

An alignment at stepped face design is also usual. However this gives rise to a risk that the inner and/or outer spirals will find their way into the gap.

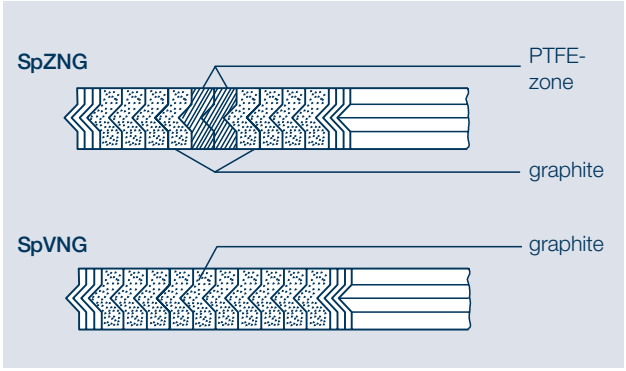
In the case of spiral seals arranged in force shunt, investigations of the spring-back behaviour have shown that the flange rotation of both flanges in the centre of the seal should lead to a gap s of no more than 0.05 mm. Gap s ≥ 0.1 mm lead to difficulties.

Our Spiroflex gasket fulfils the particular requirement of the user for the lowest possible ferrite and chloride content in the filler. Spiroflex gaskets Profile SpZNG are virtually chloride and ferrite free. For temperatures up to 280 °C we recommend our Profile SpZNG with graphite and PTFE. Here the intermediate filler windings are made of PTFE. During use, a zone of increased surface pressure is produced due to the incompressibility of the PTFE material. Up to temperatures of approximately 350 °C we recommend our gaskets made of pure graphite. We supply gaskets with a thickness of 5.5 mm as double-corrugated models.

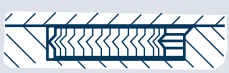
The application limit of approx. 350 °C is due to the peculiarities of metal-to-metal connections. Spiral-wound gaskets should not be used in metal-to-metal contact at temperatures above 350 °C without prior testing or experiment.



* s ≤ 0,05 : tight
0,05 < s < 0,10 : possibly leaking
0,10 ≤ s : leaking



Gasket profiles

Profile	Cross-section
SpVNG	
SpZNG	

SPIROFLEX SPIRAL-WOUND GASKETS

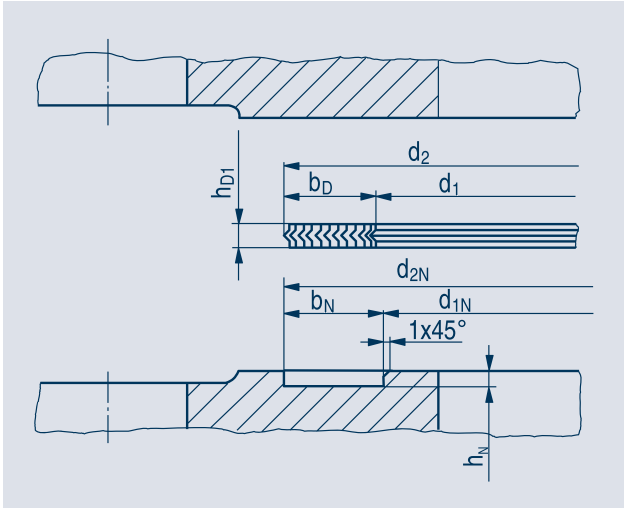
Gasket limiting values

Material	1.4541	< 280 °C = graphite/PTFE
		> 280 °C = graphite
		> 350 °C not recommended
k_0K_D	[N/mm]	70 b_D
k_1	[mm]	1,4 b_D
R_Z*	[µm]	12,5 to 25

Works standard 121

Ordering example for a spiral-wound gasket "SPIROFLEX", Profile SpZNG, works standard 121, for groove d_{1N} x d_{2N} x 3,3, made of ...[1]:

Spiral-wound gasket, SpZNG, WN 121,
for groove 600 x 634 x3.3, 1.4541/graphite/PTFE



Recommended gasket and groove width

Ø-Range	40 to 400	80 to 800	160 to 1000	320 to 1600
b_D	6,0 to 8,5	8,6 to 12,0	12,1 to 17	17,1 to 25,0
b_N	8,0 to 10,0	10,5 to 14,0	14,5 to 19,0	19,5 to 28,0

Recommended application range

Range	d_2 < 1200	d_2 < 1600
Number of corrugations	1	2
$h_{D1}^{+0,3}$	4,5**	5,5**
d_{1N} $d_{2N}^{+0,2}$ $b_N^{+0,1}$	Specified by client	Specified by client
Depth of groove $h_N^{+0,1}$	3,3	3,6

* Recommended maximum roughness of the flange surfaces
** Height of the metal strips; the filler protrudes further

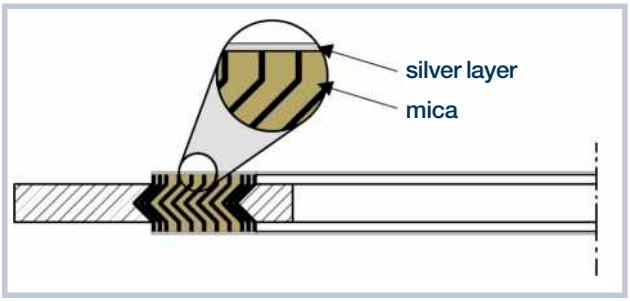
[1] Specify material when placing order

SPIROFLEX SPIRAL-WOUND GASKETS

SPV2I-HT

This type of gasket unifies the features of high-temperature suitable metallic gaskets and the good return-ability behaviour of spiral wound gaskets.

Through the combination of modified spiral wound gaskets with a metallic layer a lowest possible leakage rate is also probable in a temperature range up to 750 °C.



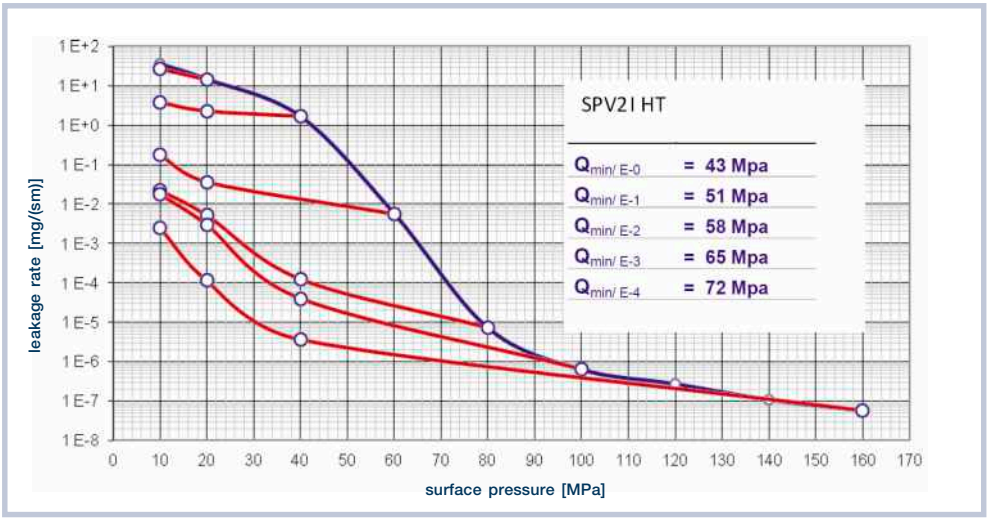
The decisive, leak relevant construction feature is the execution of the soft-material-filled spiral wound gasket, especially that the filling material lines up precisely with the metal band. So the metal band is in direct contact with the silver layer. This leads to a pure metallic sealing between flanges and metall band.

The elastic core additionally enables the compensation of flange distance increase, e.g. by thermic expansion. Up to 0,1 mm this gasket can rebound, thanks to the elastic spiral core.

In the leakage diagram according to EN 13555 this advantageous behaviour is visible in the nearly horizontally running returnability branches. A reduction of the surface pressure therefore does not necessarily lead to a distinctly higher leakage rate. In practice this also means a high blow-off proofness.

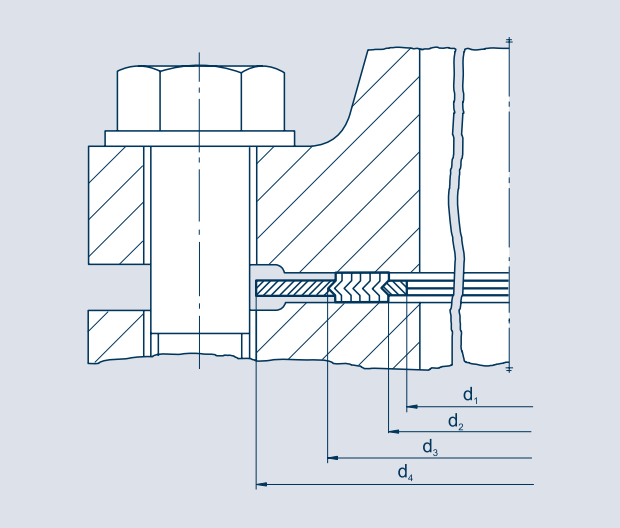
The mica filled core is covered by the metallic layer. Thereby the soft material is chambered and protected against volume loss through oxidation.

In contrast to conventional metallic gaskets this gasket only needs one third of the normally needed surface pressure.



SPIROFLEX SPIRAL-WOUND GASKETS

for flanges with raised face



Conforms to EN 1514-2 for DIN flanges

Ordering example for a spiral-wound gasket "SPIROFLEX", Profile SpV2l, DN 150, PN 63, EN 1514-2, made of ...[1]:

Spiral-wound gasket SpV2l, DN 150, PN 63, EN 1514-2, 1.4571 / graphite

EN 1514-2 for DIN flanges

DN	d_1	d_2^{min}	d_3^{min}		PN		d_4			
			10-40	63-160	10	25	40	63	100	160
10	18	24	34	34	46	46	46	56	56	56
15	23	29	39	39	51	51	51	61	61	61
20	28	34	46	-	61	61	61	72	72	-
25	35	41	53	53	71	71	71	82	82	82
32	43	49	61	-	82	82	82	-	-	-
40	50	56	68	68	92	92	92	103	103	103
50	61	70	86	86	107	107	107	113	119	119
65	77	86	102	106	127	127	127	137	143	143
80	90	99	115	119	142	142	142	148	154	154
100	115	127	143	147	162	168	168	174	180	180
125	140	152	172	176	192	194	194	210	217	217
150	167	179	199	203	217	224	224	247	257	257
200	216	228	248	252	272	284	290	309	324	324
250	267	279	303	307	327	340	352	364	391	388
300	318	330	354	358	377	400	417	424	458	458
350	360	376	400	404	437	457	474	486	512	-
400	410	422	450	456	488	514	546	543	572	-
500	510	522	550	556	593	624	628	657	704	-
600	610	622	650	656	695	731	747	764	813	-
700	710	722	756	762	810	833	852	879	950	-
800	810	830	864	870	917	942	974	988	-	-
900	910	930	964	970	1017	1042	1084	1108	-	-
1000	1010	1030	1074	1080	1124	1154	1194	-	-	-

- Flanges compliant with the standard not available

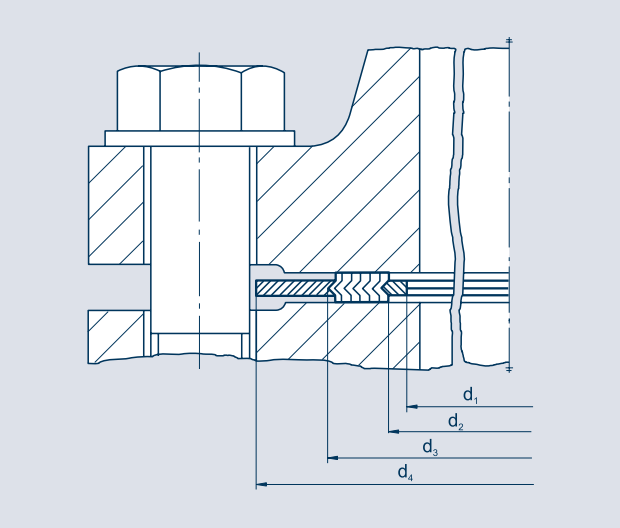
Size delivered corresponding to EN 1514-2 in accordance with WN 190

Dimensions in mm

[1] Specify material when placing order

SPIROFLEX SPIRAL-WOUND GASKETS

for flanges with raised face



Conforms to works standard 104 for DIN flanges

Ordering example for a spiral-wound gasket "SPIROFLEX", Profile SpV2l, DN 150, PN 63 for DIN flanges, works standard 104, made of ...[1]:

Spiral-wound gasket SpV2l, DN 150, PN 63, works standard 104, 1.4571 / graphite

Works standard 104 for DIN flanges

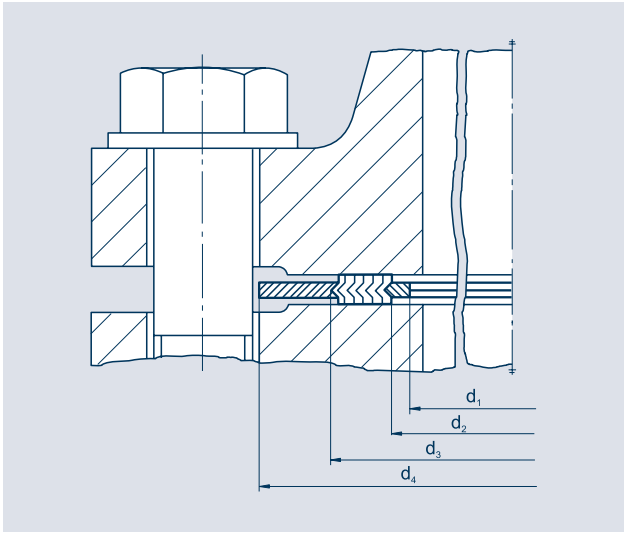
DN	d_1	d_2	d_3		PN	d_4								
	10-400	10-400	10-40	63-400	10	16	25	40	63	100	160	250	320	400
10	18	24	36	36	46	46	46	46	56	56	56	67	67	67
15	22	28	40	40	51	51	51	51	61	61	61	72	72	78
20	27	33	47	47	61	61	61	61	-	-	-	-	-	-
25	34	40	54	54	71	71	71	71	82	82	82	83	92	104
32	43	49	65	65	82	82	82	82	-	-	-	-	-	-
40	48	54	70	70	92	92	92	92	103	103	103	109	119	135
50	57	66	84	84	107	107	107	107	113	119	119	124	134	150
65	73	82	102	104	127	127	127	127	137	143	143	153	170	192
80	86	95	115	119	142	142	142	142	148	154	154	170	190	207
100	108	120	140	144	162	162	168	168	174	180	180	202	229	256
125	134	146	168	172	192	192	194	194	210	217	217	242	274	301
150	162	174	196	200	217	217	224	224	247	257	257	284	311	348
175	183	195	221	227	247	247	254	265	277	287	284	316	358	402
200	213	225	251	257	272	272	284	290	309	324	324	358	398	442
250	267	279	307	315	327	328	340	352	364	391	388	442	488	-
300	318	330	358	366	377	383	400	417	424	458	458	538	-	-
350	363	375	405	413	437	443	457	474	486	512	-	-	-	-
400	414	426	458	466	488	495	514	546	543	572	-	-	-	-
500	518	530	566	574	593	617	624	628	657	704	-	-	-	-
600	618	630	666	674	695	734	731	747	764	813	-	_	-	-
700	718	730	770	778	810	804	833	852	879	950	-	-	-	-
800	818	830	874	882	917	911	942	974	988	-	-	-	-	-
900	910	930	974	982	1017	1011	1042	1084	1108	-	-	-	-	-
1000	1010	1030	1078	1086	1124	1128	1154	1194	1220	-	-	-	-	-
1200	1210	1230	1280	1290	1341	1342	1364	1398	1452	-	-	-	-	-
1400	1420	1450	1510	-	1548	1542	1578	1618	-	-	-	-	-	-
1600	1630	1660	1720	-	1772	1764	1798	1830	-	-	-	-	-	-
1800	1830	1860	1920	-	1972	1964	2000	-	-	-	-	-	-	-
2000	2020	2050	2120	-	2182	2168	2230	-	-	-	-	-	-	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order

SPIROFLEX SPIRAL-WOUND GASKETS



Dimensions for spiral-wound gaskets in accordance with EN 12560-2 for flanges in accordance with ASME/ANSI B16.5

Ordering example for a spiral-wound gasket "SPIROFLEX", Profile SpV2I, NPS 5, Class 600, in accordance with EN 12560-2 for flanges in accordance with ASME/ANSI B 16.5, made of ...[1]:

Spiral-wound gasket SpV2I, NPS 5, Class 600, EN 12560-2, ASME/ANSI B16.5, 316L / graphite

EN 12560-2 for flanges in accordance with ASME/ANSI B16.5

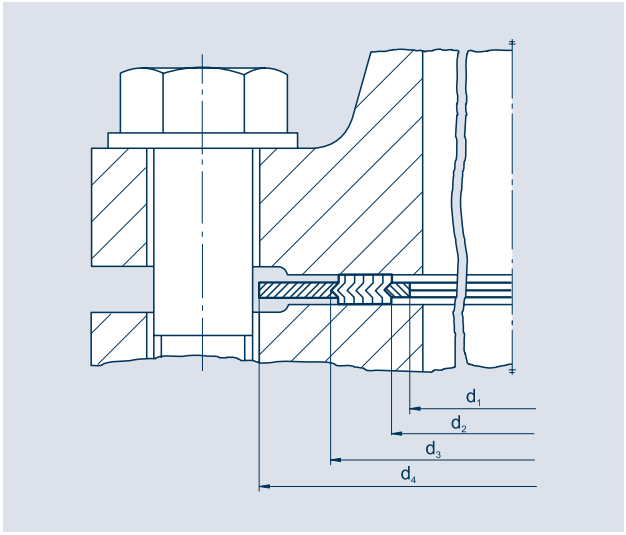
	d_1 Class					d_2 Class					d_3 Class		d_4 Class					
NPS	150/ 300	600	900	1500	2500	150/ 300	600	900	1500	2500	150 600	900- 2500	150	300	600	900	1500	2500
½	14,3	14,3	14,3	14,3	14,3	19,1	19,1	19,1	19,1	19,1	31,8	31,8	47,8	54,1	54,1	63,5	63,5	69,9
¾	20,7	20,7	20,7	20,7	20,7	25,4	25,4	25,4	25,4	25,4	39,6	39,6	57,2	66,8	66,8	69,9	69,9	76,2
1	27,0	27,0	27,0	27,0	27,0	31,8	31,8	31,8	31,8	31,8	47,8	47,8	66,8	73,2	73,2	79,5	79,5	85,9
1¼	38,1	38,1	33,4	33,4	33,4	47,8	47,8	39,6	39,6	39,6	60,5	60,5	76,2	82,6	82,6	88,9	88,9	104,9
1½	44,5	44,5	41,3	41,3	41,3	54,1	54,1	47,8	47,8	47,8	69,9	69,9	85,9	95,3	95,3	98,6	98,6	117,6
2	55,6	55,6	52,4	52,4	52,4	69,9	69,9	58,7	58,7	58,7	85,9	85,9	104,9	111,3	111,3	143,0	143,0	146,1
2½	66,7	66,7	63,5	63,5	63,5	82,6	82,6	69,9	69,9	69,9	98,6	98,6	124,0	130,3	130,3	165,1	165,1	168,4
3	81,0	81,0	81,0	81,0	81,0	101,6	101,6	95,3	92,2	92,2	120,7	120,7	136,7	149,4	149,4	168,4	174,8	196,9
4	106,4	106,4	106,4	106,4	106,4	127,0	120,7	120,7	117,6	117,6	149,4	149,4	174,8	181,1	193,8	206,5	209,6	235,0
5	131,8	131,8	131,8	131,8	131,8	155,7	147,6	147,6	143,0	143,0	177,8	177,8	196,9	215,9	241,3	247,7	254,0	279,4
6	157,2	157,2	157,2	157,2	157,2	182,6	174,8	174,8	171,5	171,5	209,6	209,6	222,3	251,0	266,7	289,1	282,7	317,5
8	215,9	209,6	196,9	196,9	196,9	233,4	225,6	222,3	215,9	215,9	263,7	257,3	279,4	308,1	320,8	358,9	352,6	387,4
10	268,3	260,4	246,1	246,1	246,1	287,3	274,6	276,4	266,7	270,0	317,5	311,2	339,9	362,0	400,1	435,1	435,1	476,3
12	317,5	317,5	292,1	292,1	292,1	339,9	327,2	323,9	323,9	317,5	374,7	368,3	409,7	422,4	457,2	498,6	520,7	549,4
14	349,3	349,3	320,8	320,8	-	371,6	362,0	355,6	362,0	-	406,4	400,1	450,9	485,9	492,3	520,7	577,9	-
16	400,0	400,0	374,7	368,3	-	422,4	412,8	412,8	406,4	-	463,6	457,2	514,4	539,8	565,2	574,8	641,4	-
18	449,3	449,3	425,5	425,5	-	474,7	469,9	463,6	463,6	-	527,1	520,7	549,4	596,9	612,9	638,3	704,9	-
20	500,0	500,0	482,6	476,3	-	525,5	520,7	520,7	514,4	-	577,9	571,5	606,6	654,1	682,8	698,5	755,7	-
24	603,3	603,3	590,6	577,9	-	628,7	628,7	628,7	616,0	-	685,8	679,5	717,6	774,7	790,7	838,2	901,7	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order

SPIROFLEX SPIRAL-WOUND GASKETS



Dimensions for spiral-wound gaskets in accordance with ASME B16.20 for flanges in accordance with ASME/ANSI B16.5

Ordering example for a spiral-wound gasket "SPIROFLEX", Profile SpV2I, NPS 5, Class 600, in accordance with ASME B16.20 for flanges in accordance with ASME/ANSI B 16.5, made of ...[1]:

Spiral-wound gasket SpV2I, NPS 5, Class 600, ASME B16.20, ASME/ANSI B16.5, 316L / graphite

For flanges in accordance with ASME/ANSI B16.5

	d_1 Class					d_2 Class					d_3 Class		d_4 Class						
NPS	150/ 300	400/ 600	900	1500	2500	150/ 300	400/ 600	900	1500	2500	150- 600	900- 2500	150	300	400	600	900	1500	2500
½	14,2	14,2	-	14,2	14,2	19,1	19,1	-	19,1	19,1	31,8	31,8	47,8	54,1	-	54,1	-	63,5	69,9
¾	20,6	20,6	-	20,6	20,6	25,4	25,4	-	25,4	25,4	39,6	39,6	57,2	66,8	-	66,8	-	69,9	76,2
1	26,9	26,9	-	26,9	26,9	31,8	31,8	-	31,8	31,8	47,8	47,8	66,8	73,2	-	73,2	-	79,5	85,9
1¼	38,1	38,1	-	33,3	33,3	47,8	47,8	-	39,6	39,6	60,5	60,5	76,2	82,6	-	82,6	-	88,9	104,9
1½	44,5	44,5	-	41,4	41,4	54,1	54,1	-	47,8	47,8	69,9	69,9	85,9	95,3	-	95,3	-	98,6	117,6
2	55,6	55,6	-	52,3	52,3	69,9	69,9	-	58,7	58,7	85,9	85,9	104,9	111,3	-	111,3	-	143,0	146,1
2½	66,5	66,5	-	63,5	63,5	82,6	82,6	-	69,9	69,9	98,6	98,6	124,0	130,3	-	130,3	-	165,1	168,4
3	81,0	81,0	81,0	81,0	81,0	101,6	101,6	95,3	92,2	92,2	120,7	120,7	136,7	149,4	-	149,4	168,4	174,8	196,9
4	106,4	106,4	106,4	106,4	106,4	127,0	120,7	120,7	117,6	117,6	149,4	149,4	174,8	181,1	177,8	193,8	206,5	209,6	235,0
5	131,8	131,8	131,8	131,8	131,8	155,7	147,6	147,6	143,0	143,0	177,8	177,8	196,9	215,9	212,9	241,3	247.7	254,0	279,4
6	157,2	157,2	157,2	157,2	157,2	182,6	174,8	174,8	171,5	171,5	209,6	209,6	222,3	251,0	247,7	266,7	289,1	282,7	317,5
8	215,9	209,6	196,9	196,9	196,9	233,4	225,6	222,3	215,9	215,9	263,7	257,3	279,4	308,1	304,8	320,8	358,9	352,6	387,4
10	268,2	260,4	246,1	246,1	246,1	287,3	274,6	276,4	266,7	270,0	317,5	311,2	339,9	362,0	358,9	400,1	435,1	435,1	476,3
12	317,5	317,5	292,1	292,1	292,1	339,9	327,2	323,9	323,9	317,5	374,7	368,3	409,7	422,4	419,1	457,2	498,6	520,7	549,4
14	349,3	349,3	320,8	320,8	-	371,6	362,0	355,6	362,0	-	406,4	400,1	450,9	485,9	482,6	492,3	520,7	577,9	-
16	400,1	400,1	374,7	368,3	-	422,4	412,8	412,8	406,4	-	463,6	457,2	514,4	539,8	536,7	565,2	574,8	641,4	-
18	449,3	449,3	425,5	425,5	-	474,7	469,9	463,6	463,6	-	527,1	520,7	549,4	596,9	593,9	612,9	638,3	704,9	-
20	500,1	500,1	482,6	476,3	-	525,5	520,7	520,7	514,4	-	577,9	571,5	606,6	654,1	647,7	682,8	698,5	755,7	-
24	603,3	603,3	590,6	577,9	-	628,7	628,7	628,7	616,0	-	685,8	679,5	717,6	774,7	768,4	790,7	838,2	901,7	-

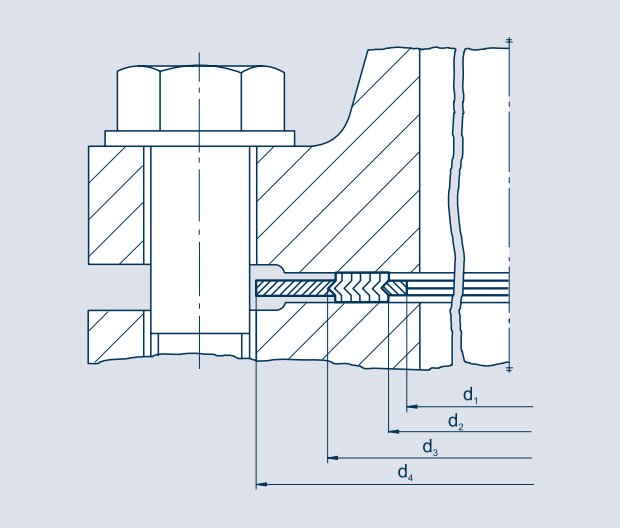
- Flanges compliant with the standard not available

Dimensions in mm

1) Specify material when placing order

2) With metric bolts it can be advisable to use gaskets in the d_4 size which is approx. 3 mm smaller sizes deviating from ASME B16.20 should in particular be reconciled.

SPIROFLEX SPIRAL-WOUND GASKETS



Dimensions for spiral-wound gaskets in accordance with ASME B16.20 for flanges in accordance with ASME/ANSI B16.47 Series B

(previously API 601 for flanges in accordance with API 605)

Ordering example for a spiral-wound gasket "SPIROFLEX", Profile SpV2I, NPS 30, Class 150, in accordance with ASME B16.20 for flanges in accordance with ASME/ANSI B16.47 Series B, made of ...[1]:

Spiral-wound gasket SpV2I, NPS 30, Class 150, ASME B16.20, ASME/ANSI B16.47 Series B, 316L / graphite

For flanges in accordance with ASME/ANSI B16.47 Series B

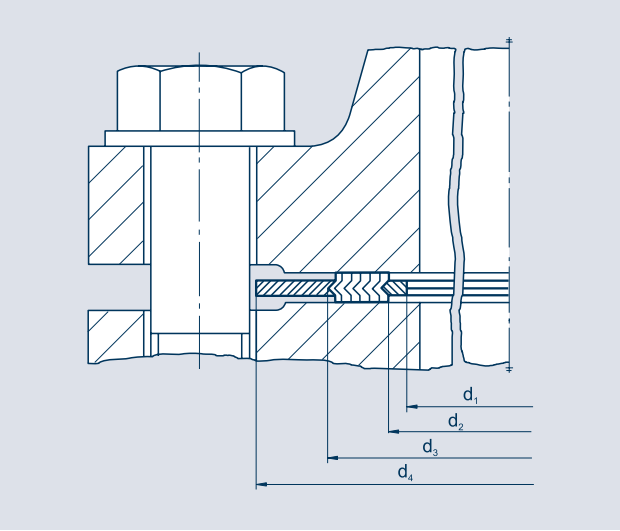
	d_1 Class					d_2 Class					d_3 Class					d_4 Class				
NPS	150	300	400	600	900	150	300	400	600	900	150	300	400	600	900	150	300	400	600	900
26	654,1	654,1	654,1	644,7	666,8	673,1	673,1	666,8	663,7	692,2	698,5	711,2	698,5	714,5	749,3	725,4	771,7	746,3	765,3	838,2
28	704,9	704,9	701,8	692,2	717,6	723,9	723,9	714,5	704,9	743,0	749,3	762,0	749,3	755,7	800,1	776,2	825,5	800,1	819,2	901,7
30	755,7	755,7	752,6	752,6	781,1	774,7	774,7	765,3	778,0	806,5	800,1	812,8	806,5	828,8	857,3	827,0	886,0	857,3	879,6	958,9
32	806,5	806,5	800,1	793,8	838,2	825,5	825,5	812,8	831,9	863,6	850,9	863,6	860,6	882,7	914,4	881,1	939,8	911,4	933,5	1016,0
34	857,3	857,3	850,9	850,9	895,4	876,3	876,3	866,9	889,0	920,8	908,1	914,4	911,4	939,8	971,6	935,0	993,9	962,2	997,0	1073,2
36	908,1	908,1	898,7	901,7	920,8	927,1	927,1	917,7	939,8	946,2	958,9	965,2	965,2	990,6	997,0	987,6	1047,8	1022,4	1047,8	1124,0
38	958,9	971,6	952,5	952,5	1009,7	974,6	1009,7	971,6	990,6	1035,1	1009,7	1047,8	1022,4	1041,4	1085,9	1044,7	1098,6	1073,2	1104,9	1200,2
40	1009,7	1022,4	1000,3	1009,7	1060,5	1022,4	1060,5	1025,7	1047,8	1098,6	1063,8	1098,6	1076,5	1098,6	1149,4	1095,5	1149,4	1127,3	1155,7	1251,0
42	1060,5	1085,9	1051,1	1066,8	1111,3	1079,5	1111,3	1076,5	1104,9	1149,4	1114,6	1149,4	1127,3	1155,7	1200,2	1146,3	1200,2	1178,1	1219,2	1301,8
44	1111,3	1124,0	1104,9	1111,3	1155,7	1124,0	1162,1	1130,3	1162,1	1206,5	1165,4	1200,2	1181,1	1212,9	1257,3	1197,1	1251,0	1231,9	1270,0	1368,6
46	1162,1	1178,1	1168,4	1162,1	1219,2	1181,1	1216,2	1193,8	1212,9	1270,0	1224,0	1254,3	1244,6	1263,7	1320,8	1255,8	1317,8	1289,1	1327,2	1435,1
48	1212,9	1231,9	1206,5	1219,2	1270,0	1231,9	1263,7	1244,6	1270,0	1320,8	1270,0	1311,4	1295,4	1320,8	1371,6	1306,6	1368,6	1346,2	1390,7	1485,9
50	1263,7	1267,0	1257,3	1270,0	-	1282,7	1317,8	1295,4	1320,8	-	1325,6	1355,9	1346,2	1371,6	-	1357,4	1419,4	1403,4	1447,8	-
52	1314,5	1317,8	1308,1	1320,8	-	1333,5	1368,6	1346,2	1371,6	-	1376,4	1406,7	1397,0	1422,4	-	1408,2	1470,2	1454,2	1498,6	-
54	1365,3	1365,3	1352,6	1378,0	-	1384,3	1403,4	1403,4	1428,8	-	1422,4	1454,2	1454,2	1479,6	-	1463,8	1530,4	1517,7	1555,8	-
56	1422,4	1428,8	1403,4	1428,8	-	1444,8	1479,6	1454,2	1479,6	-	1477,8	1524,0	1505,0	1530,4	-	1514,6	1593,9	1568,5	1612,9	-
58	1478,0	1484,4	1454,2	1473,2	-	1500,4	1535,2	1505,0	1536,7	-	1528,8	1573,3	1555,8	1587,5	-	1579,6	1655,8	1619,3	1663,7	-
60	1535,2	1557,3	1517,7	1530,4	-	1557,3	1589,0	1568,5	1593,9	-	1586,0	1630,4	1619,3	1644,7	-	1630,4	1706,6	1682,8	1733,6	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order

SPIROFLEX SPIRAL-WOUND GASKETS



Dimensions for spiral-wound gaskets in accordance with ASME B16.20 for flanges in accordance with ASME/ANSI B16.47 Series A

(previously API 601 for flanges in accordance with MSS SP-44)

Ordering example for a spiral-wound gasket "SPIROFLEX", Profile SpV2I, NPS 30, Class 150, ASME B16.20, ASME/ANSI B16.47 Series A, made of ...[1]:

Spiral-wound gasket SpV2I, NPS 30, Class 150, ASME B16.20, ASME/ANSI B16.47 Series A, 316L / graphite

For flanges in accordance with ASME/ANSI B16.47 Series A

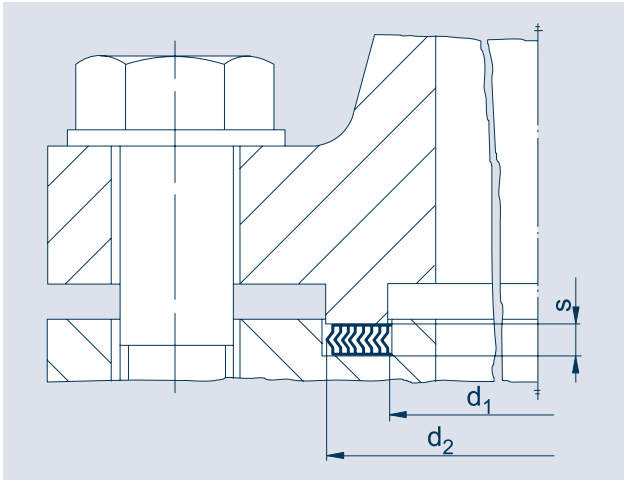
	d_1 Class					d_2 Class					d_3 Class					d_4 Class				
NPS	150	300	400	600	900	150	300	400	600	900	150	300	400	600	900	150	300	400	600	900
26	654,1	654,1	660,4	647,7	660,4	673,1	685,8	685,8	685,8	685,8	704,9	736,6	736,6	736,6	736,6	774,7	835,2	831,9	866,9	882,7
28	704,9	704,9	711,2	698,5	711,2	723,9	736,6	736,6	736,6	736,6	755,7	787,4	787,4	787,4	787,4	831,9	898,7	892,3	914,4	946,2
30	755,7	755,7	755,7	755,7	774,7	774,7	793,8	793,8	793,8	793,8	806,5	844,6	844,6	844,6	844,6	882,7	952,5	946,2	971,6	1009,7
32	806,5	806,5	812,8	812,8	812,8	825,5	850,9	850,9	850,9	850,9	860,6	901,7	901,7	901,7	901,7	939,8	1006,6	1003,3	1022,4	1073,2
34	857,3	857,3	863,6	863,6	863,6	876,3	901,7	901,7	901,7	901,7	911,4	952,5	952,5	952,5	952,5	990,6	1057,4	1054,1	1073,2	1136,7
36	908,1	908,1	917,7	917,7	920,8	927,1	955,8	955,8	955,8	958,9	968,5	1006,6	1006,6	1006,6	1009,7	1047,8	1117,6	1117,6	1130,3	1200,2
38	958,9	952,5	952,5	952,5	1009,7	977,9	977,9	971,6	990,6	1035,1	1019,3	1016,0	1022,4	1041,4	1085,9	1111,3	1054,1	1073,2	1104,9	1200,2
40	1009,7	1003,3	1000,3	1009,7	1060,5	1028,7	1022,4	1025,7	1047,8	1098,6	1070,1	1070,1	1076,5	1098,6	1149,4	1162,1	1114,6	1127,3	1155,7	1251,0
42	1060,5	1054,1	1051,1	1066,8	1111,3	1079,5	1073,2	1076,5	1104,9	1149,4	1124,0	1120,9	1127,3	1155,7	1200,2	1219,2	1165,4	1178,1	1219,2	1301,8
44	1111,3	1104,9	1104,9	1111,3	1155,7	1130,3	1130,3	1130,3	1162,1	1206,5	1178,1	1181,1	1181,1	1212,9	1257,3	1276,4	1219,2	1231,9	1270,0	1368,6
46	1162,1	1152,7	1168,4	1162,1	1219,2	1181,1	1178,1	1193,8	1212,9	1270,0	1228,9	1228,9	1244,6	1263,7	1320,8	1327,2	1273,3	1289,1	1327,3	1435,1
48	1212,9	1209,8	1206,5	1219,2	1270,0	1231,9	1235,2	1244,6	1270,0	1320,8	1279,7	1286,0	1295,4	1320,8	1371,6	1384,3	1324,1	1346,2	1390,7	1485,9
50	1263,7	1244,6	1257,3	1270,0	-	1282,7	1295,4	1295,4	1320,8	-	1333,5	1346,2	1346,2	1371,6	-	1435,1	1378,0	1403,4	1447,8	-
52	1314,5	1320,8	1308,1	1320,8	-	1333,5	1346,2	1346,2	1371,6	-	1384,3	1397,0	1397,0	1422,4	-	1492,3	1428,8	1454,2	1498,6	-
54	1358,9	1352,6	1352,6	1378,0	-	1384,3	1403,4	1403,4	1428,8	-	1435,1	1454,2	1454,2	1479,6	-	1549,4	1492,3	1517,7	1555,8	-
56	1409,7	1403,4	1403,4	1428,8	-	1435,1	1454,2	1454,2	1479,6	-	1485,9	1505,0	1505,0	1530,4	-	1606,6	1543,1	1568,5	1612,9	-
58	1460,5	1447,8	1454,2	1473,2	-	1485,9	1511,3	1505,0	1536,7	-	1536,7	1562,1	1555,8	1587,5	-	1663,7	1593,9	1619,3	1663,7	-
60	1511,3	1524,0	1517,7	1530,4	-	1536,7	1562,1	1568,5	1593,9	-	1587,5	1612,9	1619,3	1644,7	-	1714,5	1644,7	1682,8	1733,6	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order

SPIROFLEX SPIRAL-WOUND GASKETS



Spiral gaskets ”SPIROFLEX“" for flanges with tongue and groove

Gasket thickness

Measurements	DN		NPS	s
in mm	to 80	resp.	to 3	2,5
	100 to 300	resp.	4 to 12	3,0
	350 to 900	resp.	14 to 36	3,5
	for 1000	resp.	40	4,5

Conforming to EN 1514-1 Form TG

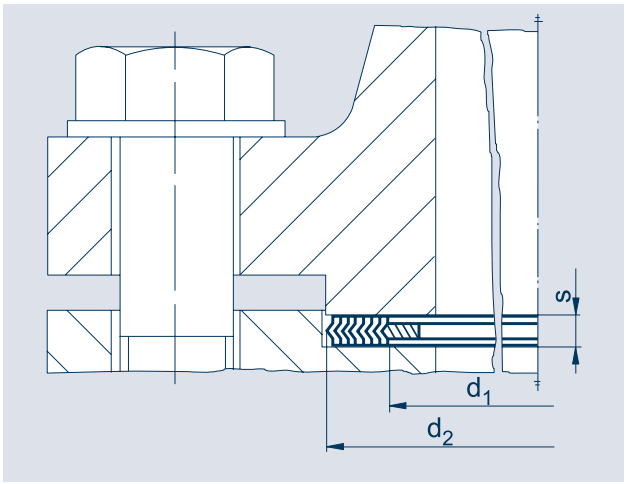
Ordering example for a spiral-wound gasket ”SPIROFLEX“, Form TG, Profile SpV1, in accordance with EN 1514-1, DN 100, made of ...[1]:

Spiral-wound gasket TG, SpV1, EN 1514-1, DN 100, 1.4571 / graphite

Conforming to EN 12560-1 Form TG

Ordering example for a spiral-wound gasket ”SPIROFLEX“, Form TG, Profile SpV1, NPS 5, EN 12560-1, made of ...[1]:

Spiral-wound gasket TG, SpV1, NPS 5", EN 12560-1, 1.4571 / graphite



Spiral gaskets ”SPIROFLEX“ for flanges with male and female

Gasket thickness

Measurements	DN		NPS	s
in mm	10 to 80	resp.	⅜ to 3	$2,5^{+0,3}$
	100 to 300	resp.	4 to 12	$3,0^{+0,3}$
	350 to 900	resp.	14 to 36	$3,5^{+0,3}$

Conforming to EN 1514-1 Form SR

Ordering example for a spiral-wound gasket ”SPIROFLEX“, Form SR, Profile SpV1I, DN 100, EN 1514-1, made of ...[1]:

Spiral-wound gasket SR, SpV1I, DN 100, EN 1514-1, 1.4571 / graphite

Conforming to EN 12560-1 Form SR

Ordering example for a spiral-wound gasket ”SPIROFLEX“, Form SR, Profile SpV1I, NPS 5, EN 12560-1, made of ...[1]:

Spiral-wound gasket SR, SpV1I, NPS 5", EN 12560-1, 1.4571 / graphite

* see section 3 ”General Dimension Tables for DIN, ASME/ANSI, BS for flat gaskets“

[1] Specify material when placing order

GROOVED GASKETS

Types of gaskets

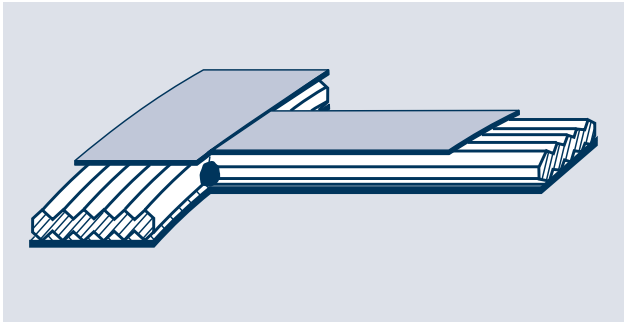
Grooved gaskets have proven extremely useful in all areas of industry, including the most demanding sealing tasks. Our grooved gaskets can be found in conventional power plants as well as in the primary circuit of nuclear power plants. In nuclear power plants, they are used e.g. as a heat exchanger gasket, as a valve cap gasket or as a manhole cover gasket on steam generators or pressurisers.

Grooved gaskets have also been used to great success in the chemical and petrochemical industries. Particularly in places where there are high pressures and temperatures, and therefore high bolt loads, to contend with. In order to avoid damage to the flanges by the metal core, grooved gaskets are generally used with layers of PTFE, graphite, aluminium or silver. This gives total protection to the flanges, as the profile geometry has been specifically adjusted to suit the thickness of the layer.

We have developed a range of profiles to suit the various properties of the layer materials.

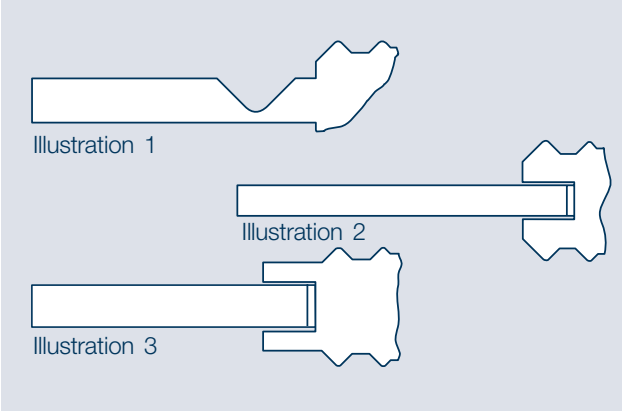
The principal purpose of the soft layers is not however to protect the flanges, but to provide a secure seal even at low minimum surface pressures. A triaxial stress is created in the profiling of the metallic carrier which has been filled with the layer material. The load capacity is limited by the breaking point of the gasket and/or flange material. The stability of this combination is therefore significantly higher than with a pure PTFE, graphite, aluminium or silver seal.

Grooved gaskets be produced in sizes ranging from a few millimetres to a diameter of 4,500 mm on our lathes. The possibility of producing gaskets with greater diameters or one-off production from drawings, such as oval gaskets, can be examined in individual cases. For gaskets in heat exchangers with partitions, it is necessary to insert partitions with grooves of the same profile.



Gaskets for flanges with raised face or for smooth flanges are supplied with a centring ring, so that the gasket is centred on the bolts. If the width of the centring ring is <= 10 mm, then this ring is a part of the gasket (fixed central frame). At greater widths, the integrated has a stress-relieving groove (illustration 1). A loose centring ring should be used with gaseous media. The loose centring ring is also advantageous where there are large differences in temperatures between internal and external diameters. The loose centring ring is fitted in a groove (illustration 2 and 3).

The illustrations show the layout for a nominal thickness of the metal core of 4 mm.



Grooved gaskets are available that conform to works standards WN 100, WN 101, WN 136, WN145 (DIN EN 1514-6), WN 146 and WN 147. Works standards 100 and 101 only contain a sealing width for all nominal pressure levels.

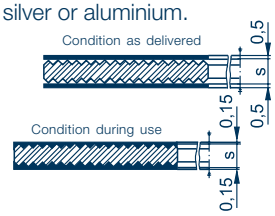
The sealing width $b_D = (d_2 - d_1)/2$ should always increase as the nominal pressure level increases. Due to the extremely large difference between σ_ϑ and σ_V, in grooved gaskets, as expressed in the application security SB = $\sqrt{\sigma_\vartheta/\sigma_V}$, works standards 100 and 101 can be simplified.

GROOVED GASKETS

Materials for the layers

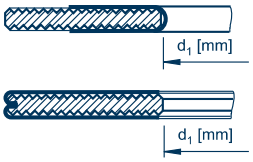
PTFE, graphite and in certain cases silver or aluminium.

Soft-material layers are generally supplied glued to the gasket. When putting the gasket into use, it should be noted that the gasket is thicker around the layers.



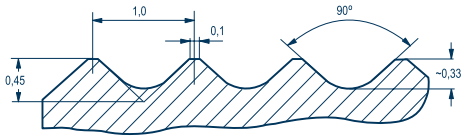
We recommend PTFE or graphite as layers for pipelines, apparatus parts or valves made from austenitic materials. The layers should be either attached without glue or a low-chloride adhesive should be used.

In metal casings in narrow gaskets where $b_D < 0,5\sqrt{d_1}$,single-part casings are used and in wide gaskets with $b_D > 0,5\sqrt{d_1}$ [mm] two-part casings are used.



Grooved gaskets with standard profiling

In the standard profile, the peaks of the groove are on one level and the troughs are parallel to them. This profiling is designed in accordance with DIN EN 1514-6. The layer thickness for graphite, aluminium and silver should be 0.5 mm and for PTFE 0.35 mm.



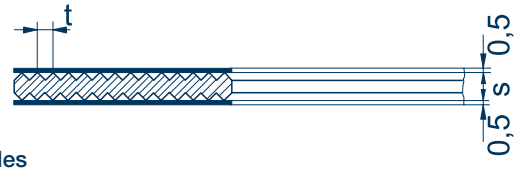
This profiling should be used with gaskets for flange connections with male or female faces or tongue and groove flanges. The minimum requirements are set out in our works standard WN 123.

Sealing thickness and groove pitch

For flanges with tongue and groove faces and flanges with male and female faces.

In accordance with works standard 123

DN			NPS			s
		to 80	resp.	to	3	1,5
from	100	to 300	resp. 4	to	12	2,0
from	350	to 900	resp. 14	to	36	2,5
over	900		36			3,0
Groove pitch t:			with B7A, B9A, B15A	=	1,0 mm	
			with B27A, B29A, B25A	=	1,5 mm	



Profiles

The B7A profile is for use with flange connections with tongue and groove and male and female faces. The Profile B9A with integrated centring ring should be selected for use with smooth flanges and flanges with raised face. With gaseous media, or where there are large differences in temperature between internal and external diameters, the Profile B15A with loose sheet metal centring ring should be used. The grooved insert ring conforming to E7A is for groove-on-groove flange connections.

Gasket profiles

Profile	Cross-section
B7A	
B9A	
B15A	
E7A	

Gasket limiting values

Profiles			B7A, B9A, B15A, E7A					
Materials			1.7335 graphite	1.7335 PTFE*	1.4541 graphite	1.4541 PTFE*	1.4541 aluminium	1.4541 silver
Recommended max. roughness of the flange surfaces	µm	from	12,5	50	12,5	50	12,5	12,5
		to	50	100	50	100	25	25
Surface pressure limits for 20 °C	N/mm²	σ_v	15	15	15	15	80	125
		σ_ϑ	450	450	500	500	500	500
Surface pressure limits for 300 °C	N/mm²	σ_v	30	30[1)]	30	30[1)]	95	140
		σ_ϑ	390	390[1)]	420	420[1)]	420	420

1) Groove gaskets with PTFE layers are only suitable for use at 280 °C to a limited extent.

* Gaskets that are electrically isolated from the usual pipelines by two PTFE layers can become electrostatically charged. Appropriate measures must be taken to discharge any electrical charge that may arise depending on the medium.

Characteristic values according to EN 13555 can be found on our website under www.klinger-kempchen.de.

GROOVED GASKETS

The “convex” grooved gasket

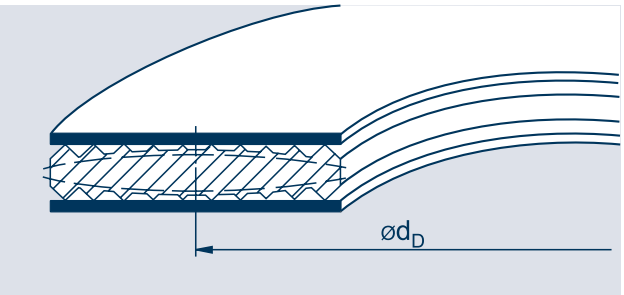
The convex grooved gaskets in Profile B27A, B29Aand B25A exhibit improved sealing properties compared to standard grooved profiles.

The improvement is achieved by the decreasing depth of the groove troughs towards the midpoint of the profile. The profiling is created as a step profile.

The sealing layer made from soft, plastic deformable material creates a thicker padding at the profile centre line than in the internal and external zones. The layer thickness for graphite, aluminium and silver should be 0.5 mm and for PTFE 0.35 mm.

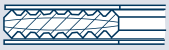
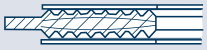
The specific surface pressure is greatest at the profile centre line, causing the sealing layers to flow well into the unavoidable irregularities and roughness on the flange surface. Grooved gaskets in Profile B27A, B29A and B25A reduce edge pressure.

The increased surface pressure at the profile centre line has a positive effect on the sealing properties in tilted flanges. With ordinary gaskets, when a flange is strongly tilted ($\alpha \sim 1°$) it causes a raising of the internal diameter of the gasket to be observed, as the flange is now loading the seal more on the outer diameter. But with Profile B27A, B29A and B25A the contact diameter is kept at d_G. These gaskets are therefore particularly suitable for flange connections where the pressures and temperatures are constantly fluctuating.



With gaseous media or large differences in temperature between the internal and external diameters, Profile B25A with loose sheet metal central edge should be used.

Gasket profiles

Profile	Cross/section
B27A	
B29A	
B25A	
E27A	

Profiles

The B27A profile is for use with flange connections with tongue and groove and male and female faces. The Profile B29A with integrated centring ring should be selected for use with smooth flanges and flanges with raised face. The grooved insert conforming to E27A is for groove-on-groove flange connections.

Surface pressures

The minimum surface pressure σ_V is determined by the layer material used with the convex grooved gasket.

The highest permissible surface pressure at a temperature of ϑ is σ_ϑ and this determines the “allowable gasket load reaction”. The maximum allowable surface pressure σ_ϑ is determined by the material used in the metal core.

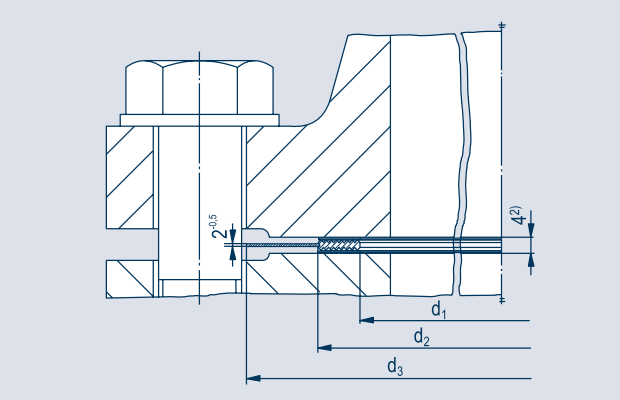
Gasket limiting values

Profiles			B27A, B29A, B25A, E27A								
Materials			1.0038 graphite	1.5415 graphite	1.5415 PTFE*	1.4541 graphite	1.4541 PTFE*	1.4828 graphite	1.4541 aluminium	1.4541 silver	1.4828 silver
Recommended max. roughness (R_Z) of the flange surfaces	µm	from	12,5	12,5	50	12,5	50	12,5	12,5	12,5	12,5
		to	50	50	100	50	100	50	25	25	25
Surface pressure limits for 20 °C	N/mm²	σ_v	15	15	15	15	15	15	70	100	100
		σ_ϑ	350	450	450	500	500	500	500	500	500
Surface pressure limits for 300 °C	N/mm²	σ_v	20	20	20[1)]	20	20[1)]	20	80	110	110
		σ_ϑ	210	330	330[1)]	420	420[1)]	420	420	420	500

1) Groove gaskets with PTFE layers are only suitable for use at 280°C to a limited extent.

* Gaskets that are electrically isolated from the usual pipelines by two PTFE layers can become electro-statically charged. Appropriate measures must be taken to discharge any electrical charge that may arise depending on the medium.

GROOVED GASKETS



Works standard 145 = DIN EN 1514-6 for DIN flanges

Ordering example for a grooved gasket with layers, Profile B29A, DN 100, PN 40, works standard 145, made of ...[1]:

Grooved gasket B29A, DN 100, PN 40, works standard 145, 1.4541 / PTFE

For DIN flanges

DN	d_1	d_2 PN 10-PN 40	d_2 PN 63-PN 160	d_2 PN 250-PN 400	d_3 PN 10	PN 16	PN 25	PN 40	PN 63	PN 100	PN 160	PN 250	PN 320	PN 400
10	22	36	36	36	46	46	46	46	56	56	56	67	67	67
15	26	42	42	42	51	51	51	51	61	61	61	72	72	78*
20	31	47	47	47	61	61	61	61	72	72	-	-	-	-
25	36	52	52	52	71	71	71	71	82	82	82	83	92	104
32	46	62	62	66	82	82	82	82	-	-	-	-	-	-
40	53	69	69	73	92	92	92	92	103	103	103	109	119	135
50	65	81	81	87	107	107	107	107	113	119	119	124	134	150
65	81	100	100	103	127	127	127	127	137	143	143	153	170	192
80	95	115	115	121	142	142	142	142	148	154	154	170	190	207
100	118	138	138	146	162	162	168	168	174	180	180	202	229	256
125	142	162	162	178	192	192	194	194	210	217	217	242	274	301
150	170	190	190	212	217	217	224	224	247	257	257	284	311	348
175	195	215	215	245	247	247	254	265	277	287	284	316	358	402
200	220	240	248	280	272	272	284	290	309	324	324	358	398	442
250	270	290	300	340	327	328	340	352	364	391	388	442	488	-
300	320	340	356	400	377	383	400	417	424	458	458	536	-	-
350	375	395	415	-	437	443	457	474	486	512	-	-	-	-
400	426	450	474	-	489	495	514	546	543	572	-	-	-	-
450	480	506	-	-	539	555	-	571	-	-	-	-	-	-
500	530	560	588	-	594	617	624	628	657	704	-	-	-	-
600	630	664	700	-	695	734	731	747	764	813	-	-	-	-
700	730	770	812	-	810	804	833	852	879	950	-	-	-	-
800	830	876	886	-	917	911	942	974	988	-	-	-	-	-
900	930	982	994	-	1017	1011	1042	1084	1108	-	-	-	-	-
1000	1040	1098	1110	-	1124	1128	1154	1194	1220	-	-	-	-	-
1200	1250	1320	1334	-	1341	1342	1364	1398	1452	-	-	-	-	-
1400	1440	1522	-	-	1548	1542	1578	1618	-	-	-	-	-	-
1600	1650	1742	-	-	1772	1764	1798	1830	-	-	-	-	-	-
1800	1850	1914	-	-	1972	1964	2000	-	-	-	-	-	-	-
2000	2050	2120	-	-	2182	2168	2230	-	-	-	-	-	-	-
2200	2250	2328	-	-	2384	2378	-	-	-	-	-	-	-	-
2400	2460	2512	-	-	2594	-	-	-	-	-	-	-	-	-
2600	2670	2728	-	-	2794	-	-	-	-	-	-	-	-	-
2800	2890	2952	-	-	3014	-	-	-	-	-	-	-	-	-
3000	3100	3166	-	-	3228	-	-	-	-	-	-	-	-	-

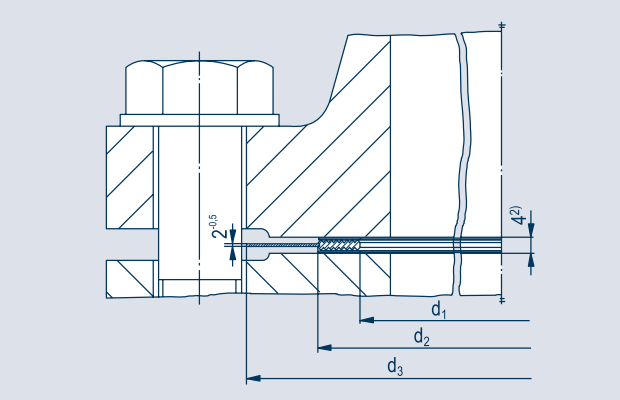
- Flanges compliant with the standard not available

Dimensions in mm

* WN 145

[1] Specify material when placing order
[2] Please arrange other thicknesses when ordering.

GROOVED GASKETS



Works standard 146 for flanges in accordance with ANSI B16.5

Ordering example for a grooved gasket with layers, Profile B9A, NPS 5, for ANSI flanges, Class 600, works standard 146, made of ...[1]:

Grooved gasket B9A, NPS 5, Class 600, works standard 146, 1.4541 / graphite

04

For flanges in accordance with ANSI B16.5

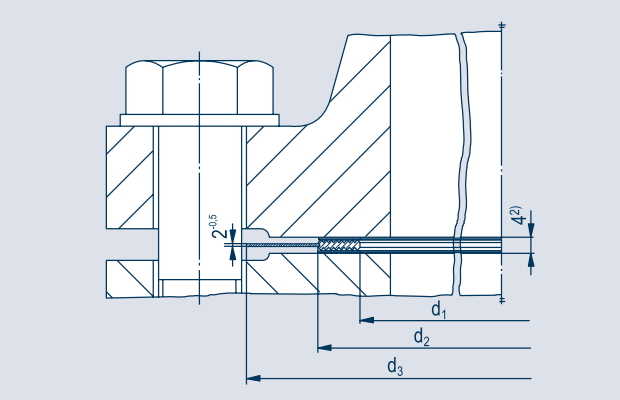
NPS	d_1	d_2 Class 150-300	d_2 Class 400-600	d_2 Class 900-2500	Class / d_3 150	300	400	600	900	1500	2500
½	20	30	30	30	44,4	50,8	50,8	50,8	60,3	60,3	66,7
¾	25	35	35	35	53,9	63,5	63,5	63,5	66,7	66,7	73,0
1	32	42	42	42	63,5	69,8	69,8	69,8	76,2	76,2	82,5
1¼	40	56	56	56	73,0	79,4	79,4	79,4	85,7	85,7	101,6
1½	45	61	61	61	82,5	92,1	92,1	92,1	95,2	95,2	114,3
2	60	80	80	80	101,6	108,0	108,0	108,0	139,7	139,7	142,8
2½	70	90	90	90	120,6	127,0	127,0	127,0	161,9	161,9	165,1
3	85	105	105	110	133,4	146,1	146,1	146,1	165,1	171,5	193,7
3½	100	120	120	-	158,8	161,9	158,7	158,7	-	-	-
4	110	130	130	135	171,5	177,8	174,6	190,5	203,2	206,4	231,7
5	135	155	155	165	193,7	212,7	209,5	238,1	244,5	250,8	276,2
6	160	180	180	195	219,1	247,7	244,5	263,5	285,8	279,4	314,3
8	210	230	230	250	276,2	304,8	301,6	317,5	355,6	349,3	384,1
10	265	285	295	315	336,5	358,8	355,6	396,9	431,8	431,8	473,0
12	315	335	350	375	406,4	419,1	415,9	454,0	495,3	517,5	546,1
14	350	370	390	405	447,7	482,6	479,4	488,9	517,5	574,7	-
16	400	425	445	460	511,2	536,6	533,4	561,9	571,5	638,1	-
18	450	480	500	525	546,1	593,7	590,5	609,6	635,0	701,7	-
20	500	535	555	575	603,2	650,9	644,5	679,5	695,3	752,4	-
24	600	640	665	685	714,4	771,5	765,2	787,4	835,0	898,5	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order
[2] Please arrange other thicknesses when ordering.

GROOVED GASKETS



Works standard 147 for flanges in accordance with ASME B16.47 Series A

Ordering example for a grooved gasket with layers, Profile B9A, NPS 30, for flanges in accordance with ASME B16.47, Series A, Class 600, works standard 147, made of ...[1]:

Grooved gasket B9A, NPS 30, Class 600, works standard 147, 1.4541 / graphite

For flanges in accordance with ASME B16.47 Series A

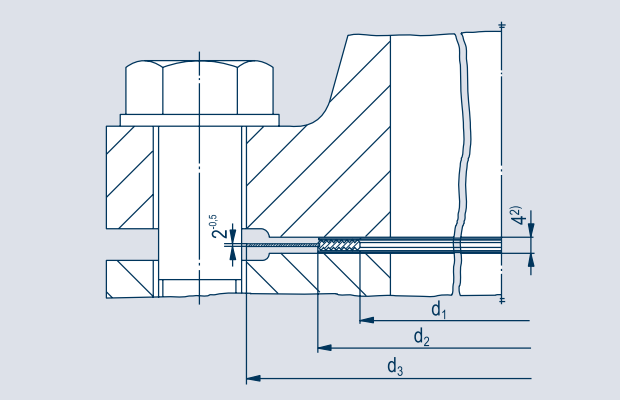
NPS	d_1	d_2 Class 150-300	d_2 Class 400-600	d_2 Class 900-2500	d_3 Class 150	300	400	600	900
26	650	685	705	725	772	832	829	864	880
28	705	745	765	785	829	895	889	911	943
30	755	795	820	840	880	949	943	968	1007
32	805	850	875	895	937	1003	1000	1019	1070
34	855	900	930	950	987	1054	1051	1070	1134
36	905	955	985	1005	1045	1114	1114	1127	1197
38	960	1015	1030	1065	1108	1051	1070	1102	1197
40	1010	1065	1085	1120	1159	1111	1124	1153	1248
42	1060	1120	1135	1175	1216	1162	1175	1216	1299
44	1110	1170	1190	1230	1273	1216	1229	1267	1365
46	1160	1225	1250	1285	1324	1270	1286	1324	1432
48	1210	1275	1300	1340	1381	1321	1343	1388	1483
50	1260	1330	1355	-	1432	1375	1400	1445	-
52	1310	1385	1405	-	1489	1426	1451	1495	-
54	1360	1435	1460	-	1546	1489	1515	1553	-
56	1410	1490	1515	-	1603	1540	1565	1610	-
58	1460	1540	1565	-	1661	1591	1616	1661	-
60	1510	1595	1625	-	1711	1742	1680	1730	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order
[2] Please arrange other thicknesses when ordering.

GROOVED GASKETS



Works standard 101* for DIN flanges

Ordering example for a grooved gasket with layers, Profile B29A, DN 100, PN 40, works standard 101, made of ...[1]:

Grooved gasket B29A, DN 100, PN 40, works standard 101, 1.4541 / PTFE

* Grooved gaskets can also be manufactured with a sealing width optimised to the nominal pressure in accordance with works standard 145

For DIN flanges

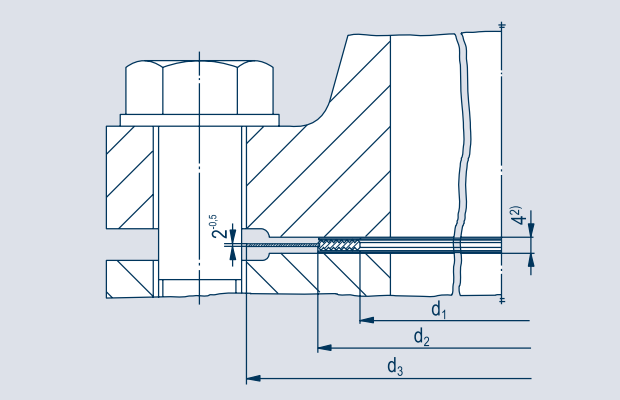
DN	d_1	d_2	d_3									
			PN 10	PN 16	PN 25	PN 40	PN 63	PN 100	PN 160	PN 250	PN 320	PN 400
10	22	36	46	46	46	46	56	56	56	67	67	67
15	26	42	51	51	51	51	61	61	61	72	72	78
20	31	47	61	61	61	61	-	-	-	-	-	-
25	36	52	71	71	71	71	82	82	82	83	92	104
32	46	66	82	82	82	82	-	-	-	-	-	-
40	53	73	92	92	92	92	103	103	103	109	119	135
50	65	87	107	107	107	107	113	119	119	124	134	150
65	81	103	127	127	127	127	137	143	143	153	170	192
80	95	121	142	142	142	142	148	154	154	170	190	207
100	118	144	162	162	168	168	174	180	180	202	229	256
125	142	176	192	192	194	194	210	217	217	242	274	301
150	170	204	217	217	224	224	247	257	257	284	311	348
175	195	229	247	247	254	265	277	287	284	316	358	402
200	224	258	272	272	284	290	309	324	324	358	398	442
250	275	315	327	328	340	352	364	391	388	442	488	-
300	325	365	377	383	400	417	424	458	458	536	-	-
350	375	420	437	443	457	474	486	512	-	-	-	-
400	426	474	489	495	514	546	543	572	-	-	-	-
450	480	528	539	555	-	571	-	-	-	-	-	-
500	530	578	594	617	624	628	657	704	-	-	-	-
600	630	680	695	734	731	747	764	813	-	-	-	-
700	730	780	810	804	833	852	879	950	-	-	-	-
800	830	880	917	911	942	974	988					
900	930	980	1017	1011	1042	1084	1108					
1000	1040	1090	1124	1128	1154	1194	1220					
1200	1250	1310	1341	1342	1364	1398	1452					
1400	1440	1510	1548	1542	1578	1618	-					
1600	1650	1730	1772	1764	1798	1830	-					
1800	1850	1930	1972	1964	2000	-	-					
2000	2050	2130	2182	2168	2230	-	-					
2200	2250	2340	2384	2378	-	-	-					
2400	2460	2550	2594	-	-	-	-					
2600	2670	2760	2794	-	-	-	-					
2800	2890	2980	3014	-	-	-	-					
3000	3100	3190	3228	-	-	-	-					

- Flanges compliant with the standard not available

Dimensions in mm

1) Specify material when placing order
2) The thickness of the metal part $3.8^{+0.2}$ mm at a nominal size of 4. Please arrange other thicknesses when ordering.

GROOVED GASKETS



Works standard 100* = EN 12560-6 for flanges in accordance with ANSI B16.5

Ordering example for a grooved gasket with layers, Profile B9A, NPS 5, for ANSI flanges, Class 600, works standard 100, made of ...[1]:

Grooved gasket B9A, NPS 5, Class 600, works standard 100, 1.4541/graphite

* Grooved gaskets can also be manufactured with a sealing width optimised to the nominal pressure in accordance with works standard 146

For flanges in accordance with ANSI B16.5

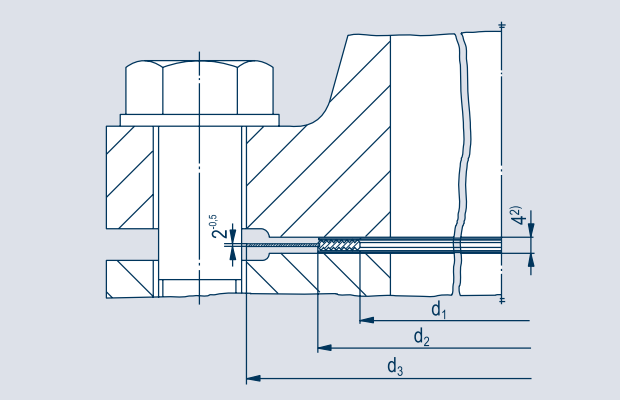
NPS	d_1	d_2	Class / d_3						
			150	300	400	600	900	1500	2500
½	23,0	33,3	44.4	50,8	50,8	50,8	60,3	60,3	66,7
¾	28,6	39,7	53,9	63,5	63,5	63,5	66,7	66,7	73,0
1	36.5	47,6	63,5	69,8	69,8	69,8	76,2	76,2	82,5
1¼	44,4	60,3	73,0	79,4	79,4	79,4	85,7	85,7	101,6
1½	52,4	69,8	82,5	92,1	92,1	92,1	95,2	95,2	114,3
2	69,8	88,9	101,8	108,0	108,0	108,0	139,7	139,7	142,8
2½	82,5	101,6	120,6	127,0	127,0	127,0	161,9	161,9	165,1
3	98,4	123,8	133,4	146,1	146,1	146,1	165,1	171,5	193,7
3½	111,1	136,5	158,8	161,9	158,7	158,7	-	-	-
4	123,8	154,0	171,5	177,8	174,6	190,5	203,2	206,4	231,7
5	150,8	182,6	193,7	212,7	209,5	238,1	244,5	250,8	276,2
6	177,8	212,7	219,1	247,7	244,5	263,5	285,8	279,4	314,3
8	228,6	266,7	276,2	304,8	301,6	317,5	355,6	349,3	384,1
10	282,6	320,7	336,5	358,8	355,6	396,9	431,8	431,8	473,0
12	339,7	377,8	406,4	419,1	415,9	454,0	495,3	517,5	546,1
14	371,5	409,6	447,7	482,6	479,4	488,9	517,5	574,7	-
16	422,3	466,7	511,2	536,6	533,4	561,9	571,5	638,1	-
18	479,4	530,2	546,1	593,7	590,5	609,6	635,0	701,7	-
20	530,2	581,0	603,2	650,9	644,5	679,5	695,3	752,4	-
22	581,0	631,8	657,2	701,7	698,5	730,3	-	-	-
24	631,8	682,6	714,4	771,5	765,2	787,4	835,0	898,5	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order

GROOVED GASKETS



Works standard 136* for flanges in accordance with ASME B16.47 Series A

Ordering example for a grooved gasket with layers, Profile B9A, NPS 30, for flanges in accordance with ASME B16.47, Series A, Class 600, works standard 136, made of ...[1]:

Grooved gasket B9A, NPS 30, Class 600, works standard 136, 1.4541 / graphite

* Grooved gaskets can also be manufactured with a sealing width optimised to the nominal pressure in accordance with works standard 147

For flanges in accordance with ASME B16.47 Series A

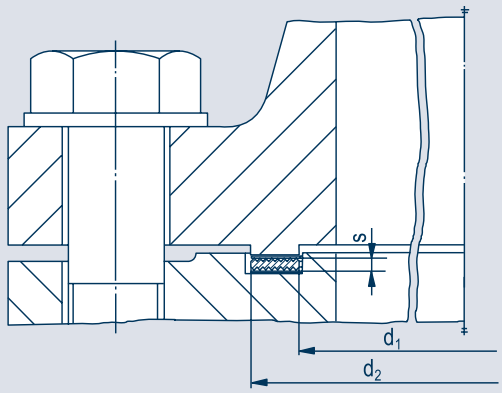
NPS	d_1	d_2	Class d_3 150	300	400	600	900
26	690	740	772	832	829	864	880
28	740	790	829	895	889	911	943
30	800	850	880	949	943	968	1007
32	845	905	937	1003	1000	1019	1070
34	895	955	987	1054	1051	1070	1134
36	950	1010	1045	1114	1114	1127	1197
38	960	1020	1108	1051	1070	1102	1197
40	1015	1075	1159	1111	1124	1153	1248
42	1065	1125	1216	1162	1175	1216	1299
44	1125	1185	1273	1216	1229	1267	1365
46	1175	1235	1324	1270	1286	1324	1432
48	1220	1290	1381	1321	1343	1388	1483
50	1270	1350	1432	1375	1400	1445	-
52	1320	1400	1489	1426	1451	1495	-
54	1375	1455	1546	1489	1515	1553	-
56	1430	1510	1603	1540	1565	1610	-
58	1485	1565	1661	1591	1616	1661	-
60	1535	1615	1711	1742	1680	1730	-

- Flanges compliant with the standard not available

Dimensions in mm

1) Specify material when placing order
2) The thickness of the metal part $3.8^{+0.2}$ mm at a nominal size of 4. Please arrange other thicknesses when ordering.

GROOVED GASKETS



The gasket thickness is ever smaller than the groove depth

For flanges with tongue and groove
Conforms to DIN 2691 edition 11.71 (PN 10 to PN 160)

Ordering example for a grooved gasket with layers, Profile B7A, DN100, made of ...[1]:

Grooved gasket, B7A, DN 100, DIN 2691, 1.4571 / graphite

In accordance with ANSI B 16.21 (150 to 1500)

Ordering example for a grooved gasket with layers, Profile B7A, NPS 5, wide model, made of ...[1]:

Grooved gasket, B7A, NPS 5, ANSI B 16.5 wide, tongue and groove, 1.4541 / graphite

For DIN flanges

DN	d_1	d_2
4-6[2]	20	30
8[2]	22	32
10	24	34
15	29	39
20	36	50
25	43	57
32	51	65
40	61	75
50	73	87
65	95	109
80	106	120
100	129	149
125	155	175
150	183	203
175	213	233
200	239	259
250	292	312
300	343	363
350	395	421
400	447	473
500	549	575
600	649	675
700	751	777
800	856	882
900	961	987
1000	1062[3]	1092[3]

Dimensions in mm

For flanges in accordance with ASME/ANSI B16.5

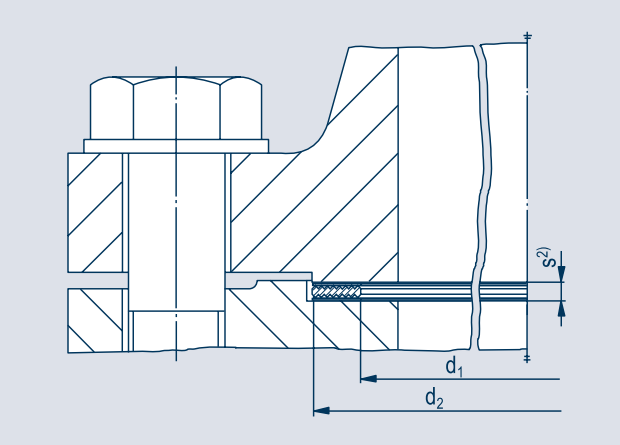
NPS	d_1	narrow d_2	wide d_2
½	25	35	35
¾	33	43	43
1	38	48	51
1¼	48	57	64
1½	54	64	73
2	73	83	92
2½	86	95	105
3	108	117	127
3½	121	130	140
4	132	145	157
5	160	173	186
6	191	203	216
8	238	254	270
10	286	305	324
12	343	362	381
14	375	394	413
16	425	448	470
18	489	511	533
20	533	559	584
24	641	667	692

Dimensions in mm

1) Specify material when placing order
2) Only for flanges in refrigeration engineering
3) Dimensions in accordance with DIN 2512

GROOVED GASKETS

For flanges with male and female



Conforms to DIN 2692 edition 5.66 (PN 10 to PN 100)

Ordering example for a grooved gasket with layers, Profile B7A.DN 100, made of ...[1]:

Grooved gasket, B7A, DN 100, DIN 2692, 1.4541 / graphite

In accordance with ANSI B16.21 (150 to 1500)

Ordering example for a grooved gasket with layers, Profile B7A, NPS 5, wide model, made of ...[1]:

Grooved gasket, B7A, NPS 5, ANSI B 16.21 wide, male and female, 1.4541/graphite

For DIN flanges

DN	d_1	d_2
10	18	34
15	22	39
20	28	50
25	35	57
32	43	65
40	49	75
50	61	87
65	77	109
80	90	120
100	115	149
125	141	175
150	169	203
175	195	233
200	220	259
250	274	312
300	325	363
350	368	421
400	420	473
500	520	575
600	620	675
700	720	777
800	820	882
900	920	987
1000	1020	1091

Dimensions in mm

For flanges in accordance with ASME/ANSI B16.5

NPS	narrow		wide	
	d_1	d_2	d_1	d_2
½	to be specified by user	18	21	35
¾		24	27	43
1		30	34	51
1¼		38	42	64
1½		44	48	73
2		57	60	92
2½		68	73	105
3		84	89	127
3½		97	102	140
4		109	114	157
5		137	141	186
6		162	168	216
8		213	219	270
10		267	273	324
12		318	324	381
14		349	356	413
16		400	406	470
18		451	457	533
20		502	508	584
24		603	610	692

Dimensions in mm

1) Specify material when placing order
2) The gasket thickness is always less than the female face depth

METAL JACKETED GASKETS

Metal jacketed gaskets are proven sealing elements for use in apparatus construction, which are however increasingly being replaced at temperatures up to 550 °C by metal/soft-material gaskets, such as grooved gaskets (see remarks on the next page).

At temperatures above 500 °C, such as in hot-blast areas, metal jacketed gaskets can still hold their own against solid metal gaskets such as weld ring gaskets.

Jacketed gaskets generally consist of a metal sheet coating with an insert of RivaTherm Super, graphite or FA[1)] or some layers of sheet metal.

The metal sheet coating should be as soft and flexible as possible, but to prevent corrosion it is often made from a stainless steel jacket in 1.4541 or 1.4571 steel.

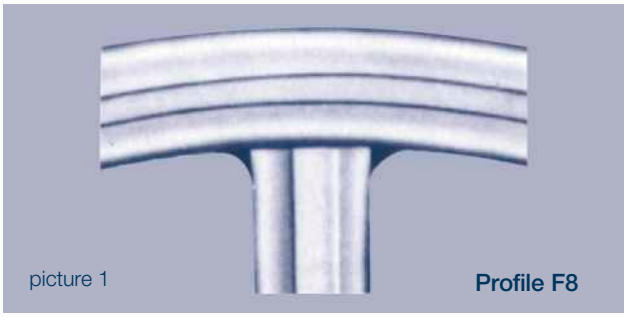
The harder the jacket, the finer the flange roughness needs to be.

The inlay is selected according to the flange irregularities that need to be covered. The better the quality and the evenness of the sealing surfaces, the harder the inlay can be.

There is a wide range of possible combinations; the following are extremes at both ends:

very soft: Coating of aluminium, inlay of graphite

very hard: Coating of stainless steel, inlay of mica

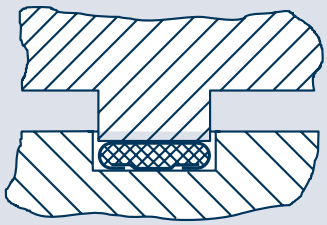


picture 1 **Profile F8**

Metal jacketed gaskets for heat exchangers are supplied with partitions in the model shown (picture 1).

Metal jacketed gaskets are also available as frames with rounded corners.

In flanges with tongue and groove or male and female face joints the jacketed gaskets should be fitted so that the tongue and/or the male face is against the smooth side of the gasket (picture 2).



picture 2

Gasket limiting values

Profiles / Materials			F2 to F17 Aluminium Graphite	F2 to F17 Copper Brass Graphite	F2 to F17 Iron Nickel Graphite	F2 to F17 Stainless steel Graphite	Fw3 Iron Nickel Graphite	F3L Iron Iron
Recommended max. roughness (R_z) of the flange surfaces	µm	from	25	12,5	6,3	2,5	6,3	6,3
		to	50	25	12,5	6,3	12,5	12,5
Surface pressure limits for 20 °C	N/mm²	σ_v	30	60	70	100	60	200
		σ_ϑ	100	150	180	250	180	500
Surface pressure limits for 300 °C	N/mm²	σ_v	(40)	70	80	115	70	200
		σ_ϑ	(60)	120	150	200	150	350

[1)] Fibre sheets with binder

METAL JACKETED GASKETS

Jacketed gaskets Profile F3, F4, F8, FW3 and F17 are for flanges with raised face

Due to its dimensions, Profile F17 produces lower bolt loads and more favourable deformation behaviour than Profiles F3, F4, F8 and FW3.

Jacketed gaskets Profile F8 and F10 are mostly used in apparatus construction.

Materials for the coating

1.0333; 1.4541; 1.4571; 1.4828; 3.0255; 2.0090; 2.0321; 2.4066; 2.4360, other materials available on request.

Materials for the insert

RivaTherm Super, graphite, Fa[1)]

[1)] Fibre sheets with binder

Gasket profiles

Profile	Cross-section
F2	
F3	
F4	
F8	
F10	
F12	
F17	
FW3	

Remarks

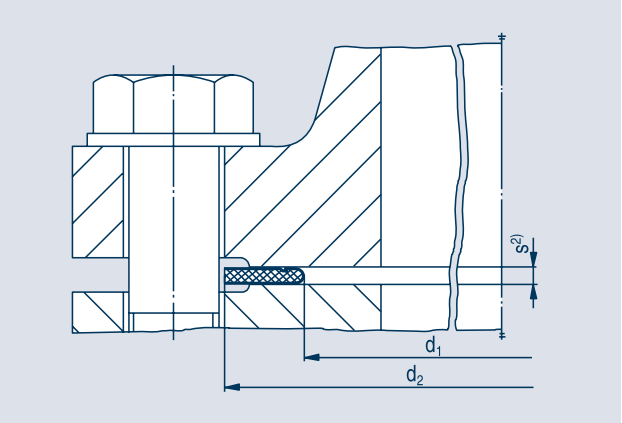
Particularly in apparatus and equipment engineering, there are situations where extraordinary stability is required of the gasket. This is the case for example when the shell pressure test is carried out in a floating-head heat exchanger while the pipe bundle is drained. In addition to the pre-tensioning force on the (sometimes notably large) floating head surface is added an additional pressure force from the test pressure of the shell. This will lead to overload and subsequent destruction of the gasket if it does not have the required stability.

Experience shows that the stability of metal jacketed gaskets is in many cases insufficient to solve this problem. Due to their particular design, a stress condition can be created in the sheet metal coating of metal jacketed gaskets with inlays from soft-materials which destroys the gasket, particularly if the flange sealing surfaces have been coated with sealing compounds or grease to make them easier to fit.

We recommend dry installation and the use of stable gaskets.

Particularly suitable are grooved gaskets with layers of graphite or PTFE. These can also be supplied with the appropriate pass partitions, so that the switch from metal jacketed gaskets can be made without any problem.

METAL JACKETED GASKETS



Ordering example for a jacketed gasket, Profile F4, DN 100, PN 16, works standard 107, made of ...[1]:

Jacketed gasket F4, DN 100, PN 16, works standard 107-1, copper/FS

Works standard 107-1 for flanges in accordance with DIN and BS4504, Profile F3, F4, F8 and FW3

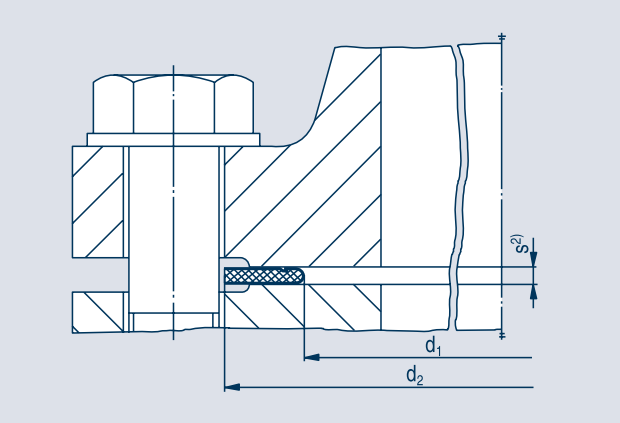
DN	PN 10		PN 16		PN 25		PN 40		PN 64		PN 100	
	d_1	d_2	d_1	d_2	d_1	d_2	d_1	d_2	d_1	d_2	d_1	d_2
10	25	46	25	46	25	46	25	46	30	56	30	56
15	30	51	30	51	30	51	30	51	35	61	35	61
20	40	61	40	61	40	61	40	61	-	-	-	-
25	50	71	50	71	50	71	50	71	55	82	55	82
32	60	82	60	82	60	82	60	82	-	-	-	-
40	70	92	70	92	70	92	70	92	75	103	75	103
50	85	107	85	107	85	107	85	107	85	113	85	119
65	105	127	105	127	105	127	105	127	105	138	105	144
80	120	142	120	142	120	142	120	142	120	148	120	154
100	140	162	140	162	145	168	145	168	140	174	137	180
125	170	192	170	192	170	194	170	194	165	210	160	217
150	195	218	195	218	200	224	200	224	195	247	190	257
175	225	248	225	248	230	254	240	265	235	277	230	287
200	250	273	250	273	260	284	260	290	255	309	250	324
250	300	328	300	329	315	340	320	352	315	364	310	391
300	350	378	355	384	370	400	380	417	375	424	370	458
350	410	438	415	444	425	457	435	474	430	486	425	512
400	460	489	460	495	475	514	505	546	500	543	495	572
500	565	594	580	617	580	624	580	628	575	657	570	704
600	660	695	695	734	695	731	695	747	690	764	685	813
700	780	810	765	804	785	833	800	852	795	879	790	950
800	880	917	870	911	890	942	910	974	905	988	-	-
900	980	1017	970	1011	990	1042	1020	1084	1010	1108	-	-
1000	1080	1124	1085	1128	1100	1154	1130	1194	1120	1220	-	-
1200	1300	1341	1295	1342	1300	1364	1325	1398	1320	1425	-	-
1400	1500	1548	1495	1542	1510	1578	1545	1618	-	-	-	-
1600	1720	1772	1715	1764	1730	1798	1755	1830	-	-	-	-
1800	1920	1972	1910	1964	1930	2000	-	-	-	-	-	-
2000	2120	2182	2105	2168	2150	2230	-	-	-	-	-	-
2200	2320	2384	2310	2378	-	-	-	-	-	-	-	-
2400	2520	2594	-	-	-	-	-	-	-	-	-	-
2600	2730	2794	-	-	-	-	-	-	-	-	-	-
2800	2950	3014	-	-	-	-	-	-	-	-	-	-
3000	3150	3228	-	-	-	-	-	-	-	-	-	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order
[2] standard thickness of 3 mm, other thicknesses on request

METAL JACKETED GASKETS



Ordering example for a jacketed gasket, Profile F4, NPS 5, Class 600, conforms to EN 12560-7, made of ...[1]:

Jacketed gasket F4, NPS 5, Class 600, EN 12560-4, copper/ FA

04

Conforms to EN 12560-7 for flanges in accordance with ANSI B 16.5

	d_1	d_2	Class	d_3				
NPS	150 - 300	660 - 2500	150	300	600	900	1500	2500
½	22	22	47,6	54,0	54,0	63,5	63,5	69,9
¾	29	29	57,2	66,7	66,7	69,9	69,9	76,2
1	38	38	66,7	73,0	73,0	79,4	79,4	85,7
1¼	48	48	76,2	82,6	82,6	88,9	88,9	104,8
1½	57	54	85,7	95,3	95,3	98,4	98,4	117,5
2	75	73	104,8	111,1	111,1	142,9	142,9	146,1
2½	90	86	123,8	130,2	130,2	165,1	165,1	168,3
3	113	108	136,5	149,2	149,2	168,3	174,6	196,9
4	141	132	174,6	181,0	193,7	206,4	209,6	235,0
5	165	152	196,9	215,9	241,3	247,7	254,0	279,4
6	196	190	222,3	250,8	266,7	288,9	282,6	317,5
8	253	238	279,4	308,0	320,7	358,8	352,4	387,4
10	294	286	339,7	362,0	400,1	435,0	435,0	476,3
12	356	343	409,6	422,3	457,2	498,5	520,7	549,2
14	382	375	450,9	485,8	492,1	520,7	577,9	-
16	434	425	514,4	539,8	565,2	574,7	641,4	-
18	500	489	549,3	596,9	612,8	638,2	704,9	-
20	540	533	606,4	654,1	682,6	698,5	755,7	-
24	647	641	717,6	774,7	790,6	838,2	901,7	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order
[2] standard thickness of 3 mm, other thicknesses on request

METAL JACKETED GASKETS

Works standard 107-2 for flanges in accordance with ANSI/ASME B 16.5, Profile F3, F4, F8, FW3

		Class	d_2					
NPS	d_1	150	300	400	600	900	1500	2500
½	25	47	53	53	53	63	63	69
¾	33	57	66	66	66	69	69	76
1	38	66	73	73	73	79	79	85
1¼	47	76	82	82	82	88	88	104
1½	54	85	95	95	95	98	98	117
2	73	104	111	111	111	142	142	146
2½	86	123	130	130	130	165	165	168
3	108	136	149	149	149	168	174	196
3½	120	161	165	161	161	-	-	-
4	132	174	180	177	193	206	209	234
5	160	196	215	212	241	247	254	279
6	190	222	250	247	266	288	282	317
8	238	279	307	304	320	358	352	387
10	286	339	361	358	400	434	434	476
12	343	409	422	419	457	498	520	549
14	374	450	485	482	492	520	577	-
16	425	514	539	536	565	574	641	-
18	489	549	596	593	612	638	704	-
20	533	606	654	647	682	698	755	-
22	587	660	704	701	733	-	-	-
24	641	717	774	768	790	838	901	-

For dimensions below the stepped line, we recommend Profile F17 rather than FW3 for manufacturing reasons.

Dimensions in mm

Works standard 107-3 for flanges in accordance with ANSI/ASME B 16.5, Profile F17

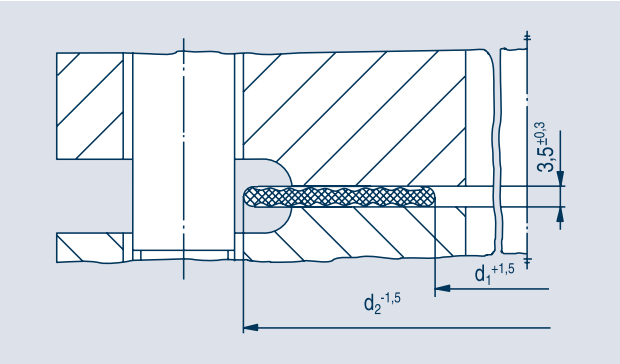
			Class	d_3					
NPS	d_1	d_2	150	300	400	600	900	1500	2500
½	21	31	47	53	53	53	63	63	69
¾	27	37	57	66	66	66	69	69	76
1	33	46	66	73	73	73	79	79	85
1¼	42	58	76	82	82	82	88	88	104
1½	48	68	85	95	95	95	98	98	117
2	60	80	104	111	111	111	142	142	146
2½	73	92	123	130	130	130	165	165	168
3	89	108	136	149	149	149	168	174	196
3½	102	121	161	165	161	161	-	-	-
4	114	140	174	180	177	193	206	209	234
5	141	167	196	215	212	241	247	254	279
6	168	194	222	250	247	266	288	282	317
8	219	251	279	307	304	320	358	352	387
10	273	311	339	361	358	400	434	434	476
12	324	362	409	422	419	457	498	520	549
14	356	394	450	485	482	492	520	577	-
16	406	451	514	539	536	565	574	641	-
18	457	502	549	596	593	612	638	704	-
20	508	559	606	654	647	682	698	755	-
22	559	610	660	704	701	733	-	-	-
24	610	660	717	774	768	790	838	901	-

- Flanges compliant with the standard not available

Dimensions in mm

METAL JACKETED GASKETS

Profile FW3



Ordering example for a double-corrugated gasket, Profile FW3, NPS 3, Class 600, in accordance with ASME B16.20 for flanges in accordance with ASME/ANSI B 16.5, made of ...[1]:

Double-corrugated gasket, Profile FW3, NPS 3, Class 600, ASME B16.20 for flanges in accordance with ASME/ANSI B16.5, steel/FA

In accordance with ASME B16.20 for flanges in accordance with ASME/ANSI B16.5

NPS	d_1	class 150	class 300	class 400	d_2 class 600	class 900	class 1500	class 2500
½	22,4	44,5	50,8	50,8	50,8	60,5	60,5	66,8
¾	28,7	54,1	63,5	63,5	63,5	66,8	66,8	73,2
1	38,1	63,5	69,9	69,9	69,9	76,2	76,2	82,6
1¼	47,8	73,2	79,5	79,5	79,5	85,9	85,9	101,6
1½	54,1	82,6	92,2	92,2	92,2	95,3	95,3	114,3
2	73,2	101,6	108,0	108,0	108,0	139,7	139,7	143,0
2½	85,9	120,7	120,7	127,0	127,0	162,1	162,1	165,1
3	108,0	133,4	146,1	146,1	146,1	165,1	171,5	193,8
4	131,8	171,5	177,8	174,8	190,5	203,2	206,5	231,9
5	152,4	193,8	212,9	209,6	238,3	244,6	251,0	276,4
6	190,5	219,2	247,7	244,6	263,7	285,8	279,4	314,5
8	238,3	276,4	304,8	301,8	317,5	355,6	349,3	384,3
10	285,8	336,6	358,9	355,6	397,0	431,8	431,8	473,2
12	342,9	406,4	419,1	416,1	454,2	495,3	517,7	546,1
14	374,7	447,8	482,6	479,6	489,0	517,7	574,8	-
16	425,5	511,3	536,7	533,4	562,1	571,5	638,3	-
18	489,0	546,1	593,9	590,6	609,6	635,0	701,8	-
20	533,5	603,3	651,0	644,7	679,5	695,5	752,6	-
24	641,4	714,5	771,7	765,3	787,4	835,2	898,7	-

Dimensions in mm

In accordance with ASME B16.20 for flanges in accordance with ASME B16.47 Series B

NPS	d_1	class 150	class 300	d_2 class 400	class 600	class 900
26	673,1	722,4	768,4	743,0	762,0	835,1
28	723,9	773,2	822,5	797,1	816,1	898,7
30	774,7	824,0	882,7	854,2	876,3	955,8
32	825,5	877,8	936,8	908,1	930,4	1013,0
34	876,3	931,9	990,6	958,9	993,9	1070,1
36	927,1	984,3	1044,7	1019,3	1044,7	1120,9
38	977,9	1041,4	1095,4	1070,1	1101,9	1197,1
40	1028,7	1092,2	1146,3	1124,0	1152,7	1247,9
42	1079,5	1143,0	1197,1	1174,8	1216,2	1298,7
44	1130,3	1193,8	1247,9	1228,9	1267,0	1365,5
46	1181,1	1252,5	1314,5	1286,0	1324,1	1432,1
48	1231,9	1303,3	1365,3	1343,2	1387,6	1482,9
50	1282,7	1354,1	1416,1	1400,3	1444,8	-
52	1333,5	1404,9	1466,9	1451,1	1495,6	-
54	1384,3	1460,5	1527,3	1514,6	1552,7	-
56	1435,1	1511,1	1590,8	1565,4	1603,5	-
58	1485,9	1576,3	1652,5	1616,2	1660,7	-
60	1536,7	1627,1	1703,3	1679,7	1730,5	-

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order

Ordering example for a double-corrugated gasket, Profile FW3, NPS 30, Class 150, in accordance with ASME B16.20 for flanges in accordance with ASME 16.47 Series B, made of ...[1]:

Double-corrugated gasket FW3, NPS 30, Class 150, ASME B16.20 for flanges in accordance with ASME B16.47 Series B, Steel/FA

METAL JACKETED GASKETS

In accordance with ASME B16.20 for flanges in accordance with ASME B16.47 Series A

NPS	d_1	d_2 class 150	class 300	class 400	class 600	class 900
26	673,1	771,7	831,9	828,8	863,6	879,6
28	723,9	828,8	895,4	889,0	911,4	943,1
30	774,7	879,6	949,5	943,1	968,5	1006,6
32	825,5	936,8	1003,3	1000,3	1019,3	1070,1
34	876,3	987,6	1054,1	1051,1	1070,1	1133,6
36	927,1	1044,7	1114,6	1114,6	1127,3	1197,1
38	977,9	1108,2	1051,1	1070,1	1101,9	1197,1
40	1028,7	1159,0	1111,3	1124,0	1152,7	1247,9
42	1079,5	1216,2	1162,1	1174,8	1216,2	1298,7
44	1130,3	1273,3	1216,2	1228,9	1267,0	1365,5
46	1181,1	1324,1	1270,0	1286,0	1324,1	1432,1
48	1231,9	1381,3	1320,8	1343,2	1387,6	1482,9
50	1282,7	1432,1	1374,9	1400,3	1444,8	-
52	1333,5	1489,2	1425,7	1451,1	1495,6	-
54	1384,3	1546,4	1489,2	1514,6	1552,7	-
56	1435,1	1603,5	1540,0	1565,4	1603,5	-
58	1485,9	1660,7	1590,8	1616,2	1660,7	-
60	1536,7	1711,5	1641,6	1679,7	1730,5	-

- Flanges compliant with the standard not available

Dimensions in mm

Ordering example for a double-corrugated gasket, Profile FW3, NPS 30, Class 300, in accordance with ASME B16.20 for flanges in accordance with ASME B 16.47 Series A, made of ...[1]:

Double-corrugated gasket, Profile FW3, NPS 30, Class 300, ASME B16.20 for flanges in accordance with ASME B16.47, Series A, steel/FS

For flanges with tongue and groove*

Conforms to En1514
(PN 10 to PN 160)

Ordering example for a jacketed gasket, Profile F8, DN 100, made of ...[1]:

Jacketed gasket F8, DN 100, PN 2691, copper/FA

For flanges with male and female*

Conforms to En1514
(PN 10 to PN 100)

Ordering example for a jacketed gasket, Profile F8, DN 100, made of ...[1]:

Jacketed gasket F8, DN 100, PN 2692, copper/FA

In accordance with ANSI for flanges in accordance with ASME/ANSI B16.5

(Class 150 to Class 1500)

Ordering example for a jacketed gasket, Profile F8, NPS 5, wide model, made of ...[1]:

Jacketed gasket, F8, NPS 5, ASME/ANSI B16.5 wide, tongue and groove, copper/FA

In accordance with ANSI B for flanges in accordance with ASME/ANSI B16.5

(Class 150 to Class 1500)

Ordering example for a jacketed gasket, Profile F8, NPS 5, wide model, made of ...[1]:

Jacketed gasket, F8, NPS 5, ASME/ANSI B16.5 wide, male and female, copper/FA

Warning:

At gasket margin widths below 10 mm use Profile F10 and/or F12, above 10 mm use Profile F8.

Gasket thickness: to DN 80 resp. NPS 3½ = 2,5 mm
above DN 80 resp. NPS 3½ = 3,0 mm

* See section 3 “Flat gaskets for DIN, ASME/ANSI, BS“

[1] Specify material when placing order

PTFE-ENVELOPED GASKETS

In flange connections where there are high levels of chemical attack, PTFE flat gaskets are used. Due to the cold flow affinity of unfilled PTFE, use is mainly made of PTFE composites and PTFE-enveloped gaskets which have increased resistance to stress relaxation.

Because of their high chemical resistance and outstanding sealing properties, PTFE-enveloped gaskets have proven excellent when used at fluctuating pressures and temperatures ranging from -195 °C to +250 °C. Glass tubes, metal-enveloped glass tubes and glass equipment from laboratory or pilot installations can be connected up as easily as enamelled, coated or lined pipes and equipment in large plants.

PTFE-enveloped gaskets are particularly useful with aggressive chemicals in the chemical industry, due to their high resistant strength. PTFE is also physiologically harmless, and so can be used in the food and pharmaceutical sectors.

Apart from their high resistance to chemicals, PTFE is also extremely anti-adhesive. This non-stick effect means that no material will adhere to the surface of the PTFE.

PTFE-enveloped gaskets consist of a stable gasket insert and a PTFE envelope. Only high-quality, non-porous PTFE is used for the envelope, so as to protect the insert against chemical attack. The PTFE envelopes are open onto the outer or inner diameter, or encase the entire insert, depending on what is required. The envelope is 0.5 mm thick and therefore very stable. Lathed envelopes can be produced with an internal diameter 2 to 4 mm thicker to provide greater diffusion sealing.

For dimensions see the section 3 ”Flat gaskets made from Graphite, Fibre, PTFE, Elastomer“.

Insert: Soft material flat gaskets

The insert is made of a graphite laminate or fibre sealing material. With a graphite laminate insert, the gasket is also suitable for use with plastic or GRP flanges due to its greater conformity and softness.

» Profile PF2 with a envelope that can be supplied as a lathed or shaped envelope, depending on the size of the gasket

» Profile PF3 with a envelope with a reinforced internal diameter.

» Profile PF18 with a envelope that is punctured without cutting.

» Profile PF21 with a lathed envelope.

PTFE-enveloped gaskets fulfil the requirements of the TA-Luft having regard to clause 3.3.1.4 of the VDI Guidelines 2440.

Gasket profiles

Profile	Cross-section
PF2	
PF3	
PF18	
PF21	

Gasket limiting values

Profiles			Pf2 to PF21	
Materials			Graphite laminate 2 mm	Fibre sheets 2 mm
Recommended max. roughness of the flange surfaces	µm	from	50	50
		to	100	100
Surface pressure limits for 20 °C	N/mm²	σ_v	20	15
		σ_ϑ	90	60
Surface pressure limits for 250 °C	N/mm²	σ_v	25	-
		σ_ϑ	80	-
Temperature range	°C		-195	-100
			250	150

You can find gasket characteristic values in accordance with EN13555 on our homepage at www.klinger-kempchen.de

PTFE-ENVELOPED GASKETS

Insert: Corrugated gaskets

Profile PWA2: With a corrugated ring, thin metal sheet layer on both sides and a layer of RivaTherm Super. With the use of a sheet metal insert, the corrugated ring is not filled out with soft material, so that the spring effect of the corrugated carrier is less impeded.

Profile PW4: Here the insert consists of a corrugated ring, with a layer of RivaTherm Super on both sides.

Profile PW5: Like PW4, but with a PTFE envelope reinforced by approx. 2.5 mm on the internal diameter, to improve diffusion sealing.

Profile PW21: Lathed PTFE envelope, reinforced internally with a corrugated ring insert. Up to DN 200, the corrugated ring is concentric at the inner edge.

Profile PW1A-3: Corrugated gasket with parallel concentric centre ring, an abbreviated PTFE envelope and graphite layer on both sides to provide a fire-safe seal.

Insert: Grooved gaskets

PTFE-enveloped gasket with a grooved gasket insert of metal for even sealing surfaces, ceramic or glass is used for higher pressures.

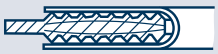
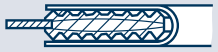
Profile PF7, PF9 and PF15 with an even basic profile, Profile PF27, PF29 and PF25 with a convex basic profile.

The sealing surfaces must be surface-ground for ceramic and glass, so that no stress peaks arise that could cause the material to be destroyed.

Gasket profiles

Profile	Cross-section
PWA2	
PW4	
PW5	
PW21	
PW1A-3	

Gasket profiles

Profile	Cross-section
PF7	
PF9	
PF15	
PF27	
PF29	
PF25	

Gasket limiting values

Profiles			PW4 PW5	PW21
Materials			PTFE, RS 1.4571	PTFE 1.4571
Recommended max. roughness of the flange surfaces	µm	from	25	25
		to	50	50
Surface pressure limits for 20 °C	N/mm²	σ_v	25	25
		σ_ϑ	80	80
Surface pressure limits for 250 °C	N/mm²	σ_v	30	30
		σ_ϑ	60	60

Gasket limiting values

Profiles			PF7,PF9 PF15	PF27,PF29 PF25
Materials			PTFE 1.4541	PTFE 1.4541
Recommended max. roughness of the flange surfaces	µm	from	25	25
		to	50	50
Surface pressure limits for 20 °C	N/mm²	σ_v	15	15
		σ_ϑ	500	500
Surface pressure limits for 250 °C	N/mm²	σ_v	17	17
		σ_ϑ	450	450

You can find gasket characteristic values in accordance with EN13555 on our homepage at www.klinger-kempchen.de

METAL PROFILE GASKETS

Solid **metal flat gaskets** are used in areas where, due to the medium, temperature, pressure and/or permitted leakage rate, soft-material or metal/soft-material gaskets are not particularly suitable. They have proven reliable at low temperatures of -200 °C as well as at high temperatures of over 600 °C. They are used at pressures ranging from relatively low to extremely high.

The thickness of the seal and the sealing material are generally dependent on the flange surface and the operating conditions. The better the flange surface in terms of surface quality and evenness, the thinner the gasket that can be used, e.g. 0.5 - 1 mm as a gasket in spinning nozzle fittings or 2 - 3 mm for aluminium gaskets in heat exchangers.

It should be noted that soft metals (such as aluminium or silver) need only relatively low surface pressures to become deformed, harder materials on the other hand, particularly steel, require high sealing pressure.

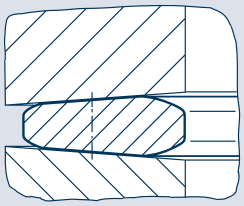
In **convex gaskets** on the other hand, the contact geometry is such that it is self-sealing at high internal pressures. The sealing diameter is retained and edge pressure is avoided.

Narrow gaskets are more heavily loaded at the same bolt force and can flow when insufficiently stable, leading to a loss of bolt load and leakages.

To avoid flowing when loaded or even a destruction of the entire gasket, narrow flat gaskets should be chambered if necessary, as is the case with flanges with tongue and groove faces. Even with a chambered specimen there can be damage to the gasket, particularly if the sealing material is sensitive to crevice corrosion. In this case, fitting in a groove can actually be disadvantageous. In order to prevent damage to the gasket, ensure that the maximum permitted surface pressure σ_{ϑ} is not exceeded under any operating conditions.

Gasket profiles

Profile	Cross-section
A1	



To reduce the sealing surfaces of gaskets with rectangular cross-section such as Profile A1, choose a convex cross-section shape. Information on this can be found in DIN 7603 at Form D.

The absolute level of the sealing press capacity can be reduced by using narrow gaskets instead of wide gaskets or harder metals galvanised with thin overlays of soft metal.

Coatings of copper, nickel, silver or tin up to a maximum of 100 µm will give significantly better sealing properties and significantly lower deformation surface pressure ov. For the stated flange surface roughnesses a coating thickness of 35 to 50 µm is sufficient.

In metal profile gaskets, a line contact arises first. The bolt loads are clearly lower compared to metal flat gaskets (Profile A1). With the rectangular profile A1, even a slight flange twist can lead to sealing problems. The sealing diameter in the middle of the gasket jumps to the size of the external diameter, causing the leverage to be adversely affected. The greater internal pressure also has a negative effect.

Profiles A7 and H7 are centred by the corresponding shape of the flange e.g. male and female face joint. Gaskets of the type Profile H9 and H15 can also be used as high-pressure,

high-temperature gaskets with flanges with raised or flat face flanges. The gaskets are then centred on the bolts. Profile H15, with a loose centring ring, is ideal for use with gaseous media and/or centring ring with widths greater than 15 mm. Profiles H7, H9 and H15 have an osculating radius R which is determined by the prevailing surface pressure.

Gasket profiles

Profile	Cross-section
A7	
H7	
H9	
H15	

METAL PROFILE GASKETS

Flat ring gaskets and other special shapes produced using special tools are also available. To protect from corrosion, galvanised overlays are possible. In copper gaskets with corrosion protection layers of hard nickel, the covering layer is only a few µm, so that the sealing properties are affected as little as possible by the harder protective layer.

We produce gaskets in all commonly used metals. See also **"Materials commonly used"**.

Convex gaskets made from metal are dimensioned as follows:

Oval flanges

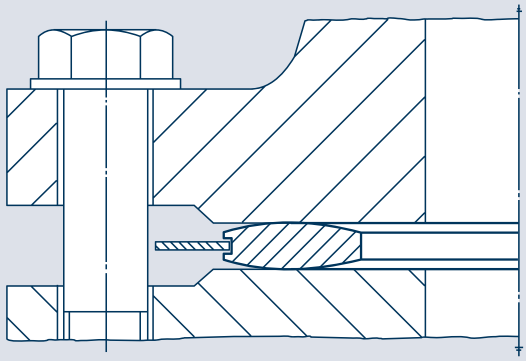
» in accordance with DIN 71511

Sealing discs for connections to pressure gauges and associated valves

» in accordance with DIN 837

Union fittings

» in accordance with DIN 7603



Profile H15 in flange with raised face

For measurements see
section 3, DN, ANSI, BS for flat gaskets.

Gasket limiting values

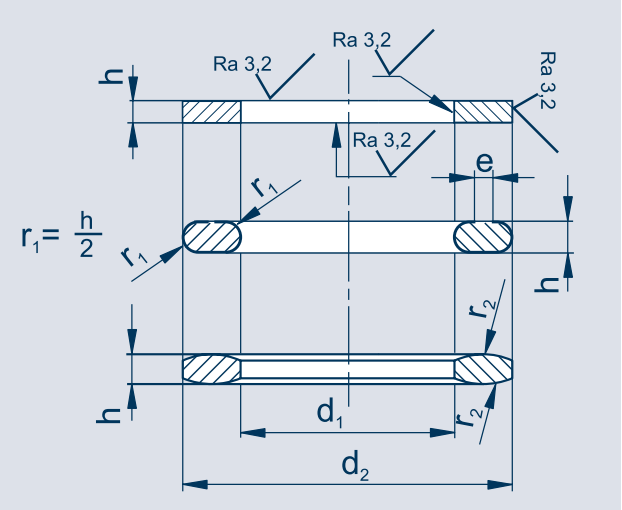
Profiles			A1									
Materials			Iron (1.1003) RSt 28 (1.0326)	St 35 (1.0308) St 38.8 (1.0305)	12CrMo19 5 (1.7362)	13CrMo 44 (1.7335)	X6CrNiTi 18 10 (1.4541)	X15CrNiSi 20 12 (1.4828)	Nickel Ni 99.6 (2.4060) Ni 99.2 (2.4066)	Copper	aluminium	Fine silver 99,98 Ag
Recommended max. roughness of the flange surfaces	µm	from	1,6	1,6	1,6	1,6	1,6	1,6	1,6	3,2	12,5	6,3
		to	3,2	3,2	3,2	3,2	3,2	3,2	3,2	6,3	25	12,5
Surface pressure limits for 20 °C	N/mm²	σ_v	235	265	400	300	335	400	190	135	70	50
		σ_ϑ	525	600	900	675	750	900	510	300	140	160
Surface pressure limits for 300 °C	N/mm²	σ_v	235	265	400	300	335	400	190	135	-	50
		σ_ϑ	315	390	730	585	630	750	480	150	-	135

Gasket characteristic values

Profiles			A7, H7, H9, H15								
Materials			Iron 1.1003	Heat-resistant mild steel 1.5415	Heat-resistant mild steel 1.7362	Stainless steel 1.4541	Stainless steel 1.4828	Steel St 35 copper-plated	Stainless steel 1.4541 silver-plated	Copper 2.0090	Monel 2.4360
Recommended max. roughness of the flange surfaces	µm	from	3,2	3,2	3,2	1,6	1,6	3,2	6,3	3,2	3,2
		to	6,3	6,3	6,3	3,2	3,2	6,3	12,5	6,3	6,3
Surface pressure limits for 20 °C	N/mm²	σ_v	235	300	400	335	400	135	100	135	260
		σ_ϑ	525	675	900	750	900	600	750	300	660
E-Modul at 20 °C	kN/mm²		210	210	210	200	200	210	200	128	178
Surface pressure limits for 300 °C	N/mm²	σ_v	235	300	400	335	400	135	100	135	260
		σ_ϑ	315	585	730	630	750	390	630	150	650
E-Modul at 300 °C	kN/mm²		185	185	190	186	186	185	186	114	175

GASKETS IN ACCORDANCE WITH DIN 7603

for pipe fittings (DIN 3850), plug screws (DIN 908) and ball and nipple connections (DIN 7601)



Ordering example for a gasket, Form A, nominal size 16x20, made of ...[1]:

Gasket DIN 7603 A 16x20 E-Cu

[1] Specify material when placing order.

Materials

Code	Material	Form DIN 7603
FA	Asbestos free gasket material	A
Al	Aluminium Al99 F11, 32 to 45 HB	A/D
Cu	Copper, max 45 HB	A/D
St	Soft iron, 80 to 95 HB	A/D
Vf	Vulcanised fibre Vf 3110 or Vf 3111	A
Zn	Zinc 99.5	A
AlFA	Aluminium Al99 F11, 32 to 45 HB, Filling FA	C
CuFA	Copper, max 45 HB, Filling FA	C
StFA	Soft iron, 80 to 95 HB, Filling FA	C

Gasket profiles

Profile	cross-section	DIN 7603	Gasket type / Materials
A1		Form A	Flat gasket FA, Al, Cu, St,Vf, Zn
F12		Form C	Filler gasket AlFA, CuFA, StFA
A7		Form D	Convex gasket Al, Cu, St

Gasket in accordance with DIN 7603

Nominal size	d_1	d_2	Maximum size e	h Material Form A Al, St, Cu, Vf, Zn	h Material Form A FA	h Material Form C AlFA CuFA StFA	h Material Form D Al Cu St	r_2	Can be use screw threads for: Internal diameter over outer screw thread	Inches	Outer diameter over internal screw thread
4 x 8	$4{,}2^{+0{,}3}$	$7{,}9_{-0{,}2}$	0,2								
5 x 7,5	$5{,}2^{+0{,}3}$	$7{,}4_{-0{,}2}$	0,12	1,0 ±0,2		1,5 ±0,2	1,0 ±0,2	4			M 10x1
5,5 x 8	$5{,}7^{+0{,}3}$	$7{,}9_{-0{,}2}$	0,12								M 10x1
6,5 x 9,5	$6{,}7^{+0{,}3}$	$9{,}4_{-0{,}2}$	0,15		1,0 ±0,2						M 12x1,5
7 x 15	$7{,}2^{+0{,}3}$	$14{,}9_{-0{,}2}$	-	1,5 ±0,2			—				
8 x 11,5	$8{,}2^{+0{,}3}$	$11{,}4_{-0{,}2}$	0,17	1,0 ±0,2		1,5 ±0,2	1,0 ±0,2	4	M 8x1		M 14x1,5
10 x 13,5	$10{,}2^{+0{,}3}$	$13{,}4_{-0{,}2}$	0,17						M 10x1	R ⅛	M 16x1,5
12 x 15,5	$12{,}2^{+0{,}3}$	$15{,}4_{-0{,}2}$	0,17			2,0 ±0,3	1,5 ±0,2	4	M 12x1,5		M 18x1,5
12 x 16	$12{,}2^{+0{,}3}$	$15{,}9_{-0{,}2}$	0,2						M 12x1,5		
12 x 19	$12{,}2^{+0{,}3}$	$18{,}9_{-0{,}2}$	-				—				
14 x 18	$14{,}2^{+0{,}3}$	$17{,}9_{-0{,}2}$	0,2	1,5 ±0,2	1,5 ±0,15				M 14x1,5	R ¼	
14 x 20	$14{,}2^{+0{,}3}$	$19{,}9_{-0{,}2}$	0,3			2,0 ±0,3	1,5 ±0,2		M 14x1,5	R ¼	
15 x 19	$15{,}2^{+0{,}3}$	$18{,}9_{-0{,}2}$	0,2								M 22x1,5
15 x 23	$15{,}2^{+0{,}3}$	$22{,}9_{-0{,}2}$	-			-	-	-			
16 x 20	$16{,}2^{+0{,}3}$	$19{,}9_{-0{,}2}$	0,2						M 16x1,5		

Dimensions in mm

GASKETS IN ACCORDANCE WITH DIN 7603

Gasket in accordance with DIN 7603

Nominal size	d_1	d_2	Maximum size e	h Material Form A Al, St, Cu, Vf, Zn	h Material Form A FA	h Material Form C AlFA CuFA StFA	h Material Form D Al Cu St	r_2	Can be use screw threads for: Internal diameter over outer screw thread	Inches	Outer diameter over internal screw thread
17 x 21	$17{,}2^{+0{,}3}$	$20{,}9_{-0{,}2}$	0,2	1,5 ±0,2	1,5 ±0,15	2,0 ±0,3	1,5 ±0,2	4		R ⅜	M24x1,5
18 x 22	$18{,}2^{+0{,}3}$	$21{,}9_{-0{,}2}$	0,2						M18x1,5		M26x1,5
20 x 24	$20{,}2^{+0{,}3}$	$23{,}9_{-0{,}2}$	0,2						M20x1,5		M27x2
21 x 26	$21{,}2^{+0{,}3}$	$25{,}9_{-0{,}2}$	0,25							R ½	M30x1,5
22 x 27	$22{,}2^{+0{,}3}$	$26{,}9_{-0{,}2}$	0,25						M22x1,5		M30x1,5
23 x 28	$23{,}3^{+0{,}3}$	$27{,}9_{-0{,}2}$	0,25	2,0 ±0,2	2,0 ±0,2	2,5 ±0,4	2,0 ±0,3	6		R ⅝	
24 x 29	$24{,}3^{+0{,}3}$	$28{,}9_{-0{,}2}$	0,25						M24x1,5		M33x2
25 x 30	$25{,}3^{+0{,}3}$	$29{,}9_{-0{,}2}$	0,25								M33x1,5
26 x 31	$26{,}3^{+0{,}3}$	$30{,}9_{-0{,}2}$	0,25						M26x1,5		
27 x 32	$27{,}3^{+0{,}3}$	$31{,}9_{-0{,}2}$	0,25						M27x2	R ¾	M36x2
28 x 33	$28{,}3^{+0{,}3}$	$32{,}9_{-0{,}2}$	0,25								M36x2
30 x 36	$30{,}3^{+0{,}3}$	$35{,}9_{-0{,}2}$	0,3						M20x1,5	R ⅞	M39x2
32 x 38	$32{,}3^{+0{,}3}$	$37{,}9_{-0{,}2}$	0,3								M42x2
33 x 39	$33{,}3^{+0{,}3}$	$38{,}9_{-0{,}2}$	0,3						M33x2	R 1	M42x1,5
35 x 41	$35{,}3^{+0{,}3}$	$40{,}9_{-0{,}2}$	0,3								M45x2
36 x 42	$36{,}3^{+0{,}3}$	$41{,}9_{-0{,}2}$	0,2						M36x1,5		M45x1,5
38 x 44	$38{,}3^{+0{,}3}$	$43{,}9_{-0{,}2}$	0,3	2,0 ±0,2	2,0 ±0,2	2,5 ±0,4	2,0 ±0,3	6	M38x1,5	R 1⅛	M48x2
39 x 46	$39{,}3^{+0{,}3}$	$45{,}9_{-0{,}2}$	0,35						M39x2		
40 x 47	$40{,}3^{+0{,}3}$	$46{,}9_{-0{,}2}$	0,35								M52x2
42 x 49	$42{,}3^{+0{,}3}$	$48{,}9_{-0{,}2}$	0,35						M42x1,5	R 1¼	M52x1,5
44 x 51	$44{,}3^{+0{,}3}$	$50{,}9_{-0{,}2}$	0,35								
45 x 52	$45{,}3^{+0{,}3}$	$51{,}9_{-0{,}2}$	0,35						M45x1,5		
48 x 55	$48{,}3^{+0{,}3}$	$54{,}9_{-0{,}2}$	0,35						M48x1,5	R 1½	
50 x 57	$50{,}2^{+0{,}3}$	$56{,}9_{-0{,}2}$	0,35								
52 x 60	$52{,}5^{+0{,}5}$	$59{,}8_{-0{,}3}$	0,4	2,5 ±0,2	2,0 ±0,2	3,0 ±0,5	2,5 ±0,4	10	M52x1,5		
54 x 62	$54{,}5^{+0{,}5}$	$61{,}8_{-0{,}3}$	0,4							R 1¾	
55 x 63	$55{,}5^{+0{,}5}$	$62{,}8_{-0{,}3}$	0,4								
56 x 64	$56{,}5^{+0{,}5}$	$63{,}8_{-0{,}3}$	0,4						M56x2		
58 x 66	$58{,}5^{+0{,}5}$	$65{,}8_{-0{,}3}$	0,4								
60 x 68	$60{,}5^{+0{,}5}$	$67{,}8_{-0{,}3}$	0,4						M60x2	R 2	
64 x 72	$64{,}5^{+0{,}5}$	$71{,}8_{-0{,}3}$	0,4						M64x2		
65 x 74	$65{,}5^{+0{,}5}$	$73{,}8_{-0{,}3}$	0,45						M65x2		
70 x 79	$70{,}5^{+0{,}5}$	$78{,}8_{-0{,}3}$	0,45								
75 x 84	$75{,}5^{+0{,}5}$	$83{,}8_{-0{,}3}$	0,45								
78 x 88	$78{,}5^{+0{,}5}$	$87{,}8_{-0{,}3}$	0,5						M78x2		
80 x 90	$80{,}7^{+0{,}5}$	$89{,}8_{-0{,}3}$	0,5								
85 x 95	$85{,}7^{+0{,}5}$	$94{,}8_{-0{,}3}$	0,5								
90 x 100	$90{,}7^{+0{,}5}$	$99{,}8_{-0{,}3}$	0,5								

Dimensions in mm

ROUND WIRE GASKETS

Round wire gaskets are used in gas and vacuum engineering. Standard materials used include soft-annealed aluminium, copper, silver and nickel.

Lathed rings and rings bended and welded from calibrated wire can be supplied. Round wire gaskets are usually inserted in grooves. Some possible options are shown here.

Gasket profiles

Profile	Cross-section
A10	

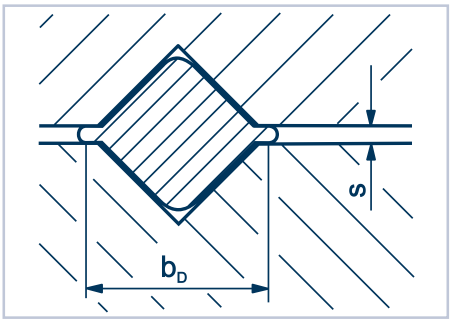
If the gaskets are generally elastically deformed, the sealing surface width arising should first be calculated using the following formula

$$b_D = 100 \cdot \frac{\sigma}{E_D} \cdot r \cdot n \cdot \sin\alpha \; ^{2)}$$

It should be noted that a small wire and/or sealing diameter will place higher demands on the groove and on the gasket with regard to size, tolerances and surface quality. Lathed rings should be used in this case. With welded models, strong plastic deformation is required.

If the material displays full plasticity, such as aluminium, soft copper, silver or gold, the seal width b_D is equal to the groove width b. Full plastic deformation requires much higher bolt loads than the more predominant elastic deformation.

The cross-section surfaces for full plastic deformation should be dimensioned in such a way that the round ring can fill the groove cross-section in its deformed state. Generally a gap of a few tenths of a millimetre should be left.



1) Specify material when placing order.

2) Formula taken from "Optimization of static gaskets" by H.J. Tuckmantel, published by Kempchen.

Materials

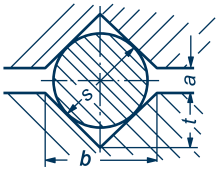
1.0333, 3.0255, 2.0090, 2.4066, fine-grain silver

Further technical data can be found in our section under **"Materials commonly used"**.

Ordering example for a round wire gasket, Profile A10 with internal diameter of 110 m and wire diameter of 5 mm made of ...1>:

Round wire gasket, Profile A10, 110 x 5 / 2.0090

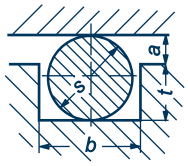
Double-sided contact



s	b	t	a
2	2,5	1,25	0,16
3	3,8	1,9	0,24
4	5,0	2,5	0,32
5	6,3	3,1	0,40
6	7,5	3,8	0,48
8	10,0	5,0	0,64
10	12,5	6,3	0,80

Dimensions in mm

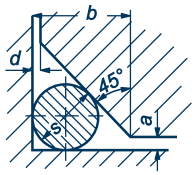
Single-sided contact



s	b	t	a
2	2,1	1,4	0,6
3	3,3	2,1	0,9
4	4,4	2,8	1,2
5	5,5	3,5	1,5
6	6,6	4,2	1,8
8	8,8	5,6	2,4
10	11,0	7,0	3,0

Dimensions in mm

Single-sided contact



s	b		a
2	2,8		0,6
3	4,2		0,9
4	5,6		1,2
5	7,0	d is the result from the fit H 8 / e 8	1,5
6	8,4		1,8
8	11,2		2,4
10	14,0		3,0

Dimensions in mm

Gasket limiting values

Profiles			A10				
Materials			Iron 1.0333	Aluminium 3.0255	Copper 2.0090	Nickel 2.4066	Fine-grain silver
Recommended max. roughness of the flange surfaces	µm	from	3,2	3,2	3,2	3,2	3,2
		to	6,3	6,3	6,3	6,3	6,3
Surface pressure limits for 20 °C	N/mm²	σ_v	265	70	135	190	100
		σ_ϑ	600	140	300	510	190
E-Modul at 20 °C	kN/mm²		210	70	128	206	79
Surface pressure limits for 300 °C	N/mm²	σ_v	265	-	135	100	100
		σ_ϑ	390	-	150	480	145
E-Modul at 300 °C	kN/mm²		185	-	114	118	70

RING-JOINTS RTJ

Ring joint gaskets are made from metallic materials. The requirements in terms of dimensional accuracy and surface quality are therefore high. This relates to both the gasket and the sealing section of the flange.

The necessary surface quality depends substantially on the Brinell hardness of the gasket material. The relationship $R_Z[\propto m] \leq 300/HB$ provides a useful indication.

A distinction is made between two kinds of ring joint gaskets and two different calculation methods are therefore used:

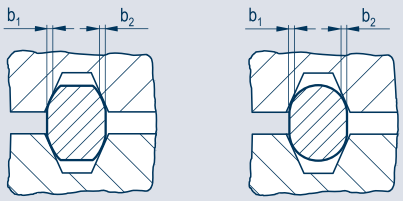
1. RTJ gaskets with osculating radius (Figure 1)

a) The convex octagonal RTJ gaskets, Profile AR 13, in which the convex cone case surfaces of the gasket are pressed against the even cone case surfaces of the groove when tensioned.

b) The oval ring-joint gasket, Profile A11, in which the circular surface is pressed against the cone case surfaces of the groove.

The sealing surface pressure increases or decreases to a **lesser extent** in response to any change in the bolt load.

Figure 1



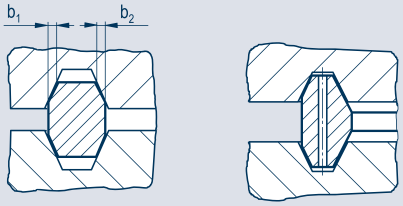
AR13 A11

2. RTJ gaskets with flat sealing surfaces (Figure 2)

The octagonal RTJ gasket, Profiles A13 and A14, are flat gaskets in which the sealing surfaces are two cone case surfaces. The projection in the direction of the bolting force $b_G = b_1 + b_2$ should be set as the sealing surface width.

The sealing surface pressure increases or decreases **proportionally** in response to any change in the bolt load.

Figure 2



A13 A14

The application thresholds values of oval octagonal RTJ gaskets can be more accurately calculated in relation to material, diameter, pressure, temperature and the surface pressure limits.

Here the fictitions sealing characteristic values in accordance with AD are replaced with the values of σ_V and σ_ϑ.

It should be noted that in Profile A12 the flanges have metal-to-metal contact. Profile AR13 with convex sealing surfaces.

Ring Joint gaskets can be produced as blind gaskets in Profile A11S, A13S etc. or as blind spectacle gaskets in Profile A11BS, A13BS (see Blind Gaskets).

Material

Code designation	Material no.	Hardness (HB)	US-Type AISI	Code
Pure iron, e.g.Armco	1.1003	90-100	Soft-Iron	D
Stw24mod	-	90-110	Soft-Iron	D
Low-Carbon-Steel	-	120	Low-Carbon-Steel	S
13 CrMo 4 4	1.7335	ca. 160	-	7335
12 CrMo 19 5 mod	1.7362 mod	ca. 130	501	F5
X6 Cr 13	1.4000	ca. 160	410	S 410
X5 CrNi 18 10	1.4301	ca. 160	304	S 304
X5 CrNiMo 17 12 2	1.4401	ca. 160	316	S 316
X6 CrNiTi 1810	1.4541	ca. 160	321	S 321
X6 CrNiNb 1810	1.4550	ca. 160	347	S 347
X6 CrNiMo Ti1712 2	1.4571	ca. 160	316Ti	316 Ti

* Further technical data see section **“Materials commonly used”**.

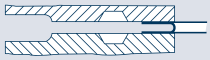
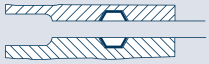
RING-JOINTS RTJ

Material, profiles, surface pressure limits, surface roughness

With the addition of a protective ring made from sheet metal to Profile F22, disruptive turbulence and accretions are avoided. At small edge widths the protective gaskets are symmetrical, at larger edge widths they are centred on one side. We can supply soft-iron compensating caps for damaged grooves, such as Profile AK11, AK12, AK13, AK14.

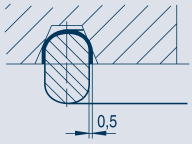
For a complete estimate on sealing flange connections, our efficient sealing estimate service is available.

Gasket profiles

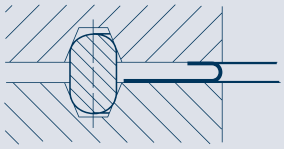
Profile	Cross-section
A11	
A12	
A13	
AR13	
A14	
F22	
AK11	
AK12	
Ak13	
AK14	

Compensating caps, protective gaskets

Compensating caps for damaged grooves



Protective gaskets Profile F22

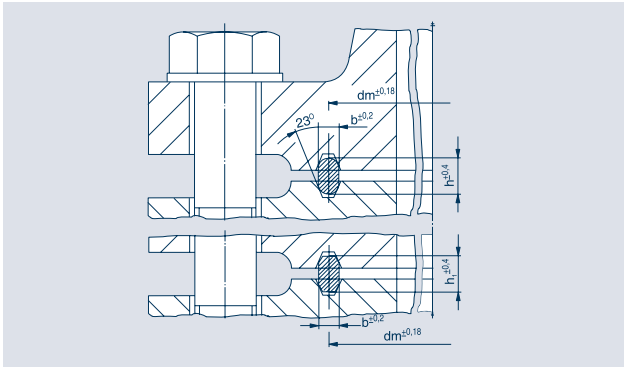


Gasket limiting values

Profiles			A11, A11S, A11BS, A12, A13, A13S, A13BS, AR13, AR13S, AR13BS, A14								
Materials			Iron 1.1003 Stw24mod	Heat-resistant mild steel 1.5415	Heat-resistant mild steel 1.7362	Stainless Steel 1.4541	Stainless Steel 1.4828	Carbon steel 1.0308 copper-plated	Stainless steel 1.4541 plated	Copper 2.0090	Monel 2.4360
Recommended max. roughness of the flange surfaces	µm	from	3,2	3,2	3,2	1,6	1,6	3,2	6,3	3,2	3,2
		to	6,3	6,3	6,3	3,2	3,2	6,3	12,5	6,3	6,3
Surface pressure limits for 20 °C	N/mm²	σ_v	235	300	400	335	400	135	100	135	260
		σ_ϑ	525	675	900	750	900	600	750	300	660
E-Modul at 20 °C	kN/mm²		210	210	210	200	200	210	200	128	178
Surface pressure limits for 300 °C	N/mm²	σ_v	235	300	400	335	400	135	100	135	260
		σ_ϑ	315	585	730	630	750	390	630	150	650
E-Modul at 300 °C	kN/mm²		185	185	190	186	186	185	186	114	175

RING JOINT GASKETS, TYPE R

Ring joint gaskets, Type R, dimensions
in accordance with ASME B16.20, API Std 6 A for flanges
in accordance with ASME B16.5 and ASME B16.47 Series A
in accordance with EN 12560-5



Ordering example for an oval ring joint gasket, Profile A11, NPS 5, Class 150, made of ...[1]:

Ring joint gasket R 40 A11 / 1.4541

Ordering example for an octagonal ring joint gasket, Profile A13, NPS 20, Class 1500, made of ...[1]:

Ring joint gasket R 75 A13 / 1.4541

06

Ring joint gaskets, Type R

NPS	class	Ring-No.	Ring measurements dm	b	h	h_1
½	300 to 600	R 11	34,13	6,35	11,11	9,53
½	900 1500	R 12	39,69	7,94	14,29	12,70
½	2500	R 13	42,86	7,94	14,29	12,70
¾	300 to 600	R 13	42,86	7,94	14,29	12,70
¾	900,1500	R 14	44,45	7,94	14,29	12,70
1	150	R 15	47,63	7,94	14,29	12,70
¾	2500	R 16	50,80	7,94	14,29	12,70
1	300 to 1500	R 16	50,80	7,94	14,29	12,70
1¼	150	R 17	57,15	7,94	14,29	12,70
1	2500	R 18	60,33	7,94	14,29	12,70
1V4	300 to 1500	R 18	60,33	7,94	14,29	12,70
1½	150	R 19	65,09	7,94	14,29	12,70
1½	300 to 1500	*R 20	68,26	7,94	14,29	12,70
1¼	2500	R 21	72,23	11,11	17,46	15,88
2	150	R 22	82,55	7,94	14,29	12,70
1½	2500	*R 23	82,55	11,11	17,46	15,88
2	300 to 600	*R 23	82,55	11,11	17,46	15,88
2	900,1500	*R 24	95,25	11,11	17,46	15,88
2½	150	R 25	101,60	7,94	14,29	12,70
2	2500	*R 26	101,60	11,11	17,46	15,88
2½	300 to 600	*R 26	101,60	11,11	17,46	15,88
2½	900,1500	*R 27	107,95	11,11	17,46	15,88
2½	2500	R 28	111,13	12,70	19,05	17,46
3	150	R 29	114,30	7,94	14,29	12,70
3	300 to 600	*R 30	117,48	11,11	17,46	15,88
3	300 to 900	*R 31	123,83	11,11	17,46	15,88
3	2500	R 32	127,00	12,70	19,05	17,46
3½	150	R 33	131,76	7,94	14,29	12,70
3½	300 to 600	R 34	131,76	11,11	17,46	15,88
3	1500	*R 35	136,53	11,11	17,46	15,88
4	150	R 36	149,23	7,94	14,29	12,70
4	300 to 900	*R 37	149,23	11,11	17,46	15,88
4	2500	R 38	157,16	15,88	22,23	20,64
4	1500	*R 39	161,93	11,11	17,46	15,88
5	150	R 40	171,45	7,94	14,29	12,70
5	300 to 900	*R 41	180,98	11,11	17,46	15,88
5	2500	R 42	190,50	19,05	25,40	23,81
6	150	R 43	193,68	7,94	14,29	12,70
5	1500	*R 44	193,68	11,11	17,46	15,88
6	300 to 900	*R 45	211,14	11,11	17,46	15,88
6	1500	*R 46	211,14	12,70	19,05	17,46
6	2500	*R 47	228,60	19,05	25,40	23,81
8	150	R 48	247,65	7,94	14,29	12.70
8	300 to 900	*R 49	269,88	11,11	17,46	15,88
8	1500	*R 50	269,88	15,88	22,23	20,64
8	2500	R 51	279,40	22,23	28,58	26,99
10	150	R 52	304,80	7,94	14,29	12,70
10	300 to 900	*R 53	323,85	11,11	17,46	15,88
10	1500	*R 54	323,85	15,88	22,23	20,64
10	2500	R 55	342,90	28,58	36,51	34,93
12	150	R 56	381,00	7,94	14,29	12,70
12	300 to 900	*R 57	381,00	11,11	17,46	15,88
12	1500	R 58	381,00	22,23	28,58	26,99
14	150	R 59	396,88	7,94	14,29	12,70

Dimensions in mm

NPS	class	Ring-No.	Ring measurements dm	b	h	h1
12	2500	R 60	406,40	31,75	39,69	38,10
14	300 to 600	R 61	419,10	11,11	17,46	15,88
14	900	R 62	419,10	15,88	22,22	20,64
14	1500	*R 63	419,10	25,40	33,34	31,75
16	150	R 64	454,00	7,94	14,29	12,70
16	300 to 600	*R 65	469,90	11,11	17,46	15,88
16	900	*R 66	469,90	15,88	22,23	20,64
16	1500	R 67	469,90	28,58	36,51	34,93
18	150	R 68	517,53	7,94	14,29	12,70
18	300 to 600	*R 69	533,40	11 ,11	17,46	15,88
18	900	*R 70	533,40	19,05	25,40	23,81
18	1500	R 71	533,40	28,58	36,51	34,93
20	150	R 72	558,80	7,94	14,29	12,70
20	300 to 600	*R 73	584,20	12,70	19,05	17,46
20	900	*R 74	584,20	19,05	25,40	23,81
20	1500	R 75	584,20	31,75	39,68	38,10
24	150	R 76	673,10	7,94	14,29	12,70
24	300 to 600	R 77	692,15	15,88	22,23	20,64
24	900	R 78	692,15	25,40	33,34	31,75
24	1500	R 79	692,15	34,92	44,45	41,28
22	150	R 80	615,95	7,93	-	12,70
22	300 to 600	R 81	635,00	14,28	-	19,05
1	10000	*R 82	57,15	11,11	-	15,87
1½	10000	*R 84	63,50	11,11	-	15,87
2	10000	*R 85	79,37	12,70	-	17,46
2½	10000	*R 86	90,49	15,87	-	20,63
3	10000	*R 87	100,01	15,87	-	20,63
4	10000	*R 88	123,83	19,05	-	23,81
3½	10000	R 89	114,30	19,05	-	23,81
5	10000	*R 90	155,58	22,22	-	26,98
10	10000	*R 91	260,35	31,75	-	38,10
		R 92	228,60	11,11	17,46	15,87
26	300, 400, 600	R 93[2]	749,30	19,05	-	23,81
28	300, 400, 600	R 94[2]	800,10	19,05	-	23,81
30	300, 400, 600	R 95[2]	857,25	19,05	-	23,81
32	300, 400, 600	R 96[2]	914,40	22,22	-	26,98
34	300, 400, 600	R 97[2]	965,2	22,22	-	26,98
36	300, 400, 600	R 98[2]	1022,35	22,22	-	26,98
8	2000, 3000	*R 99	234,95	11,11	-	15,87
26	900	R 100[2]	749,30	28,57	-	34,92
28	900	R 101[2]	800,10	31,75	-	38,10
30	900	R 102[2]	857,25	31,75	-	38,10
32	900	R 103[2]	914,40	31,75	-	38,10
34	900	R 104[2]	965,20	34,92	-	41,27
36	900	R 105[2]	1022,35	34,92	-	41,27

- Flanges compliant with the standard not available

Dimensions in mm

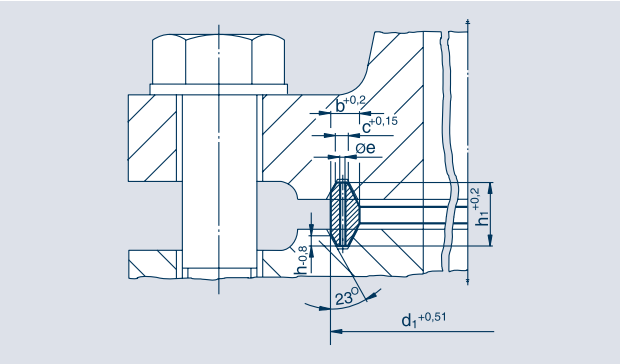
* These rings conform to API standard 6A. The measurements given in mm are converted measurements and will differ marginally from the metric API table.

1) Specify material when placing order

2) Ring for flanges in accordance with ASME B16.47 Series A

RING JOINT GASKETS, TYPE RX

Ring joint gaskets, Type RX, dimensions in accordance with ASME B16.20 and/or API Std 6 A for API 6B flanges



Ordering example for an oval ring joint gasket, Profile A14, NPS 4, Class 3000, made of ...[1]:

Ring joint gasket R 37 A14 / 1.4541

Ring joint gaskets, Type RX

NPS	class	Ring-No.	Ring measurements d_1	b	c	h_1	h	Bore* e
1½	2000, 3000, 5000	RX 20	76,2	8,73	4,62	19,05	3,18	-
2	2000	RX 23	93,27	11,91	6,45	25,4	4,24	-
2	3000,5000	RX 24	105,97	11,91	6,45	25,4	4,24	-
3⅛	5000	RX 25	109,54	8,73	4,62	19,05	3,18	-
2½	2000	RX 26	111,92	11,91	6,45	25,4	3,78	-
2½	3000, 5000	RX 27	118,27	11,91	6,45	25,4	4,24	-
3	2000, 3000	RX 31	134,54	11,91	6,45	25,4	4,24	-
3	5000	RX 35	147,24	11,91	6,45	25,4	4,24	-
4	2000, 3000	RX 37	159,94	11,91	6,45	25,4	4,24	-
4	5000	RX 39	172,64	11,91	6,45	25,4	4,24	-
5	2000, 3000	RX 41	191,69	11,91	6,45	25,4	4,24	-
5	5000	RX 44	204,39	11,91	6,45	25,4	4,24	-
6	2000, 3000	RX 45	221,85	11,91	6,45	25,4	4,24	-
6	5000	RX 46	222,25	13,49	6,68	28,58	4,78	-
8	crossover flange	RX 47	245,3	19,84	10,34	41,28	6,88	-
8	2000, 3000	RX 49	280,59	11,91	6,45	25,4	4,24	-
8	5000	RX 50	283,37	16,67	8,51	31,75	5,28	-
10	2000, 3000	RX 53	334,57	11,91	6,45	25,4	4,24	-
10	5000	RX 54	337,34	16,67	8,51	31,75	5,28	-
12	2000, 3000	RX 57	391,72	11,91	6,45	25,4	4,24	-
14	5000	RX 63	441,72	26,99	14,78	50,8	8,46	-
16	2000	RX 65	480,62	11,91	6,45	25,4	4,24	-
16	3000	RX 66	483,39	16,67	8,51	31,75	5,28	-
18	2000	RX 69	544,1	11,91	6,45	25,4	4,24	-
18	3000	RX 70	550,1	19,84	10,34	41,28	6,88	-
20	2000	RX 73	596,1	13,49	6,68	31,75	5,28	-
20	3000	RX 74	600,87	19,84	10,34	41,28	6,88	-
1	10000	RX 82	67,87	11,91	6,45	25,4	4,24	1,6
1½	10000	RX 84	74,22	11,91	6,45	25,4	4,24	1.6
2	10000	RX 85	90,09	13,49	6,68	25,4	4,24	1,6
2½	10000	RX 86	103,58	15,08	8,51	28,58	4,78	2,4
3	10000	RX 87	113,11	15,08	8,51	28,58	4,78	2,4
4	10000	RX 88	139,3	17,46	10,34	31,75	5,28	3,2
3½	10000	RX 89	129,78	18,26	10,34	31,75	5,28	3,2
5	10000	RX 90	174,62	19,84	12,17	44,45	7,42	3,2
10	10000	RX 91	286,94	30,16	19,81	45,24	7,54	3,2
8	2000, 3000	RX 99	245,67	11,91	6,45	25,4	4,24	-
1¼	5000	RX 201	51,46	5,74	3,2	11,3	1,45	-
1¾	5000	RX 205	62,31	5,56	3,05	11,1	1,83	-
2½	5000	RX 210	97,63	9,53	5,41	19,05	3,18	-
4	5000	RX 215	140,89	11,91	5,33	25,4	4,24	-
4x 4¼	5000	RX 215	140,89	11,91	5,33	25,4	4,24	-

- Flanges compliant with the standard not available

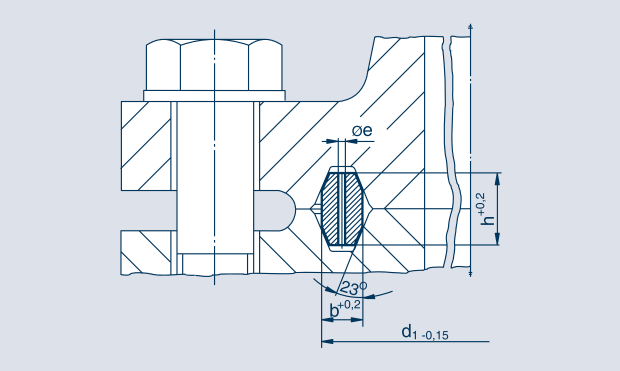
Dimensions in mm

* A compensating bore on the ring circumference.
The compensating bore equalises the pressure in both air chambers.

[1] Specify material when placing order.

RING JOINT GASKET, TYPE RX

Ring joint gasket, Type BX, dimensions in accordance with API Std 6 A for API 6BX flanges



Ordering example for an ring joint gasket, Profile A12, NPS 3 1/16, Class 15000, made of ...[1]:

Ring joint gasket BX 154 A12 / 1.4541

06

Ring joint gaskets, Type BX

NPS	class	Ring-No.	d_1	b	h	Bore* e
1 11/16	10000,15000	BX 150	72,19	9,30	9,30	1,6
1 13/16	10000,15000,20000	BX 151	76,40	9,63	9,63	1,6
2 1/16	10000,15000,20000	BX 152	84,68	10,24	10,25	1,6
2 9/16	10000,15000,20000	BX 153	100,94	11,38	11,38	1,6
3 1/16	10000,15000,20000	BX 154	116,84	12,40	12,40	1,6
4 1/16	10000,15000,20000	BX 155	147,96	14,22	14,22	1,6
7 1/16	10000,15000,20000	BX 156	237,92	18,62	18,62	3,2
9	10000,15000	BX 157	294,46	20,98	20,98	3,2
11	10000,15000	BX 158	352,04	23,14	23,14	3,2
13 5/8	10000	BX 159	426,72	25,70	25,70	3,2
13 5/8	5000	BX 160	402,59	13,74	23,83	3,2
16 3/4		BX 161	491,41	16,20	28,07	3,2
16 3/4	5000,10000	BX 162	475,49	14,22	14,22	1,6
18 3/4	5000	BX 163	556,16	17,37	30,10	3,2
18 3/4	10000	BX 164	570,56	24,59	30,10	3,2
21 1/4	5000	BX 165	624,71	18,49	32,03	3,2
21 1/4	10000	BX 166	640,03	26,14	32,03	3,2
26 3/4	2000	BX 167	759,36	13,11	35,86	1,6
26 3/4	3000	BX 168	765,25	16,05	35,86	1,6
5 1/8	10000	BX 169	173,52	12,93	15,84	1,6
9		BX 170	218,03	14,22	14,22	1,6
11		BX 171	267,44	14,22	14,22	1,6
13 5/8		BX 172	333,07	14,22	14,22	1,6
30	2000, 3000	BX 303	852,75	16,97	37,95	1,6

Dimensions in mm

* A compensating bore on the ring circumference.
The compensating bore equalises the pressure in both air chambers.

[1] Specify material when placing order.

LENS GASKETS

The proven high-pressure gaskets

Lens gaskets are reusable, as the sealing effect is generally achieved by elastic deformation of the surfaces.

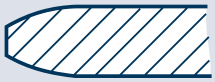
The projected sealing width b_G is calculated in relation to the angle a, which forms the sealing surface against the direction of the force (tubular axis) depending on the E modulus EG and the surface pressure exerted by

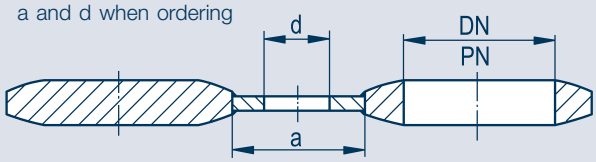
$b_G = 100\ \sigma / E_G \cdot r \cdot \sin\alpha$.

We can also specially produce bellows lenses, lens blind spectacle gaskets and half-lenses.

Lens blind spectacle gaskets are made of a sealing lens and a lens blind, which are connected by a ligament. It is also usual to use lens blinds on their own. In this case, it is useful to weld on a small plate to render the lens blind distinguishable.

Gasket profiles

Profile	Cross-section
A5	
A5S	
A5BS	



Lens gaskets are impervious to overpressure. With increasing loads, the contact surface between the spherical lens surface and the spherical flange groove increases, so that the surface pressure only increases to a lesser extent.

A disadvantage with standard sealing lenses is that, at high pressures and temperatures, the sealing lens can bulge along the circumference and weaken the tension of the connection. Also, at greater nominal diameter, the flange can become stuck in the area of the raised face diameter d5and lift up at the sealing diameter.

Steel type designation	Material number	For circulatory temperatures in °C	Code designation on the outer edge
S235JRG2	1.0038	to 425	none
P265GH	1.0425	to 425	none
16Mo3	1.5415	425 to 475	1 Punch mark
13CrMo4-5	1.7335	425 to 520	2 Punch marks
10CrMo9-10	1.7380	520 to 580	3 Punch marks
X6CrNiTi18-10	1.4541	350 to 550	4 Punch marks
12CrMo19-5	1.7362	max. 650	1 Notch
X6CrNiMoTi17-12-2	1.4571	max. 550	3 Notches

Further technical data see section **“Materials commonly used”**.

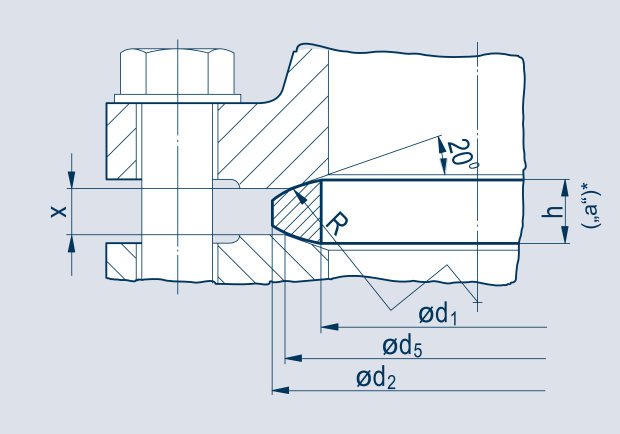
Gasket limiting values

Profile			A5, A5S, A5BS								
Materials			Iron 1.1003	Heat-resistant mild steel 1.5415	Heat-resistant mild steel 1.7362	Stainless steel 1.4541	Stainless steel 1.4828	Steel St 35 copper-plated	Steel 1.4541 silver-plated	Copper 2.0090	Monel 2.4360
Recommended max. roughness of the flange surfaces	µm	from	3,2	3,2	3,2	1,6	1,6	3,2	6,3	3,2	3,2
		to	6,3	6,3	6,3	3,2	3,2	6,3	12,5	6,3	6,3
Surface pressure limits for 20 °C	N/mm²	σ_v	235	300	400	335	400	135	100	135	260
		σ_ϑ	525	675	900	750	900	600	750	300	660
E-Modul at 20 °C	kN/mm²		210	210	210	200	200	210	200	128	178
Surface pressure limits for 300 °C	N/mm²	σ_v	235	300	400	335	400	135	100	135	260
		σ_ϑ	315	585	730	630	750	390	630	150	650
E-Modul at 300 °C	kN/mm²		185	185	190	186	186	185	186	114	175

LENS GASKETS

The proven high-pressure gaskets

Lens gaskets for flange connections PN 63 to PN 400



Conforms to DIN 2696 : 1999-08*

Ordering example for a lens gasket, DN 100, PN 63, conforming to DIN 2696, made of ...[1]:

Lens gasket, DN 100, PN 63, DIN 2696 Series 1 / 1.7335 DIN

DIN 2696 : 1999-08, Series 2

DN	d_1	d_2	d_5	h	r	x
			PN 63			
50	52	78	68	14,6	87	9
100	100	143	127	24,5	166	15
125	124	180	157	33,6	205	22
150	148	210	183	38,4	242	26
			PN 100			
10	11	21	18	8,4	21	6
15	16	28	27	9,7	31	6
25	25	43	39	10,8	47	6
40	39	62	55	13,6	68	8
50	51	78	68	14,9	87	9
100	98	143	127	25,2	164	15
125	121	180	157	34,6	203	22
150	145	210	183	39,4	240	26
			PN 160			
10	10	21	18	8,7	20	6
15	16	28	27	9,7	31	6
25	25	43	39	10,8	46	6
40	38	62	55	13,9	67	8
50	49	78	68	15,6	86	9
100	92	143	127	27,2	160	15
125	113	180	157	37,3	197	22
150	134	210	183	43,1	232	26
			PN 250			
15	15	28	27	10,0	31	6
25	23	43	39	11,4	45	6
40	35	62	55	14,9	65	8
50	45	78	68	16,9	82	9
			PN 320			
10	9	21	18	9,0	20	6
15	14	28	27	10,3	30	6
25	20	43	39	12,3	43	6
40	32	62	55	15,7	64	8
100	101	143	127	24,2	167	15
125	119	180	157	35,3	202	22

Dimensions in mm

1) Specify material when placing order

* Sealing lenses with dimensions conforming to with DIN 2696 April 1972 edition must always be arranged in advance. To avoid misunderstandings the desired sealing lens height "a" should always be given for the internal diameter d_1 specified.

DIN 2696 : 1999-08, Series 1

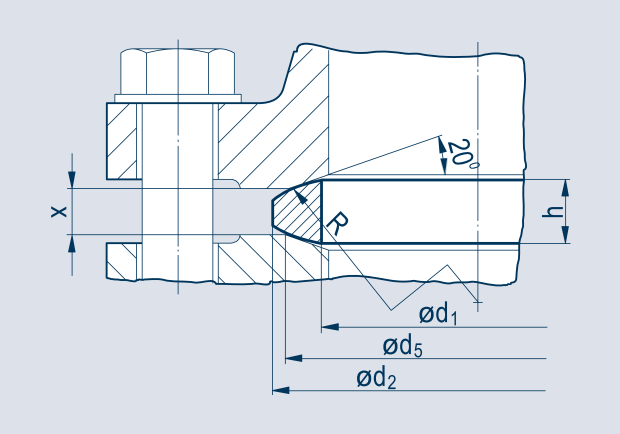
DN	d_1	d_2	d_5	h	r	x
			PN 63			
50	55	78	68	13,6	90	9
65	70	102	85	18,3	113	13
80	82	116	97	18,3	131	13
100	107	143	127	22,1	171	15
125	131	180	157	31,2	210	22
150	158	210	183	34,9	249	26
200	205	276	243	40,5	327	27
			PN 100			
10	14	21	18	7,4	23	6
15	18	28	27	9,1	32	6
25	29	43	39	9,5	49	6
40	43	62	55	12,2	71	8
50	54	78	68	13,9	89	9
65	69	102	85	18,7	112	13
80	81	116	97	18,7	130	13
100	105	143	127	22,8	169	15
125	128	180	157	32,3	208	22
150	155	210	183	36,0	146	26
200	200	276	243	42,2	323	27
			PN 160			
10	14	21	18	7,4	23	6
15	18	28	27	9,1	32	6
25	28	43	39	9,8	49	6
40	42	62	55	12,6	70	8
50	53	78	68	14,3	88	9
65	67	102	85	19,4	110	13
80	77	116	97	20,1	127	13
100	99	143	127	24,8	165	15
125	120	180	157	35,0	202	22
150	144	210	183	39,7	239	26
175	166	243	218	39,2	280	21
200	188	276	243	44,3	314	25
			PN 250			
15	17	28	27	9,4	32	6
25	27	43	39	10,2	48	6
40	39	62	55	13,6	68	8
50	48	78	68	15,9	85	9
65	61	102	85	21,4	106	13
80	80	116	97	19,0	129	13
100	99	143	127	24,8	165	15
125	121	180	157	34,6	203	22
150	143	210	183	40,1	238	26
200	195	276	243	41,9	320	25
			PN 320			
10	12	21	18	8,1	22	6
15	15	28	27	10,0	31	6
25	24	43	39	11,1	46	6
40	36	62	55	14,5	66	8
50	48	78	68	16,0	84	9
65	67	102	85	19,3	111	13
80	77	116	97	20,1	127	13
125	129	180	157	31,9	209	22
150	144	210	183	39,7	239	26
175	164	243	218	39,9	279	21
200	185	276	243	45,3	312	25
			PN 400			
10	10	21	18	8,7	20	6
15	17	28	27	9,4	32	6
25	29	43	39	9,5	49	6
40	41	62	55	12,9	70	8
50	52	78	68	14,6	87	9
65	70	102	85	18,3	113	13
80	80	116	97	19,0	129	13
100	96	143	127	25,9	162	15
125	134	180	157	30,2	212	22
150	150	210	183	37,7	243	26
200	193	276	243	42,6	319	25

Dimensions in mm

LENS GASKETS

The proven high-pressure gaskets

Lens gaskets for flange connections PN 63 to PN 400



Works standard 108[2)]

Ordering example for a lens gasket with d_1 = 94 mm internal diameter and d_2 = 143 mm external diameter, made of ...[1)]:

Lens gasket 94 x 143 WN 108 / 1.7335

Works standard 108

DN	$d_{1,\,min}$*	h_{max}	$d_{1,\,max}$*	h_{min}	d_2*	r*	d_5*	x*
PN 63 to PN 400								
10	10	8,0	14	7,0	21	25	18	5,7
15	14	10,0	18	9,0	28	32	27	6,0
25	20	11,5	29	9,5	43	50	39	6,0
40	34	15,0	43	12,5	62	70	55	8,0
50	46	16,5	55	13,5	78	88	68	9,0
65	62	21,0	70	18,5	102	112	85	13,0
80	72	21,5	82	18,5	116	129	97	13,0
100	94	26,0	108	22,0	143	170	127	15,0
125	116	35,5	135	29,5	180	218	157	22,0
150	139	41,0	158	35,0	210	250	183	26,0
PN 63 to PN 100								
(175)	176	42,5	183	40,5	243	296	218	28,0
200	198	42,5	206	40,0	276	329	243	27,0
250	246	43,0	257	39,5	332	406	298	25,0
300	295	43,5	305	40,5	385	473	345	26,0
350	330	45,5	348	39,5	425	538	394	23,0
400	385	45,5	395	42,0	475	610	445	24,0
PN 160 to PN 400								
(175)	162	40,0	177	35,5	243	296	218	21,0
200	183	45,5	200	40,0	276	329	243	25,0
250	230	48,0	246	43,0	332	406	298	25,0
300	278	53,0	285	51,0	385	473	345	30,0

Dimensions in mm

1) Specify material when placing order.

2) Unless otherwise agreed, the sealing lenses will be supplied with $d_{1,min}$ and h_{max}. The interior diameters should be adapted to the by boring of the integral or collar flanges.

* In accordance with DIN 2696 April 1972.

DIAMOND GASKETS

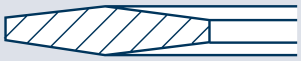
Diamond gaskets have proven excellent in high temperature engineering, high vacuum engineering, chemical and petrochemical industries as well as in nuclear technology. Diamond gaskets are metallic gaskets. Like all metal gaskets, they require high sealing surface pressures. As it is the ”tip“ of the diamond that bears pressure first of all, the necessary forces are much lower compared to other metal gaskets.

So that the diamond gasket does not damage the flanges, the gasket should have a lower hardness than the flange material.

In stainless steel flanges the diamond gasket is made of the same material. Gasket and flange have roughly the same hardness.

Diamond gaskets are also used with an inner or outer centring ring.

Gasket profiles

Profile	Cross-section
B2	
B3	

Dimensions: Specified by client

Materials: 1.0333, 1.4571, 2.0090, 3.0255

The H-gasket

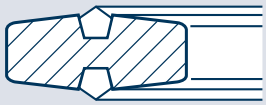
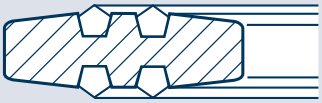
A further development of the diamond gasket is the H-gasket. A H-gasket is a fully metal gasket consisting of a chamber ring and two and/or four sealing rings.

The ring, which is H-shaped in cross-section, chambered and load-bearing, should preferably be made from a hard and elastic material.

The end faces of the chamber ring should be sloped by 2° towards the flange surfaces, so that the security of the seal diameter d_Q is retained even if the flange is tilted. Both sealing rings are pentagonal in cross-section and are made of an easily-deformable, plastic metal. At very high pressures, two or three of the same kind of sealing ring can be arranged concentrically. The surface quality of the flange should be $R_Z < 16$ µm.

In order to meet all the requirements of day-to-day use we have extended the sealing ring to three profile widths, so that, in conjunction with the double-layering technique, there are effective sealing widths of 3.2; 4 and 4.85 mm available.

Gasket profiles

Profile	Cross-section
H5-2 H5-2,5 H5-3	
H5-D2 H5-D2,5 H5-D3	

Gasket Profile H 5 has the following special features:

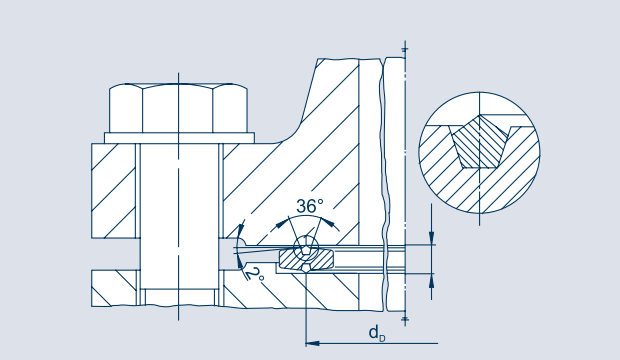
- Low sealing forces, as the sealing width is only a few millimetres.
- All deformation takes place during pre-deformation. No relaxation during operation, as the plastic sealing rings are chambered by the H-ring. The irregularities in the flange surface are filled in. There is excellent adaptability which can seal gases off effectively.
- The cross-sectionally H-shaped ring can be reused. The sealing rings should however be replaced after every use. This is easy to do as the opening angle of the groove is at 36°.
- The use of the gasket Profile H 5 is recommended everywhere where a defined installation height and/or a metallic contact is required. The combination of the small plastic sealing ring with the H-ring, which has a width of 15 to 40 mm, allows greater forces in the main flow to be conducted through the gasket. Edge pressure is avoided with the slant of 2°.
- Can also be used in valve engineering, particularly in the area of complicated control fittings and auxiliary equipment.
- Ideal for interstage pumping in nuclear installations using the double-profile H5-D. Design recommendations available on request.

Important: No sealing agents, such as solid lubricant paste, may be used with metal gaskets such as the H5 gasket.

DIAMOND GASKETS

If these sealing agents are used they can cause indentations on the flange sealing surfaces, necessitating their repair before they can be reused.

Installation sketch



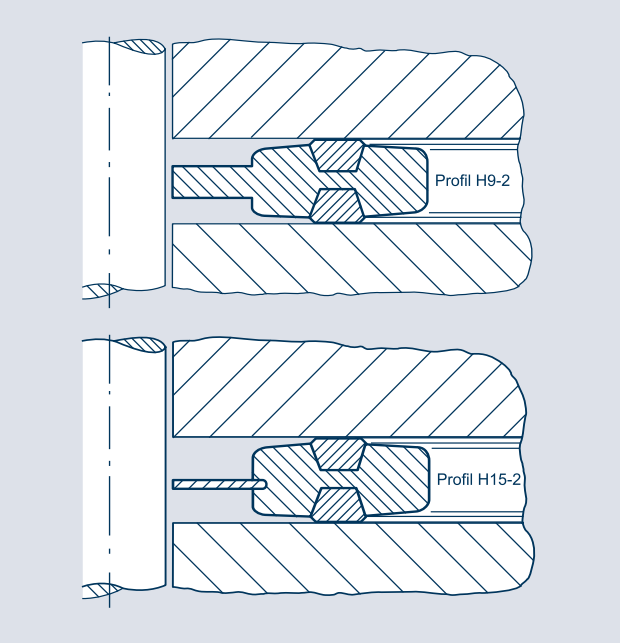
Materials for the chambering ring

1.4016,1.4541,1.4828,1.5415,1.7335, for technical data see "Materials commonly used".

Materials for the sealing ring

1.0035, 2.0090, 2.3040, 2.4066, 3.0255, fine-grain silver, technical data can be found in "Materials commonly used".

If the gasket is to be installed between two smooth flanges, we recommend Profile H9 with centring ring and/or H15 with loose metal centring ring.

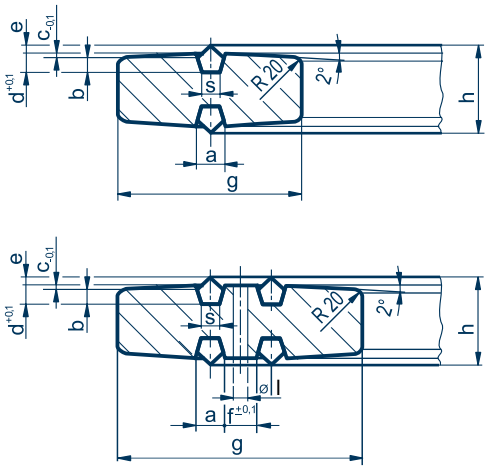


[1] Specify material when placing order.

Works standard 131

Ordering example for a H-gasket, Profile H5-2, d1 = 90 mm internal diameter, d2 = 120 mm external diameter, height = 8 mm in accordance with works standard 131, made from ...[1]:

Gasket H5-2, 90x120x8, WN131, 1.4541/3.0255



s	a	b	c	d	e~	f	Ø l*
2,0	3,2	1,9	0,4	2,3	0,78	3,0	2,0
2,5	4,0	2,4	0,5	2,9	0,97	3,5	2,5
3,0	4,85	2,85	0,6	3,45	1,16	4,0	3,0

* minimum of 2 boreholes on the circumference

Measurement recommendations for the designing engineer:

Profile	Guideline values for height "h"			
	< 200	< 500	> 500	g
H5-2	8	9	10	15
H5-2,5	9	10	11	20
H5-3	10	11	12	25
H5-D2	8	9	10	25
H5-D2,5	9	10	11	30
H5-D3	10	11	12	40

WELD RING GASKETS

We recommend weld ring gaskets for use in any place where a welded seal is necessary, due either to the danger of the medium or the danger presented by a loss of functionality, but where the connection also needs to be detachable to a certain degree.

These gaskets are therefore described as being semi-detachable, as the welded sealing joint needs to be undone as well as the flange bolts.

Weld ring gaskets are generally made of the same or a related material as the pipe or flange and are only used in pairs.

The choice between the various profiles depends on the operating conditions of the weld ring gasket. The table shows the typical features of Profiles A21 to A25. The ”attachment seam“ is the connection of a welded half with the flange. The ”attachment seam“ can be located internally or externally. The ”seal seam“ is always the welding of both weld rings with one another.

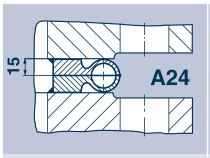
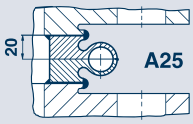
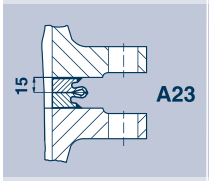
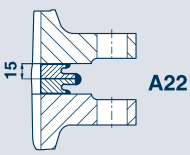
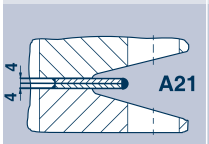
Note:

The suitability of the materials for welding (gasket to flange), the ability to weld (proper fitting) and the security of the welding (expert layout and specifications) should be assessed and tested with regard to the local operating conditions by an expert welding engineer. The ”attachment seams“ and ”seal seam“ should be arranged so that they can withstand all load conditions.

Weld rings with hollow lips in Profiles A24, A25 and A23 optimise the stress ratio in the seal seam. Weld rings with hollow lips are recommended for use when connecting components with different heat exchange properties.

The advantage of weld ring gaskets in Profile A24 and A25 lies in their greater motion absorption. They are predominantly used with heat exchangers with differing radial strain properties, e.g. as gaskets between channel flanges and tube plates. With the A24 gasket the weld seams are not accessible from the outside. However in many cases this is an advantage, particularly where creep corrosion is feared.

Typical features:

Profile	Internal ”attachment seam“ Crevice corrosion between weld ring and flange is avoided	External “attachment seam” Re-welding or disassembly possible	Capacity of radial differential expansion	Undo and re-weld
	Usual	Not possible	Depending on the thickness of the wall of the torus, to a max. Δ r ~ 5 mm	Easy to separate with a 2 mm cutting wheel. Can be re-welded 2 to 4 times
	Possible to have additional attachment. Intermittently welded	Usual	Depending on the thickness of the wall of the torus, to a max. Δ r ~ 5 mm	Easy to separate with a 2 mm cutting wheel. Can be re-welded 2 to 4 times
	a) Only as an additional attachment. Intermittently welded b) if there is a danger of corrosion	a) Usual setup b) Only as an additional attachment aid. Intermittently welded	Only low capacity due to the small lip. max. Δ r ~ 0,5 mm	Difficult to separate Can be re-welded 1 to 3 times
	a) Only as an additional attachment. Intermittently welded. b) if there is a danger of corrosion	a) Usual setup b) Only as an additional attachment aid. Intermittently welded	Not really possible. max.. Δ r ~ 0,1 mm	With cutting wheel Separation loss 2 to 3 mm respectively. Can be re-welded 3 to 5 times
	Usual	Not possible Flange form M in accordance with DIN 2526 also necessary	Modest capacity Depending on projection max.. Δ r ~ 0,3 mm	With cutting wheel Separation loss 2 to 3 mm respectively. Can be re-welded 2 to 4 times

WELD RING GASKETS

In this case we recommend the following profiles: A24H, A24K, A24KVR and A24N.

All weld ring gaskets can be combined with additional auxiliary gaskets. These can be useful for various different reasons.

a) The pressure test should be carried out with an auxiliary gasket without welding.

b) The start or run-up phase should be undertaken with the auxiliary gasket, as it is likely to need to be opened several times.

c) This application is generally in conjunction with the additional auxiliary gasket. The weld ring gasket is only welded if the auxiliary gasket fails.

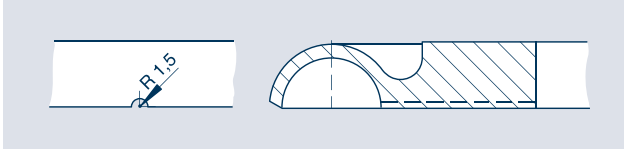
Weld ring gaskets should be fitted so that the weld ring halves lie on top of each other, and parallel to each other and to the flanges.

If weld ring gaskets are used with auxiliary gaskets, the flange and bolt calculations must be carried out once for the weld ring gasket with the seal diameter to the outermost seal seam and once for the auxiliary gasket.

With the use of auxiliary gaskets, a gap of 0.3 mm remains between the weld ring gasket halves, depending on the design.

Note:

If there is a build-up of condensation during temperature cycles, this can lead to an uncontrolled increase in pressure in the torus. This can be avoided by inserting one or more grooves (1.5 mm deep, 3 mm wide) into one of the ring halves. Please specify the number of grooves when ordering.

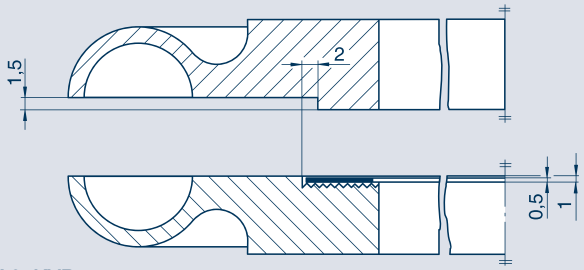


Profile A24H has a weld ring half with a convex sealing surface. The radius conforms to the pressure, temperature and the material involved. A galvanised coat can be useful.

Profile A24K has a weld ring half with a grooved profile, onto which has been attached a layer approximately 0.5 mm thick of either PTFE, graphite, silver or FA (fibre in accordance with DIN 28091), depending on the operating conditions.

Gasket profiles

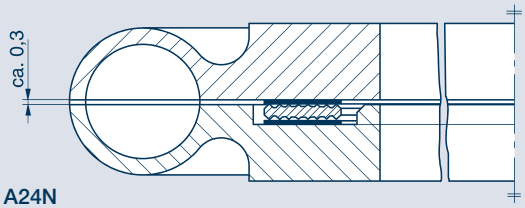
Profile	Cross-section
A23	
A24	
A24H	
A24K	
A25	



A24KVR

Profile A24KVR with male and female face joints and grooved profile as shown in diagram. Depending on the operating conditions, the layer for this gasket is either PTFE, graphite, silver or fibre* at a thickness of approximately 0.5 mm.

Grooved profile gasket Profile B27A in a floating-type seal

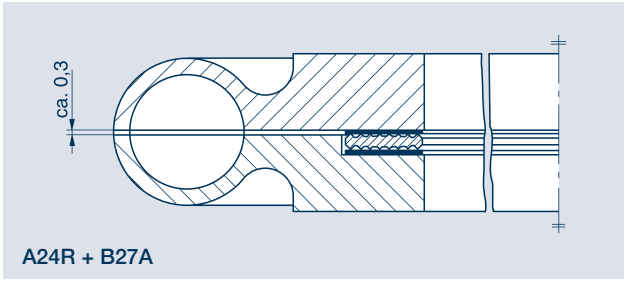


A24N

Profile A24N has a groove in one weld ring half for the addition of a grooved profile gasket Profile B27A. For the materials used in the gasket see the section ”Grooved gaskets“. The depth of the groove is less than the thickness of the grooved profile gasket, so that a floating-type seal can be guaranteed. The groove depth for the use of a grooved profile gasket = $3{,}5^{-0{,}1}$ mm, the thickness of the grooved profile gasket = $3{,}6^{+0{,}1}$ mm.

WELD RING GASKETS

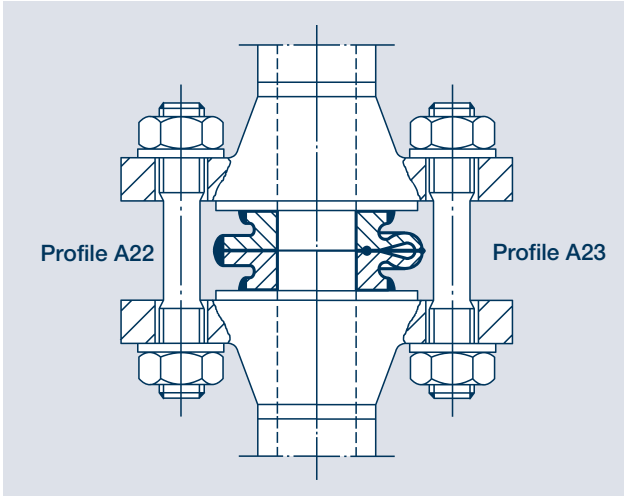
The weld ring gaskets can also be supplied with a female face in Profile A24R to receive a grooved profile gasket, so that if there is any damage to the gasket it can be replaced.



A24R + B27A

The various types of auxiliary gaskets, explained in more detail for A24, are also available for Profile A25 and A23. Profile A23 is shown with a protective gasket which is in no way leak-tight.

Weld ring gaskets in Profile A22 are, like A23 and A24, 2x15=30 mm thick therefore providing enough room to weld without special flanges, as shown in the illustration.

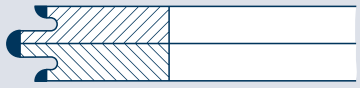
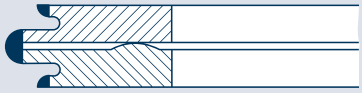
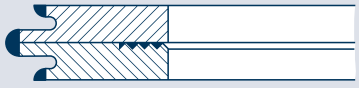
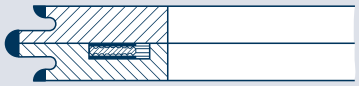


This results in large bolt lengths with good spring suspension. As all weld seams are external, any irregularities can easily be re-welded.

Profiles A22 to A22N are predominantly used in pipeline construction, where the twin flange design means that no large differences in strain properties arise when the same material for the gasket and flange is selected.

A further advantage is that due to the greater thickness an auxiliary gasket can be provided, as is explained for A24 – see weld rings with hollow lips.

Gasket profiles

Profile	Cross-section
A22	
A22H	
A22K	
A22KVR	
A22N	

WELD RING GASKETS

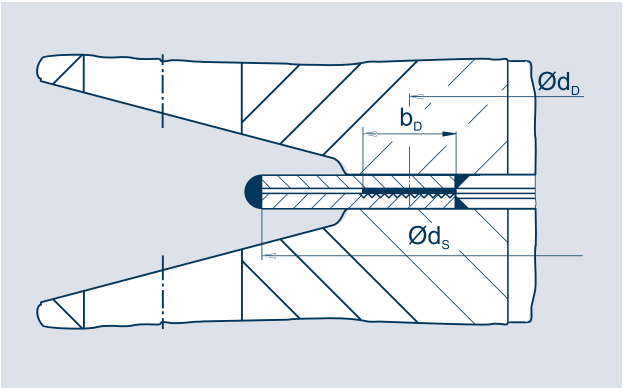
Membrane rings in accordance with DIN 2695 are each 4 mm thick and should be made of the same material as the flange due to the low absorption of radial strain differences. These gaskets are firstly welded internally to the flange using an "attachment seam", and once the flange has been assembled a "seal seam" is made externally. Any errors made when creating the internal welds can only be fixed with great difficulty.

Gasket profile

Profile	Cross-section
A21	

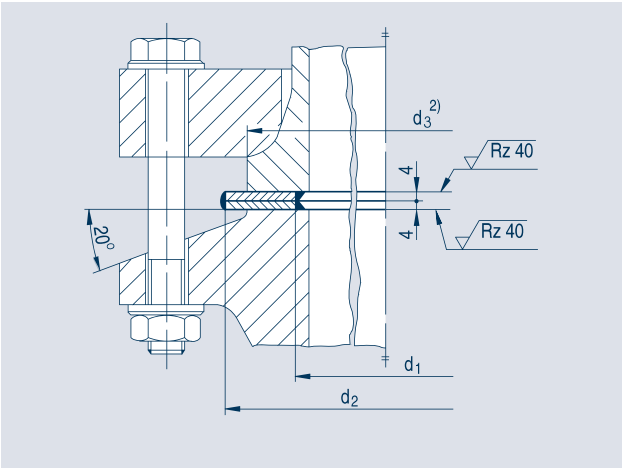
First check if there is sufficient room to make the seal weld or if bevelled flanges of the type Form M in accordance with DIN 2526 will be required.

Membrane weld ring gaskets in Profile A21K are provided with an additional grooved profile. The layers of PTFE, graphite or silver are approximately 0.5 mm thick and should be selected according to the operating conditions.



The figure shows Profile A21K as assembled between flanges of type Form M.

Profile A21



Membrane weld ring gasket Profile A21

Ordering example for a membrane weld ring gasket Profile A21 with d_1 =115 mm internal diameter and d_2 = 169 mm external diameter, made of ...[1]:

Gasket 115x169, DIN 2695, 1.5415

Each membrane weld ring gasket has two weld halves.

Conforms to DIN 2695 (PN 63 to PN 400) Model M

DN	d_2[3] at PN					
	d_1	63	100	160	250 u. 320	400
80	90	143	149	149	153	153
100	115	169	176	176	179	179
125	142	206	213	213	216	216
150	165	243	248	248	248	248
200	214	305	315	315	315	315
250	264	360	370	370	370	-
300	310	420	430	430	-	-
350	340	482	490	-	-	-
400	386	539	-	-	-	-
to 3200 possible						

Dimensions in mm

[1]Specify materials when placing order.

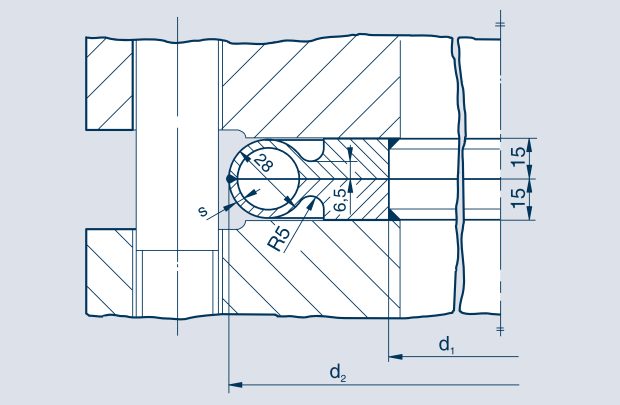
WELD RING GASKETS

Conforms to DIN 2695 (Class 150 to Class 2500) Model M

DN	NPS	d_1	d_2 in Class 150	300	600	900 to 1500	2500
80	3	92	130	142	142	157	157
100	4	118	167	172	180	187	187
125	5	114	190	208	216	216	216
150	6	170	215	243	246	246	246
200	8	220	272	300	300	300	300
250	10	273	332	354	354	354	354
300	12	322	400	411	411	411	411
350	14	360	440	443	443	443	-
400	16	412	500	500	500	500	-
to 3200 possible							

Dimensions in mm

Profile A24



Weld ring gaskets Profile A24 for DIN flanges

Ordering example for a weld ring gasket, Profile A24, DN 500, PN 40, works standard 126, made of ...[1]:

Weld ring gasket DN 500, PN 40, A24, 490 x 626, WN 126, 1.5415, s = ...*

Size d_3[2] for PN (DIN 2695) and Class

DN	NPS	d_3[2] PN 63 - 400	Class 150	300	600
80	3	123	116	122	122
100	4	149	146	150	-
125	5	186	172	180	-
150	6	218	196	-	-
200	8	285	252	-	-
250	10	340	308	-	-
300	12	400	370	-	-
350	14	460	-	-	-
400	16	519	-	-	-

Dimensions in mm

Works standard 126

DN	PN 16 d_1	16 d_2	25 d_1	25 d_2	40 d_1	40 d_2	63 d_1	63 d_2	100 d_1	100 d_2
250									258	389
300									306	456
350	-	-	-	-	348	472	341	484	334	510
400	-	-	-	-	395	544	388	541		570
500	-	-	498	622	490	626		655		702
600	*	-	598	729		745		762		811
700	-	-	696	831		850		877		948
800	-	-	795	940	to be specified by client**	972	to be specified by client**	986	to be specified by client**	-
900	-	-	892	1040		1082		1106		-
1000	1006	1126	991	1152		1192		1218		-
1200	1205	1340	to be specified by client**	1362		1396		1450		-
1400	1402	1540		1576		1616		-		-
1600	1598	1762		1796		1828		-		-
1800	1795	1962		1998		-		-		-
2000	1990	2166		2228		-		-		-

Dimensions in mm

1) Specify materials when placing order.

2) When bevelling the flanges the raised face should be machined to this size (not required for DN150, 200, 350, 400).

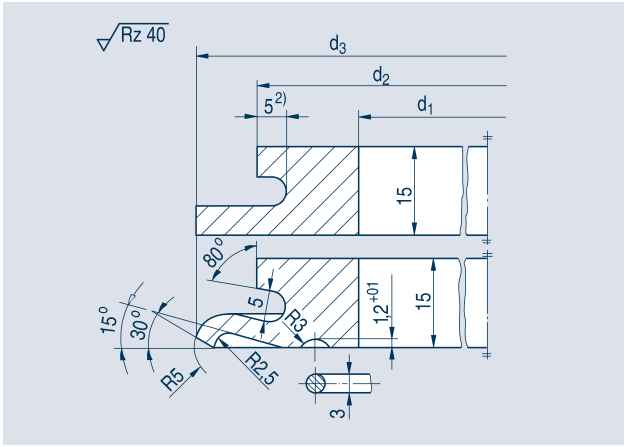
3) Aim for 15 mm membrane protrusion, but at least 10 mm (maximum size: centring diameter less than 4 mm).

* size specified by client The wall thickness s is determined according to pressure, temperature, material and motion to be absorbed.

** In Profiles A24 to A24N the total width of the weld ring gasket must be no less than $(d_2-d_1) / 2 = 60$ mm.

WELD RING GASKETS

Profile A22 und A23



Weld ring gasket Profile A22* and Profile A23 in accordance with DIN 2695-2002 for DIN flanges

Ordering example for a weld ring gasket, Profile A22, DN 100, PN 60, conforming to DIN 2695-2002, made of ...[1]:

Weld ring gasket, DN 100, PN 160, A22, DIN 2695-2002, 1.5415

Each membrane weld ring gasket has two weld ring halves.
In order to successfully carry out the welding, the customer should check
a) whether the raised face is being machined
b) whether a smooth flange is being used
c) or whether the external diameter d_2 is to be reduced other than in accordance with our works standard.

1) Specify material when placing order
2) At DN 10 and 15 only 4 mm
* Model "S" conforms to DIN 2695-2002

Dimensions in accordance with DIN 2695-2002 for DIN flanges

DN	PN 10 -40			PN 63			PN 100			PN 160			PN 250			PN 320			PN 400		
	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3
10	14	27	41	14	30	50	14	30	50	14	30	50	12	30	50	12	30	50	10	30	50
15	17	32	46	17	35	55	17	35	55	17	35	55	16	35	55	15	35	55	17	40	60
20	22	38	58	21	48	68	21	48	68	-	-	-	-	-	-	-	-	-	-	-	-
25	29	46	66	29	50	70	29	50	70	28	50	70	27	50	70	24	50	70	28	50	70
32	37	55	75	37	55	75	37	55	75	-	-	-	-	-	-	-	-	-	-	-	-
40	43	60	80	43	60	80	43	60	80	41	60	80	38	60	80	36	60	80	40	80	100
50	55	75	95	55	75	95	54	75	95	52	75	95	48	80	100	48	90	110	51	90	110
65	70	90	110	70	90	110	69	90	110	66	90	110	60	100	120	67	110	130	70	120	140
80	83	105	125	82	105	125	81	105	125	76	105	125	80	115	135	77	125	145	79	130	150
100	107	125	145	106	125	145	104	125	145	98	125	145	99	135	155	101	145	165	95	150	170
125	132	150	170	131	150	170	127	150	170	120	160	180	120	160	180	128	172	192	134	188	208
150	159	178	198	157	178	198	154	178	198	143	185	205	143	185	205	144	205	225	149	218	238
200	207	235	255	205	235	255	199	235	255	187	230	250	195	255	275	185	255	275	193	285	305
250	259	285	305	255	285	305	248	285	305	233	280	300	235	310	330	244	335	355	-	-	-
300	310	335	355	302	335	355	296	335	355	280	335	355	244	335	355	-	-	-	-	-	-

Dimensions in mm

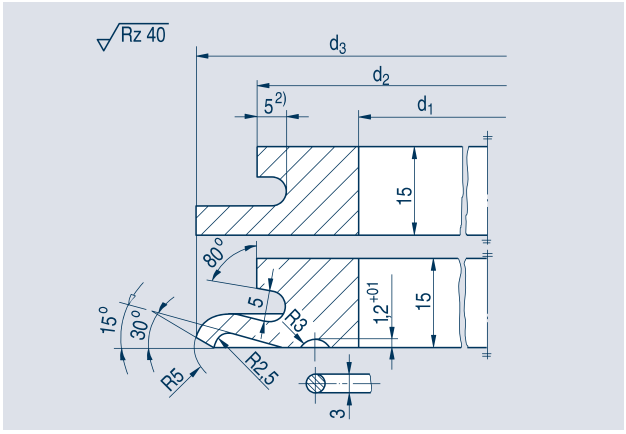
DN	PN 10			PN 16			PN 25			PN 40			PN 63			PN 100		
	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3
350	341	385	405	340	385	405	340	385	405	338	385	405	331	385	405	324	385	405
400	392	435	455	390	435	455	389	435	455	384	435	455	378	435	455	371	435	455
450	443	490	510	441	490	510	440	490	510	435	490	510	-	-	-	-	-	-
500	494	540	560	492	540	560	488	540	560	480	540	560	476	560	580	464	560	580
600	595	645	665	592	645	665	588	645	665	585	645	665	575	655	675	560	670	690
700	695	750	770	694	750	770	686	750	770	683	750	770	671	760	780	651	780	800
800	797	840	860	793	850	870	785	855	875	781	855	875	769	870	890	-	-	-
900	894	945	965	894	945	965	882	960	980	880	960	980	864	975	995	-	-	-
1000	996	1045	1065	996	1045	1065	988	1055	1075	981	1060	1080	964	1085	1105	-	-	-
1200	1198	1260	1280	1195	1260	1280	1188	1265	1285	1176	1275	1295	1156	1295	1315	-	-	-
1400	1396	1455	1475	1392	1460	1480	1385	1465	1485	1375	1475	1495	-	-	-	-	-	-
1600	1592	1665	1685	1588	1665	1685	1585	1665	1685	1570	1680	1700	-	-	-	-	-	-
1800	1790	1860	1880	1785	1865	1885	1780	1870	1890	-	-	-	-	-	-	-	-	-
2000	1984	2070	2090	1980	2070	2090	1975	2075	2095	-	-	-	-	-	-	-	-	-
2200	2184	2270	2290	2175	2275	2295	-	-	-	-	-	-	-	-	-	-	-	-
2400	2380	2470	2490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2600	2576	2675	2695	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2800	2776	2875	2895	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3000	2972	3080	3100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Flanges compliant with the standard not available

Dimensions in mm

WELD RING GASKETS

Profile A22 und A23



Weld ring gasket Profile A22 and Profile A23 for DIN flanges

Ordering example for a weld ring gasket, Profile A22, DN 100, PN 160, conforming to works standard 110, made of ...[1]:

Weld ring gasket, DN 100, PN 160, A22, works standard 110, 1.5415

Each membrane weld ring gasket has two weld ring halves.
In order to successfully carry out the welding, the customer should check
a) whether the raised face is being machined
b) whether a smooth flange is being used
c) or whether the external diameter d_2 is to be reduced other than in accordance with our works standard.

1) Specify material when placing order
2) At DN 10 and 15 only 4 mm

06

Dimensions in accordance with works standard 110 for DIN flanges

DN	PN 10 -40			PN 63			PN 100			PN 160			PN 250			PN 320			PN 400		
	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3
10	13,6	27	41	13,6	30	50	13,6	30	50	13,6	30	50	12,0	30	50	12,0	30	50	10,0	30	50
15	17,3	32	46	17,3	35	55	17,3	35	55	17,3	35	55	16,1	35	55	14,9	35	55	16,9	40	60
20	22,3	38	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	28,5	46	66	28,5	50	70	28,5	50	70	27,9	50	70	26,5	50	70	23,7	50	70	28,2	50	70
32	37,2	55	75	37,2	55	75	37,2	55	75	-	-	-	-	-	-	-	-	-	-	-	-
40	43,1	60	80	42,5	60	80	42,5	60	80	41,1	60	80	38,3	60	80	35,7	60	80	40,3	80	100
50	54,5	75	95	54,5	75	95	53,9	75	95	52,3	75	95	47,7	80	100	47,5	90	110	51,1	90	110
65	70,3	90	110	69,7	90	110	68,9	90	110	66,1	90	110	60,1	100	120	66,9	110	130	69,6	120	140
80	82,5	105	125	81,7	105	125	80,9	105	125	76,3	105	125	79,6	115	135	76,6	125	145	79,3	130	150
100	107,1	125	145	106,3	125	145	104,3	125	145	98,3	125	145	98,6	135	155	101,0	145	165	95,3	150	170
125	131,7	150	170	130,7	150	170	127,1	150	170	119,7	160	180	120,4	160	180	128,3	172	192	133,7	188	208
150	159,3	178	198	157,1	178	198	154,1	178	198	143,3	185	205	142,8	185	205	143,7	205	225	149,1	218	238
200	206,5	235	255	204,9	235	255	199,1	235	255	187,1	230	250	194,5	255	275	184,5	255	275	193,0	285	305
250	258,8	285	305	255,4	285	305	248,0	285	305	233,0	280	300	234,5	310	330	243,9	335	355	-	-	-
300	309,7	335	355	301,9	335	355	295,5	335	355	279,5	335	355	244,0	335	355	-	-	-	-	-	-

Dimensions in mm

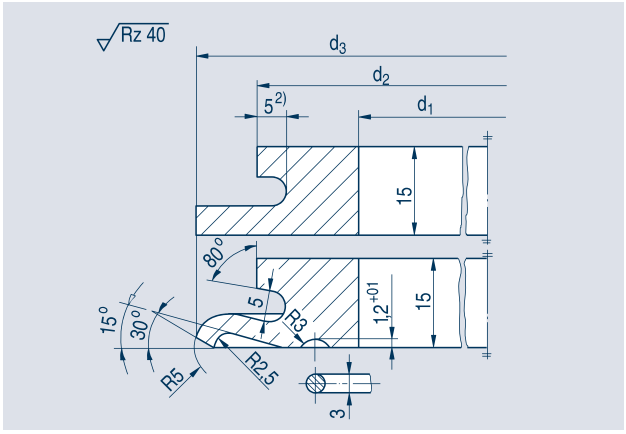
DN	PN 10			PN 16			PN 25			PN 40			PN 63			PN 100		
	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3
350	341,4	385	405	339,6	385	405	339,6	385	405	338,0	385	405	330,6	385	405	323,6	385	405
400	392,2	435	455	390,4	435	455	388,6	435	455	384,4	435	455	378	435	455	371,4	435	455
450	443	490	510	441,2	490	510	439,6	490	510	435,2	490	510	-	-	-	-	-	-
500	493,2	540	560	492	540	560	488	540	560	479,6	540	560	476	560	580	464	560	580
600	595,4	645	665	592	645	665	587,6	645	665	585	645	665	575	655	675	560	670	690
700	695,2	750	770	693,6	750	770	686,2	750	770	683	750	770	671	760	780	651	780	800
800	797	840	860	793	850	870	784,6	855	875	781	855	875	769	870	890	-	-	-
900	894	945	965	894	945	965	882	960	980	880	960	980	864	975	995	-	-	-
1000	996	1045	1065	996	1045	1065	988	1055	1075	981	1060	1080	964	1085	1105	-	-	-
1200	1198	1260	1280	1195	1260	1280	1188	1265	1285	1176	1275	1295	1156	1295	1315	-	-	-
1400	1396	1455	1475	1392	1460	1480	1385	1465	1485	1375	1475	1495	-	-	-	-	-	-
1600	1592	1665	1685	1588	1665	1685	1585	1665	1685	1570	1680	1700	-	-	-	-	-	-
1800	1790	1860	1880	1785	1865	1885	1780	1870	1890	-	-	-	-	-	-	-	-	-
2000	1984	2070	2090	1980	2070	2090	1975	2075	2095	-	-	-	-	-	-	-	-	-
2200	2184	2270	2290	2175	2275	2295	-	-	-	-	-	-	-	-	-	-	-	-
2400	2380	2470	2490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2600	2576	2675	2695	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2800	2776	2875	2895	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3000	2972	3080	3100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Flanges compliant with the standard not available

Dimensions in mm

WELD RING GASKETS

Profile A22 und A23



Weld ring gasket Profile A22* and A23 for ANSI flanges

Ordering example for a weld ring gasket, Profile A22, NPS 3, Class 900, made of ...[1]:

Weld ring gasket A22, NPS 3, Class 900, WN 111, 1.5415

* Model "S" conforms to DIN 2695-2002

06

In accordance with 2695-2002 for ANSI flanges

DN	NPS	Class 150-300 d_1	400-900 d_1	1500-2500 d_1	150 d_2	150 d_3	300-2500 d_2	300-2500 d_3
15	½	16	14	6	29	45	29	45
20	¾	21	19	11	33	53	33	53
25	1	27	24	15	42	62	42	62
32	1¼	35	33	23	52	72	55	75
40	1½	41	38	28	60	80	64	84
50	2	53	49	38	75	95	83	103
65	2½	63	59	45	96	116	96	116
80	3	78	74	58	105	125	118	138
100	4	102	97	80	148	168	148	168
125	5	128	122	103	160	180	177	197
150	6	154	146	124	185	205	207	227
200	8	203	194	174	240	260	261	281
250	10	255	248	222	295	315	315	335
300	12	305	298	273	372	392	372	392
350	14	337	330	305	404	424	404	424
400	16	387	381	356	461	481	461	481
450	18	438	432	406	525	545	525	545
500	20	499	483	457	575	595	575	595
600	24	591	584	559	683	703	683	703

Dimensions in mm

Works standard 111 for ANSI flanges

DN	NPS	Class 150-300 d_1	400-900 d_1	1500-2500 d_1	150 d_2	150 d_3	300-2500 d_2	300-2500 d_3
15	½	15,7	14,0	6,4	29	45	29	45
20	¾	20,8	18,8	11,0	33	53	33	53
25	1	26,7	24,4	15,2	42	62	42	62
32	1¼	35,1	32,5	22,8	52	72	55	75
40	1½	40,9	38,1	27,9	60	80	64	84
50	2	52,6	49,3	38,2	75	95	83	103
65	2½	62,7	58,9	45,0	96	116	96	116
80	3	78,0	73,7	58,4	105	125	118	138
100	4	102,4	97,3	80,1	148	168	148	168
125	5	128,3	122,2	103,2	160	180	177	197
150	6	154,2	146,3	124,4	185	205	207	227
200	8	202,7	193,8	174,6	240	260	261	281
250	10	254,5	247,6	222,3	295	315	315	335
300	12	304,8	298,4	273,1	372	392	372	392
350	14	336,6	330,2	304,8	404	424	404	424
400	16	387,3	381,0	355,6	461	481	461	481
450	18	438,1	431,8	406,4	525	545	525	545
500	20	488,9	482,6	457,2	575	595	575	595
600	24	590,5	584,2	558,8	683	703	683	703

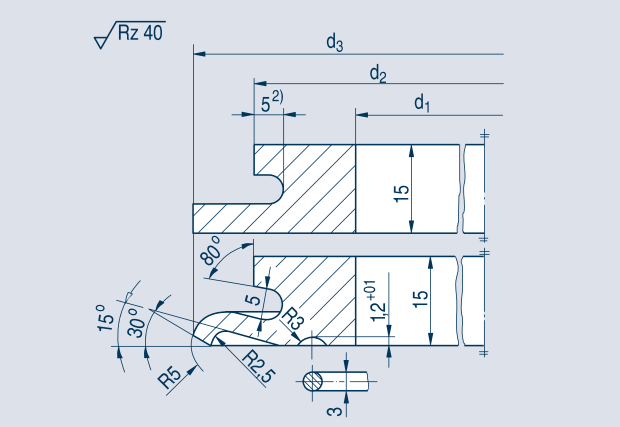
Dimensions in mm

1) Specify material when placing order

2) At NPS ½ and NPS ¾ only 4 mm

WELD RING GASKETS

Profile A22 and A23



Weld ring gasket Profile A22 and Profile A23 for flanges in accordance with ASME B16.47 Series A

Ordering example for a weld ring gasket, Profile A22, NPS 30, Class 150, made of ...[1]:

Weld ring gasket A22, NPS 30, Class 150, WN 143, 1.5415

06

Works standard 143 for ASME B16.47 Series A flanges

NPS	Class 150 - 300			Class 400 - 600			Class 900		
	d_1	d_2	d_3	d_1	d_2	d_3	d_1	d_2	d_3
26	641,4	695,8	715,8	635,0	695,8	715,8	622,4	708,4	728,4
28	692,2	746,6	766,6	685,8	746,6	766,6	673,2	759,2	779,2
30	743,0	797,4	817,4	736,6	797,4	817,4	724,0	810,0	830,0
32	793,8	848,2	868,2	787,4	848,2	868,2	774,8	860,8	880,8
34	844,6	899,0	919,0	838,2	899,0	919,0	825,6	911,6	931,6
36	895,4	949,8	969,8	889,0	949,8	969,8	876,4	962,4	982,4
38	946,2	1000,6	1020,6	939,8	1000,6	1020,6	927,2	1013,0	1033,0
40	997,0	1051,4	1071,4	990,6	1051,4	1071,4	978,0	1064,0	1084,0
42	1047,8	1102,4	1122,2	1041,4	1102,4	1122,2	1028,8	1114,8	1134,8
44	1098,6	1153,0	1173,0	1092,2	1153,0	1173,0	1079,6	1165,6	1185,6
46	1149,4	1203,8	1223,8	1143,0	1203,8	1223,8	1130,4	1216,4	1236,4
48	1200,2	1254,6	1274,6	1193,8	1254,6	1274,6	1181,2	1267,2	1287,2
50	1251,0	1305,4	1325,4	1244,6	1305,4	1325,4	-	-	-
52	1301,8	1356,2	1376,2	1295,4	1356,2	1376,2	-	-	-
54	1352,6	1407,0	1427,0	1346,2	1407,0	1427,0	-	-	-
56	1403,4	1457,8	1477,8	1397,0	1457,8	1477,8	-	-	-
58	1454,2	1508,6	1528,6	1447,8	1508,6	1528,6	-	-	-
60	1505,0	1559,4	1579,4	1498,6	1559,4	1579,4	-	-	-

- Flanges compliant with the standard not available

Dimensions in mm

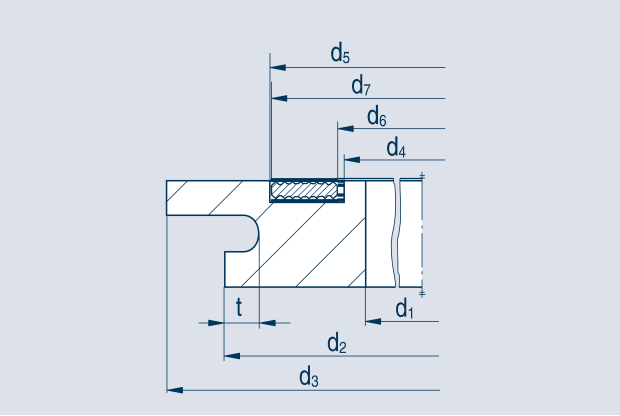
[1] Specify material when placing order

Each membrane weld ring gasket has two weld ring halves.

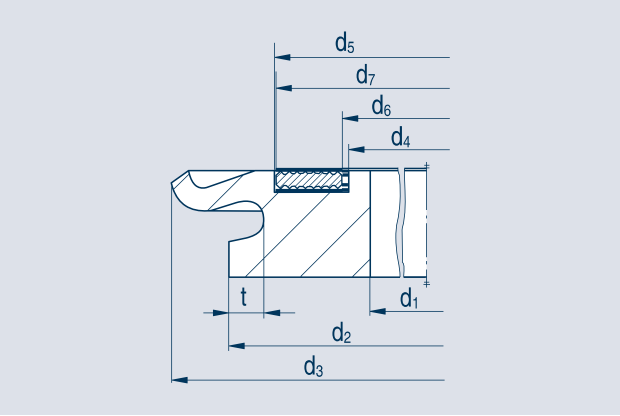
All measurements are recommendations and should be checked by the client.

WELD RING GASKETS

Profile A22N



Profile A23N



Weld ring gasket Profile A22N and Profile A23N for DIN flanges

Ordering example for a weld ring gasket, Profile A22N, DN 100, PN 6, with a grooved profile gasket Profile B27A, conform to works standard 134, made of ...[1]:

Weld ring gasket, DN 100, PN 16, A22N, B27A, 1.4541 / graphite, WN 134

* Turning in depth t 4 mm only
In order to successfully carry out the welding, the customer should check:

a) whether the raised face is being machined

b) whether a smooth flange is being used

c) or whether the external diameter d_3 is to be reduced other than in accordance with our works standard.

Works standard 134, PN 10

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
32*	37,2	65	79	40,0	54	7,0	6,0	41	53
40*	43,1	71	85	46,0	60	7,0	6,0	47	59
50*	54,5	84	98	59,0	73	7,0	6,0	60	72
65*	70,3	101	115	74,6	90	7,7	6,5	76	89
80	82,5	115	135	86,6	102	7,7	6,5	88	101
100*	107,1	141	155	111,4	128	8,3	7,0	113	127
125*	131,7	166	180	136,4	153	8,3	7,0	138	152
150*	159,3	196	210	165,2	183	8.9	7,5	167	182
(175)*	182,9	223	237	189,0	209	10,0	8,5	191	208
200*	207,3	246	260	212,0	232	10,0	8,5	214	231
250	260,4	299	315	264,0	285	10,5	9,0	266	284
300	309,7	354	370	314,6	338	11,7	10,0	317	337
350	341,4	390	410	348,6	372	11,7	10,0	351	371
400	392,2	445	465	401,2	427	12,9	11,0	404	426
(450)	443,0	500	520	453,0	481	14,0	12,0	456	480
500	493,8	555	575	506,0	534	14,0	12,0	509	533
600	595,4	660	680	608,0	638	15,0	13,0	611	637
700	695,2	770	790	710,2	745	17,4	15,0	714	744
800	797,0	875	895	813,0	850	18,5	16,0	817	849
900	894,0	970	990	908,0	945	18,5	16,0	912	944
1000	996,0	1075	1095	1012,0	1049	18,5	16,0	1016	1048

- Flanges compliant with the standard not available

Dimensions in mm

Works standard 134, PN 16

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
32*	37,2	65	79	40,0	54	7,0	6,0	41	53
40*	43,1	71	85	46,0	60	7,0	6,0	47	59
50*	54,5	84	98	59,0	73	7,0	6,0	60	72
65*	70,3	101	115	74,6	90	7,7	6,5	76	89
80	82,5	115	135	86,6	102	7,7	6,5	88	101
100*	107,1	141	155	111,4	128	8,3	7,0	113	127
125*	131,7	166	180	136,4	153	8,3	7,0	138	152
150*	159,3	196	210	165,2	183	8,9	7,5	167	182
(175)*	182,9	223	237	189,0	209	10,0	8,5	191	208
200*	207,3	246	260	212,0	232	10,0	8,5	214	231
250	260,4	299	315	264,0	285	10,5	9,0	266	284
300	309,7	354	370	314,6	338	11,7	10,0	317	337
350	339,6	390	410	348,6	372	11,7	10,0	351	371
400	390,4	445	465	401,2	427	12,9	11,0	404	426
(450)	-	-	-	-	-	-	-	-	-
500	492,0	555	575	506,0	534	14,0	12,0	509	533
600	592,4	660	680	608,0	638	15,0	13,0	611	637
700	693,4	770	790	710,2	745	17,4	15,0	714	744
800	793,0	875	895	813,0	850	18,5	16,0	817	849
900	894,0	970	990	908,0	945	18,5	16,0	912	944
1000	996,0	1075	1095	1012,0	1049	18,5	16,0	1016	1048

Dimensions in mm

[1] Specify material when placing order

WELD RING GASKETS

Works standard 134, PN 25

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
32*	37,2	65	79	40,0	54	7,0	6,0	41	53
40*	43,1	71	85	46,0	60	7,0	6,0	47	59
50*	54,5	84	98	59,0	73	7,0	6,0	60	72
65*	70,3	101	115	74,6	90	7,7	6,5	76	89
80	82,5	115	135	86,6	102	7,7	6,5	88	101
100*	107,1	141	155	111,4	128	8,3	7,0	113	127
125*	131,7	166	180	136,4	153	8,3	7,0	138	152
150*	159,3	196	210	165,2	183	8,3	7,5	167	182
(175)*	182,5	225	245	189,0	209	10,0	8,5	191	208
200*	206,5	250	270	214,0	234	10,0	8,5	216	233
250	258,8	310	330	269,0	290	10,5	9,0	271	289
300	307,9	360	380	317,6	341	11,7	10,0	320	340
350	339,6	390	410	348,6	372	11,7	10,0	351	371
400	388,8	445	465	399,2	425	12,9	11,0	402	424
500	488,0	555	575	506,0	534	14,0	12,0	509	533
600	588,0	660	680	608,0	638	15,0	13,0	611	637
700	686,0	770	790	710,2	745	17,4	15,0	714	744
800	784,6	875	895	813,0	850	18,5	16,0	817	849
900	882,0	970	990	908,0	945	18,5	16,0	912	944
1000	981,0	1075	1095	1012,0	1049	18,5	16,0	1016	1048

Dimensions in mm

Works standard 134, PN 40

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
32*	37,2	65	79	40,0	54	7,0	6,0	41	53
40*	43,1	71	85	46,0	60	7,0	6,0	47	59
50*	54,5	84	98	59,0	73	7,0	6,0	60	72
65*	70,3	101	115	74,6	90	7,7	6,5	76	89
80	82,5	115	135	86,6	102	7,7	6,5	88	101
100*	107,1	141	155	111,4	128	8,3	7,0	113	127
125*	131,7	166	180	136,4	153	8,3	7,0	138	152
150*	159,3	196	210	165,2	183	8,9	7,5	167	182
(175)*	182,5	225	245	189,0	209	10,0	8,5	191	208
200*	206,5	250	270	214,0	234	10,0	8,5	216	233
250	258,8	310	330	269,0	290	10,5	9,0	271	289
300	307,9	360	380	317,6	341	11,7	10,0	320	340
350	338,0	390	410	347,6	371	11,7	10,0	350	370
400	388,4	440	460	394,2	420	12,9	11,0	397	419
500	479,6	540	560	491,0	519	14,0	12,0	494	518

Dimensions in mm

Works standard 134, PN 63

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
25*	28,5	61	75	33,0	47	7,0	6,0	34	46
32*	37,2	65	79	40,0	54	7,0	6,0	41	53
40*	42,5	76	90	48,0	62	7,0	6,0	49	61
50	54,5	85	105	58,0	72	7,0	6,0	59	71
65	69,7	105	125	74,6	90	7,7	6,5	76	89
80	81,7	120	140	88,6	104	7,7	6,5	90	103
100	106,3	145	165	111,4	128	8,3	7,0	113	127
125	130,7	175	195	139,2	157	8,9	7,5	141	156
150	157,1	200	220	164,0	183	9,5	8,0	166	182
(175)	181,1	225	245	188,0	208	10,0	8,5	190	207
200	204,9	250	270	212,0	232	10,0	8,5	214	231
250	255,4	305	325	265,0	286	10,5	9,0	267	285
300	301,9	355	375	311,6	335	11,7	10,0	314	334
350	330,6	385	405	341,6	365	11,7	10,0	344	364
400	378,0	435	455	389,2	415	12,9	11,0	392	414

Dimensions in mm

Works standard 134, PN 100

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
25*	28,5	61	75	33,0	47	7,0	6,0	34	46
32*	37,2	65	79	40,0	54	7,0	6,0	41	53
40*	42,5	76	90	48,0	62	7,0	6,0	49	61
50	53,9	85	105	58,0	72	7,0	6,0	59	71
65	68,9	105	125	74,6	90	7,7	6,5	76	89
80	80,9	120	140	87,6	103	7,7	6,5	89	102
100	104,3	145	165	111,4	128	8,3	7,0	113	127
125	127,1	170	190	135,2	153	8,9	7,5	137	152
150	154,1	200	220	164,0	183	9,5	8,0	166	182
(175)	176,1	225	245	186,0	206	10,0	8,5	188	205
200	199,1	245	265	207,0	227	10,0	8,5	209	226
250	248,0	295	315	256,0	277	10,5	9,0	258	276
300	295,5	350	370	306,6	330	11,7	10,0	309	329
350	323.6	335	405	337,6	361	11,7	10,0	340	360

Dimensions in mm

* Turning in depth t 4 mm only

WELD RING GASKETS

Works standard 134, PN 160

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
10	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-
25	27,9	61	75	33,0	47	7,0	6,0	34	46
40*	41,1	76	90	48,0	62	7,0	6,0	49	61
50	52,3	90	110	59,0	73	7,0	6,0	60	72
65	66,1	105	125	72,6	88	7,7	6,5	74	87
80	76,3	115	135	83,6	99	7,7	6,5	85	98
100	98,3	140	160	106,4	123	8,3	7,0	108	122
125	119,7	160	180	126,2	144	8,9	7,5	128	143
150	143,3	190	210	152,0	171	9,5	8,0	154	170
(175)	165,3	215	235	175,0	195	10,0	8,5	177	194
200	187,1	230	250	194,0	214	10,0	8,5	196	213
250	233,0	280	300	241,0	262	10,5	9,0	243	261
300	279,5	335	355	290,6	314	11,7	10,0	293	313

Dimensions in mm

Works standard 134, PN 320

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
10*	12,0	46	60	18,0	32	7,0	6,0	19	31
15*	14,9	51	65	23,0	37	7,0	6,0	24	36
25	23,7	60	80	30,0	44	7,0	6,0	31	43
40	35,7	75	95	43,0	57	7,0	6,0	44	56
50	47,5	90	110	56,0	70	7,0	6,0	57	69
65	66,9	110	130	75,6	91	7,7	6,5	77	90
80	76,6	125	145	88,6	104	7,7	6,5	90	103
100	101,0	145	165	109,4	126	8,3	7,0	111	125
125	128,3	172	192	136,2	154	8,9	7,5	138	153
150	143,7	205	225	160,0	179	9,5	8,0	162	178
(175)	163,1	230	250	182,0	202	10,0	8,5	184	201
200	184,5	255	275	205,0	225	10,0	8,5	207	224
250	243,9	335	355	274,0	295	10,5	9,0	276	294

Dimensions in mm

Works standard 134, PN 250

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
10*	12,0	46	60	18,0	32	7,0	6,0	19	31
15*	16,1	51	65	23,0	37	7,0	6,0	24	36
25*	26,5	61	75	33,0	47	7,0	6,0	34	46
40	38,3	75	95	45,0	59	7,0	6,0	46	58
50	47,7	85	105	54,0	68	7,0	6,0	55	67
65	60,1	100	120	67,6	83	7,7	6,5	69	82
80	79,6	120	140	87,6	103	7,7	6,5	89	102
100	98,6	140	160	106,4	123	8,3	7,0	108	122
125	120,4	165	185	129,2	147	8,9	7,5	131	146
150	142,8	190	210	152,0	171	9,5	8,0	154	170
(175)	174,7	230	250	198,0	218	10,0	8,5	200	217
200	194,5	255	275	220,0	240	10,0	8,5	222	239
250	234,5	310	330	257,0	278	10,5	9,0	259	277

Dimensions in mm

Works standard 134, PN 400

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
10*	10,0	46	60	18,0	32	7,0	6,0	19	31
15*	16,9	51	65	23,0	37	7,0	6,0	24	36
25	28,2	65	85	35,0	49	7,0	6,0	36	48
40	40,3	80	100	49,0	63	7,0	6,0	50	62
50	51,1	90	110	59,0	73	7,0	6,0	60	72
65	69,6	120	140	82,6	98	7,7	6,5	84	97
80	79,3	130	150	92,6	108	7,7	6,5	94	107
100	95,3	150	170	109,4	126	8,3	7,0	111	125
125	133,7	188	208	147,2	165	8,9	7,5	149	164
150	149,1	218	238	169,0	188	9,5	8,0	171	187
(175)	-	-	-	-	-	-	-	-	-
200	193,0	285	305	224,0	244	10,0	8,5	226	243

Dimensions in mm

* Turning in depth t 4 mm only

WELD RING GASKETS

Weld ring gasket Profile A22N and Profile A23 for ANSI flanges

Ordering example for a weld ring gasket, Profile A22N, NPS 10, Class 150, with a grooved profile gasket Profile B27A, conform to works standard 135, made of ...[1]:

Weld ring gasket NPS 10, Class 150, A22N, B27A, 1.4541 / graphite, works standard 135

The measurement d_1 corresponds to the internal diameter for standard pipes in accordance with ANSI B36.10

* Turning in depth t 4 mm only

In order to successfully carry out the welding, the customer should check:

a) whether the raised face is being machined

b) whether a smooth flange is being used

c) or whether the external diameter d_3 is to be reduced other than in accordance with our works standard.

[1] Specify material when placing order

Works standard 135, Class 150

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
½	-	-	-	-	-	-	-	-	-
¾	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-
1¼*	-	-	-	-	-	-	-	-	-
1½	-	-	-	-	-	-	-	-	-
2*	52,6	81	95	56,0	70	7,0	6,0	57	69
2½	62,7	96	116	68,0	82	7,0	6,0	69	81
3*	78,0	111	125	82,6	98	7,7	6,5	84	97
3½	90,2	131	151	97,4	114	8,3	7,0	99	113
4	102,4	148	168	112,4	129	8,3	7,0	114	128
5	128,3	160	180	132,2	150	8,9	7,5	134	149
6	154,2	194	210	160,2	178	8,9	7,5	162	177
8	202,7	245	265	209,0	229	10,0	8,5	211	228
10	254,5	300	320	262,0	283	10,5	9,0	264	282
12	304,8	372	392	321,6	345	11,7	10,0	324	344
14	336,6	404	424	353,6	377	11,7	10,0	356	376
16	387,3	461	481	406,2	432	12,9	11,0	409	431
18	438,1	515	535	458,0	486	14,0	12,0	461	485
20	488,9	575	595	513,0	541	14,0	12,0	516	540
22	539,7	625	645	563,0	593	15,0	13,0	566	592
24	590,5	683	703	617,0	647	15,0	13,0	620	646

Dimensions in mm

Works standard 135, Class 300 - 600

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
½	-	-	-	-	-	-	-	-	-
¾*	20,8	52	62	25,0	39	7,0	5,5	27	38
1*	26,7	58	68	32,0	46	7,0	5,5	34	45
1¼*	35,1	68	78	42	56	7,0	5,5	44	55
1½*	40,9	71	85	45	59	7,0	6,0	46	58
2*	52,6	81	95	56,0	70	7,0	6,0	57	69
2½	62,7	96	116	68,0	82	7,0	6,0	69	81
3	78,0	111	125	83,6	99	7,7	6,5	85	98
3½	90,2	131	151	97,4	114	8,3	7,0	99	113
4	102,4	148	168	112,4	129	8,3	7,0	114	128
5	128,3	170	190	135,2	153	8,9	7,5	137	152
6	154,2	195	215	161,2	179	8,9	7,5	163	178
8	202,7	260	280	217,0	237	10,0	8,5	219	236
10	254,5	315	335	270,0	291	10,5	9,0	272	290
12	304,8	372	392	321,6	345	11,7	10,0	324	344
14	336,6	404	424	353,6	377	11,7	10,0	356	376
16	387,3	461	481	406,2	432	12,9	11,0	409	431
18	438,1	515	535	458,0	486	14,0	12,0	461	485
20	488,9	575	595	513,0	541	14,0	12,0	516	540
22	539,7	632	652	566,6	596	15,0	13,0	569	595
24	590,5	683	703	617,0	647	15,0	13,0	620	646

Dimensions in mm

Works standard 135, Class 900 1500

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
½*	15,7	46	56	20,0	34	7,0	5,5	22	33
¾*	20,8	52	62	25,0	39	7,0	5,5	27	38
1*	26,7	56	70	31,0	45	7,0	6,0	32	44
1¼	35,1	66	80	40,0	54	7,0	6,0	41	53
1½*	40,9	76	90	48,0	62	7,0	6,0	49	61
2	52,6	90	110	60,0	74	7,0	6,0	61	73
2½	62,7	100	120	70,0	84	7,0	6,0	71	83
3	78,0	120	140	85,6	102	7,7	6,5	88	101
4	102,4	150	170	113,4	130	8,3	7,0	115	129
5	128,3	180	200	140,2	158	8,9	7,5	142	157
6	154,2	210	230	168,2	186	8,9	7,5	170	185
8	202,7	260	280	217,0	237	10,0	8,5	219	236
10	254,5	315	335	270,0	291	10,5	9,0	272	290
12	304,8	372	392	321,6	345	11,7	10,0	324	344
14	336,6	404	424	353,6	377	11,7	10,0	356	376
16	387,3	461	481	406,2	432	12,9	11,0	409	431
18	438,1	515	535	458,0	486	14,0	12,0	461	485
20	488,9	575	595	513,0	541	14,0	12,0	516	540
24	590,5	683	703	617,0	647	15,0	13,0	620	646

Dimensions in mm

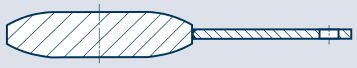
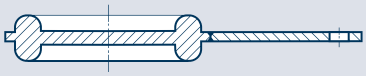
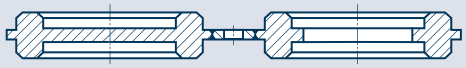
Works standard 135, Class 2500

DN	d_1	d_2	d_3	Groove measurement d_4	Groove measurement d_5	Groove width	Gasket width	Grooved gasket d_6	Grooved gasket d_7
½*	15,7	46	60	20,0	34	7,0	6,0	21	33
¾*	20,8	51	65	25,0	39	7,0	6,0	26	38
1*	26,7	61	75	33,0	47	7,0	6,0	34	46
1¼	35,1	70	90	41,0	55	7,0	6,0	42	54
1½*	40,9	80	100	49,0	63	7,0	6,0	50	62
2	52,6	95	115	62,0	76	7,0	6,0	63	75
2½	62,7	105	125	72,0	86	7,0	6,0	73	85
3	78,0	125	145	89,6	105	7,7	6,5	91	104
4	102,4	155	175	115,4	132	8,3	7,0	117	131
5	128,3	185	205	143,2	161	8,9	7,5	145	160
6	154,2	210	230	168,2	186	8,9	7,5	170	185
8	202,7	260	280	217,0	237	10,0	8,5	219	236
10	254,5	315	335	270,0	291	10,5	9,0	272	290
12	304,8	372	392	321,6	345	11,7	10,0	324	344
14	336,6	404	424	353,6	377	11,7	10,0	356	376
16	387,3	461	481	406,2	432	12,9	11,0	409	431
18	438,1	515	535	458,0	486	14,0	12,0	461	485
20	488,9	575	595	513,0	541	14,0	12,0	516	540
24	590,5	683	703	617,0	647	15,0	13,0	620	646

Dimensions in mm

BLIND GASKETS / SPECTACLE BLIND GASKETS

Gasket profiles

Profiles	Cross-section
A1S	
B7S	
B9S	
A5S	
A11S	
A13S	
A5BS	
A11BS	
A13BS	

Besides the usual blind gaskets available on the market, we also manufacture special shapes, which have certain sealing advantages compared to the blind gaskets currently available on the market.

If no thickness is specified, we set the thickness of the blind gasket in accordance with the AD Technical Specification Sheet B5-2000. Using high-strength materials, we can manufacture thin, and thereby light, blind gaskets. Blind gaskets must be as thin as possible, as they are frequently fitted between splayed flanges.

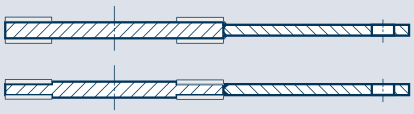
All blind gaskets are provided with a stable marker plate. The marker plate contains details about the manufacturer, nominal width and nominal pressure level, as well as a hold for a hanging storage. It can also be painted with a colour for security, to avoid accidents and unintentional isolation.

With our on-site or localised service we can also offer a blind gasket service. We can supply blind gaskets on request, as well as flat gaskets (for A1S) or sealing layers (for B7S/B9S). We can also arrange to hire these out for a fee. Contact us for further details.

Profile descriptions

Profile A1S

These blinds have soft-material gaskets on both sides. On request we can machine a recess to reduce the total thickness. Within the clamping range, the disc must be 70 % of the thickness at the middle of the disc, in accordance with AD2000 regulations. With this profile the blind gasket and the marker plate can be produced from one piece, which prevents any loss due to breaking off.



Profile B7S, Profile B9S

Like normal grooved gaskets, these blind gaskets have graphite or PTFE layers on both sides. They can also be used at very high pressures and, given the right measurements, in RTJ flanges.

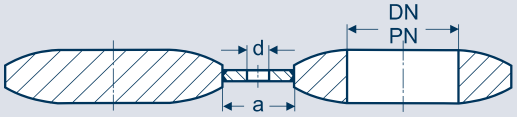
Profile A5S, Profile A11S and Profile A13S

The lens blind gasket A5S takes the shape of a lens gasket and the ring joint blind gasket takes the shape of a ring joint gasket. For ease of handling the blind gaskets have a plate which also serves as identification.

Profile A5BS

Lens blind spectacle gaskets are made of a sealing lens and a lens blind, which are connected by a ligament.

Specify DN, PN, size a and d when ordering



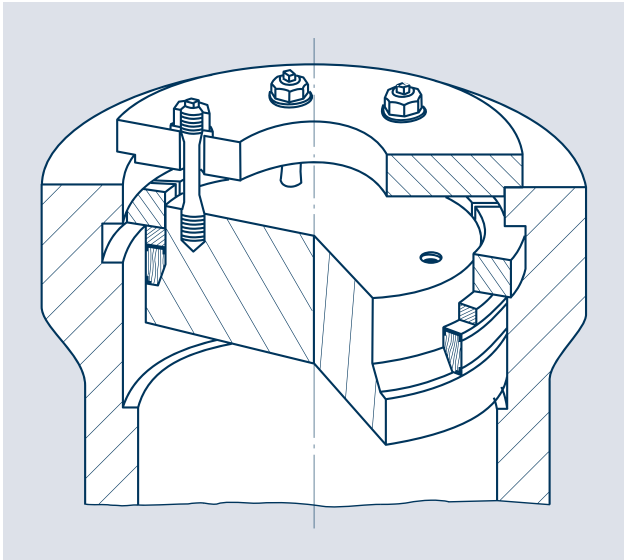
Profile A11BS, Profile A13BS

Ring joint spectacle blind gaskets have the same design shape as lens spectacle blind gaskets.

Blind gaskets and spectacle blind gaskets are produced for all current flanges. The material should be specified before ordering, see also ”Materials commonly used“.

COVER PLATE GASKETS

Cover plate gaskets are used as self-sealing gaskets, meaning that the sealing force does not come from bolts but from the internal pressure. Therefore bolts with a smaller cross-section can be selected. The entire connection is more compact. The following illustration shows the design principle.

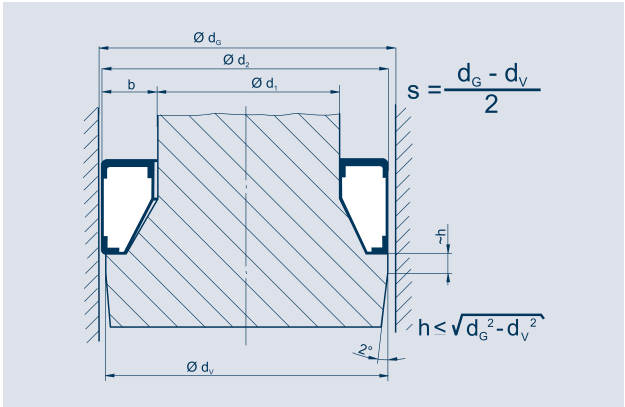


At high pressures or with reworked covers, caps should be provided, so that the graphite does not extrude into the gap between the housing and the cover plate. Compressed caps are made of 0.4 mm thick stainless steel sheet metal 1.4541. At very high pressures solid, lathed caps are usual.

Indicative values for maximum bridgeable gaps:

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

Gap width s is the average gap as shown in the illustration.



When new, the gap should be as narrow as possible. The specified fit tolerance can be used as an indicator. The selection and model is left to the equipment manufacturer.

Diameter d_2	Fit tolerance d_G/d_V
$d_2 < 500$ mm	D9/h8
$d_2 > 500$ mm	E8/h8

The cover plate can be tilted by 1° or 2° as shown in the illustration, for ease of fitting.

Cover plate gaskets have a rectangular or an internally (less often, externally) sloped cross-section. There is a range of profiles in seven different shapes available, with which all sealing problems can be solved. The necessary deformation to conform to the sealing surfaces is achieved with the cover tensioning bolts.

When laying out the bolts, attention should also be paid to the weight of the cover and where it is to be installed. Depending on the type of profile and the geometry of the gasket, achieving sufficient deformation will require the correct level of surface pressure and/or the correct internal pressure.

The minimum pressure required for a self-sealing connection is given as p_{krit}. Where d_1 = internal diameter and d_2 = external diameter of the gasket, and the sealing factor is K, the following is true:

$$p_{krit} = K \cdot \left(1 - \frac{d_1}{d_2}\right) \; [N/mm^2]$$

The sealing factor K was established in tests and can be taken from the table on the following page.

The maximum permitted operating or test pressure can also be estimated from the critical pressure. The selected tolerances and the presence or absence of metal caps or lathed protective caps is of critical importance.

The following gives an indication:

Pressure	Model
$p_{max} < 3 \cdot p_{krit}$	without caps
$3 \cdot p_{krit} < p_{max} < 6 \cdot p_{krit}$	with metal caps
$6 \cdot p_{krit} < p_{max} < 12 \cdot p_{krit}$	with lathed steel cap

COVER PLATE GASKETS

Construction and material of the gasket	 [1)]						R_z* [µm]
Graphite ring, **Profile series P70** made from chemically pure graphite, "RivaTherm"	P71	P71K	P74	P74K	P75	P75K	12,5 to 25
Factor K (N/mm²)	100	110	70	80	70	80	

Material for the caps: Stainless steel sheet metal 1.4541 and/or by arrangement

1) In packing sets of two or more rings, the intermediate caps can be done away with, please specify when ordering.

* Recommended maximum roughness depth of the flange surfaces

Application temperatures up to 650 °C (media temperature) are possible when using caps. In these cases, it must be ensured that the caps remain undamaged during installation. Only completely encapsulated cover seals are protected against oxidation to the greatest possible extent.

The pretensioning force F_{SV}, which produces sufficient sealing surface pressure, can generally be represented as:

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

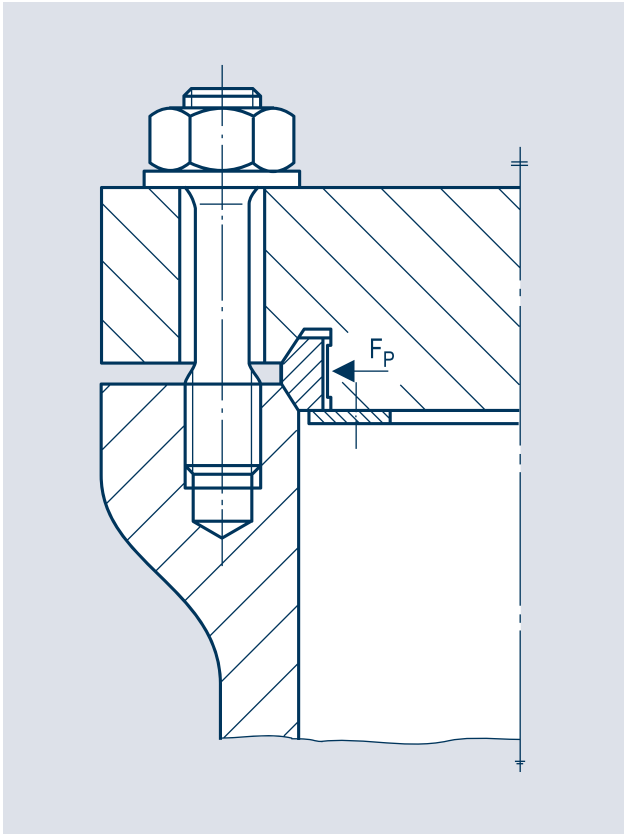
Depending on the mode of operation, smaller or greater pretensioning forces can be indicated.

The advantage is that all sealing gaps required by the design, into which the graphite could be extruded, are closed off by the caps.

Equipment with d_2 = 720 mm diameter and 770 bar test pressure will run perfectly satisfactorily. Larger diameters of more than 1000 mm are used at approx. 500 bar and are just one further example of thousands of safely installed cover gaskets. To achieve an optimal seal h_G should be = 2 · b_G.

All rings are compressed in moulds. Our extensive range includes tools from a few millimetres to more than 1000 mm in diameter. As the moulds and tools are constantly being updated, an up-to-date list cannot be given here. We would be happy to advise whether a tool is available for the required measurement or whether it would cost extra.

DOUBLE-CONE GASKETS



Double-cone gaskets are radially compressed like a circular spring by the bolt pre-tensioning force. A pre-tensioning of approximately 1/3 to 1/5 of the test pressure is generally sufficient to achieve the necessary initial seal. So that the gasket does not become overloaded, only a limited amount of clearance should be left between the cover and the gasket. After pre-tensioning the gasket will initially have contact inside to the cover. With the application of pressure it will then spring back by the compressed amount and if there is sufficient internal pressure will expand elastically, so that it offers reliable sealing in all operating conditions due to its optimal design shape.

We would be happy to carry out a cost-efficient check for tracking and to determine the measurements of the double-cone gasket as part of our gasket estimate service. The illustration above show the design principle.

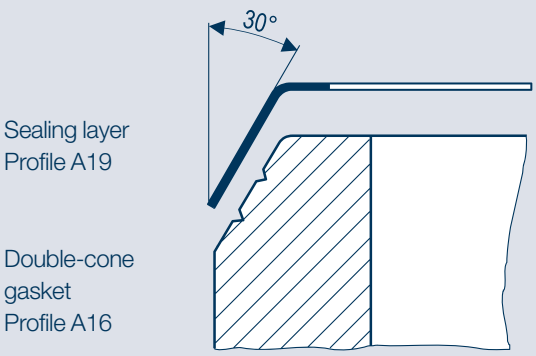
The measurements of double-cone gaskets are not standardised. We can currently supply sealing rings up to Ø 3200 mm. The sealing surfaces are conical surfaces with a sloping angle a. A sloping angle of α = 30° is usual, but is not suitable in every case.

The sealing layers should be no thicker than 1 mm. Aluminium, copper, nickel and silver layers from 0.5 mm to 1 mm in thickness have proven successful.

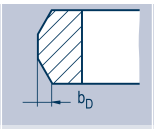
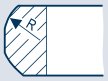
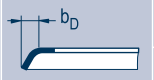
If the sealing layers can no longer be produced in one piece from the semi-finished product, they will be welded. The thickness of the welded joint deviates from the layer thickness by between +0.1 mm to -0.05 mm.

Profile AR16 has convex sealing surfaces. The convex model has proven particularly reliable where the strains and curvatures of the component vary greatly, where layers of soft metal are not suitable.

There are frequently two or three grooves of a few millimetres wide and a few tenths of a millimetre deep on each conical surface. The grooves fix the enclosed sealing layers into position. The layers provide a better initial sealing behaviour.



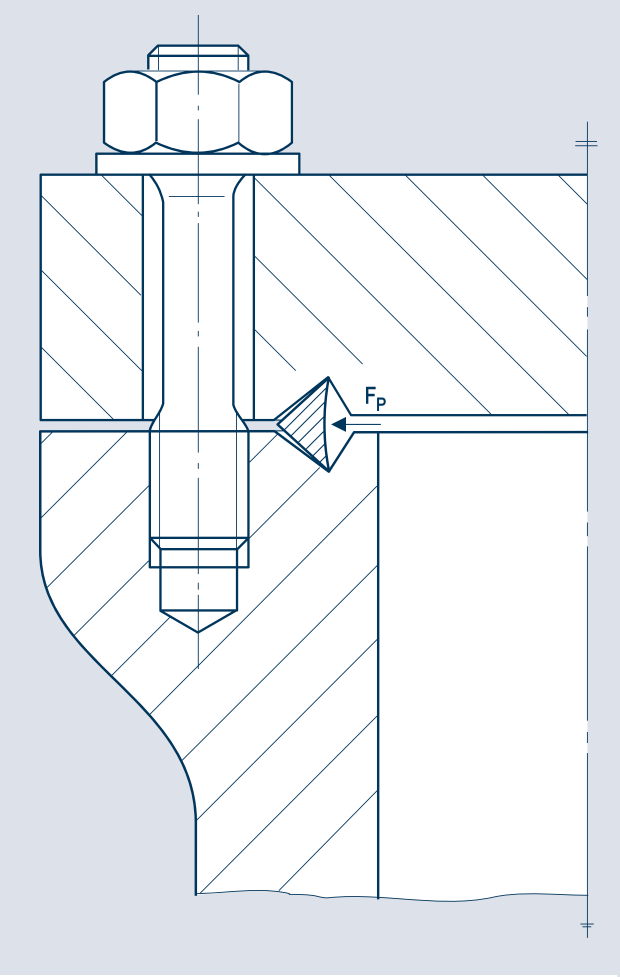
Gasket profiles

Profile	cross-section	Material	k_0 [mm]	k_1 [mm]	R_z* [µm]
A16		Steel	–		1,6 to 3,2
AR16		Steel	–		1,6 to 3,2
A19		Cu, Ni,	b_D	b_D+5	3,2 to 6,3
		Al, Ag			6,3 to 12,5

* Recommended maximum roughness of the flange surfaces.

DELTA GASKETS

Because of their geometric shape, delta gaskets require a higher level of precision from the seal grooves. As a direct result of the manufacturing process and its resulting precision, delta gaskets are only used for high-pressure autoclaves and high-pressure connections up to a maximum of 2000 mm, whereby the majority are less than 1000 mm. The following illustration shows the application as a cover gasket.



Due to its splined profile, an excellent initial seal is created by the partial plastic deformation of the opposing peaks of the gasket when bolt pre-tensioning force is applied. The radially self-sealing effect arises due to the high internal pressure resulting from the elastic extension of the gasket.

Delta gaskets are not suitable for dealing with intermittent pressures. Additional sealing layers are not practical or necessary. Delta gaskets are generally produced from seamless rings. The sealing material should be softer than the flange material if at all possible. Care should be taken to ensure adequate creep strength in the material. The gasket

is only slightly higher than the sum of the seal groove depths, therefore if the grooves are reworked at any stage a new gasket with greater height will be required.

We produce delta gaskets according to your documentation, from all usual materials. See also the section "Materials commonly used".

Gasket profiles

Profile	cross-section	Material	k_0 [mm]	k_1 [mm]	R_z* [µm]
A15		Steel	–		1,6 to 3,2

* Recommended maximum roughness of the flange surfaces.

DOUBLE SEALING SYSTEM

KHS/KNS with intermediate exhausting

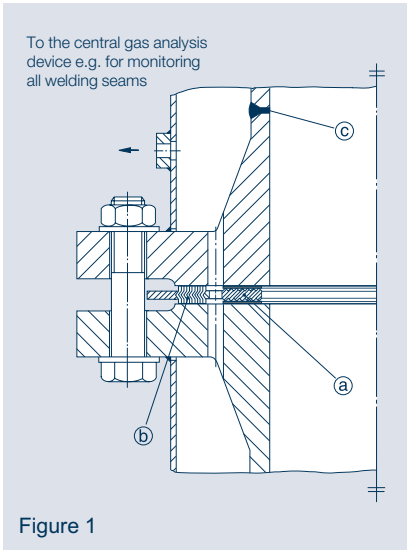


Figure 1

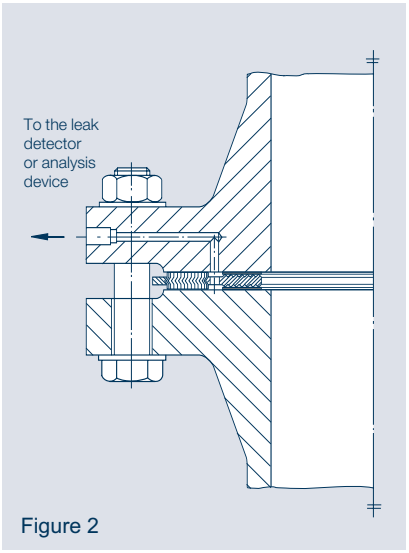


Figure 2

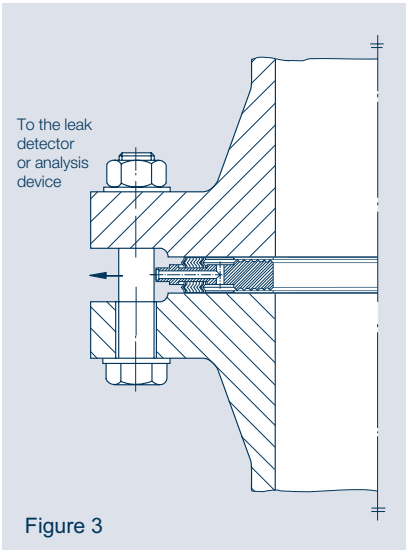


Figure 3

08

Old and new plants constantly place greater demands on safety and reliability. This applies at certain sizes to bolted flange connections on apparatuses, valves and pipelines. For many years, sealing systems with intermediate exhausting or certain areas of the chemical industry. The simplest example of this consists of two O-rings concentrically arranged in grooves.

This or similar designs are problem-free, as long as the components to be sealed are inherently stable and retain their position relative to each other. The bolt load applied, the internal pressure, the temperature or even external forces and moments all cause the flanges to take on a certain angle to each other, and so large deformations in the area of the seal should be anticipated.

The use of some gaskets leads to noticeable difficulties if the gasket is not able to securely seal the flanges as they slant against each other. The problem is even more difficult when two concentrically aligned gaskets are used.

If both gaskets are aligned as a main load seal or else if both are in off load contact, in each case significantly greater sealing recovery proportionate to the lever arms is required from a gasket than from other gaskets.

In many cases it has proven preferable not to have the components so inherently stable, so that leaks can be avoided with the pressure applied or with large applications of force

Only the combination of a main load gasket with a off load gasket as in the Kempchen double sealing system provides a secure design solution to this problem. Due to this special design, the double sealing system has proven a reliable sealing system in double-walled equipment or tanks as well as in double-lined pipes and flanges with intermediate exhausting. In double-walled systems with double sealing system gaskets the space between both walls can be used as extra heating or cooling or for monitoring any leakage arising, as shown in figure 1.

By exhausting or rinsing e.g. with nitrogen the leak-tightness of the internal gasket (a) and external gasket (b) and the welding seam (c) can always be monitored. In practice, in a 2" double sealing gasket a leak rate on the inner gasket of less than 10^{-5} mbar · l · s^{-1} can be measured for gaskets with graphite, and a leak rate of less than 10^{-8} mbar · l · s^{-1} for gaskets with PTFE.

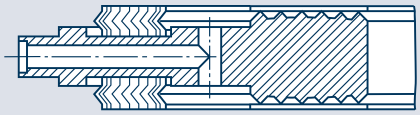
In single-wall systems the internal and external gaskets can be monitored by intermediate exhausting in the flange. The principle of intermediate exhausting is shown in figure 2.

By changing the height of the gasket the intermediate exhausting can be done from the centring ring, see figure 3.

DOUBLE SEALING SYSTEM

KHS/KNS with intermediate exhausting

Gasket profiles

Profile	Cross-section
HN21A	
HN21H	
HN22A	
HN222A	

The standard material for the metal carrier of the inner gasket and for the metal strip of the spiral gasket is 1.4541 or 1.4571 steel. Other materials available on request. See also the section ”Materials commonly used“.

Double sealing systems can be used with smooth flanges, flanges with raised face and even with flanges with male and female faces, if the recess is wide and deep enough.

Double sealing system gaskets can only be reused on a limited basis, i.e. if the layers and/or the PTFE envelope and the spiral part are replaced, the gaskets can be used again, as long as there is no damage to the metal core of the primary gasket. Reprocessing is only economical for gaskets greater than DN 500 and is done in our workshop.

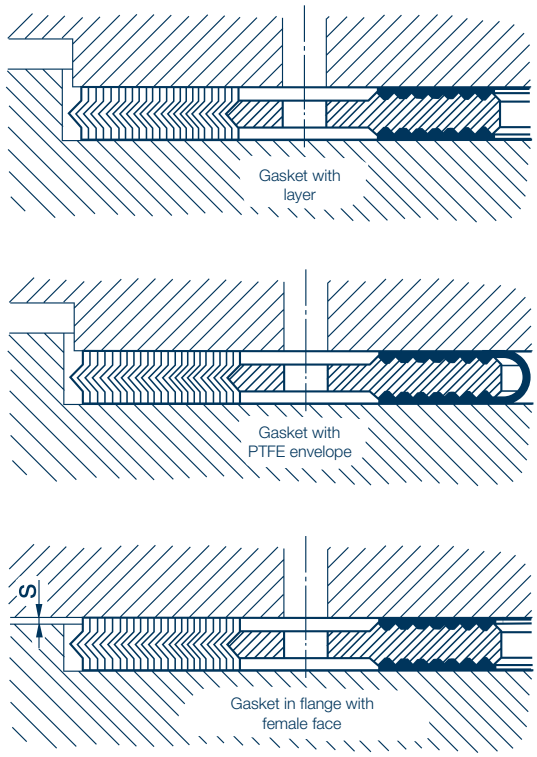
For main load gaskets, a gasket with greater spring stiffness such as a grooved gasket is used, whereas for off load gaskets a gasket with lower spring stiffness, such as a spiral wound gasket, is more appropriate. The height of the main load gasket is measured in such a way that the anticipated flange inclination and anticipated change in the flange inclination does not overload the off load gasket and allows it to be used safely.

Ask us for advice on the calculations and characteristic values of this gasket system.

The preferred areas of application for this gasket are:

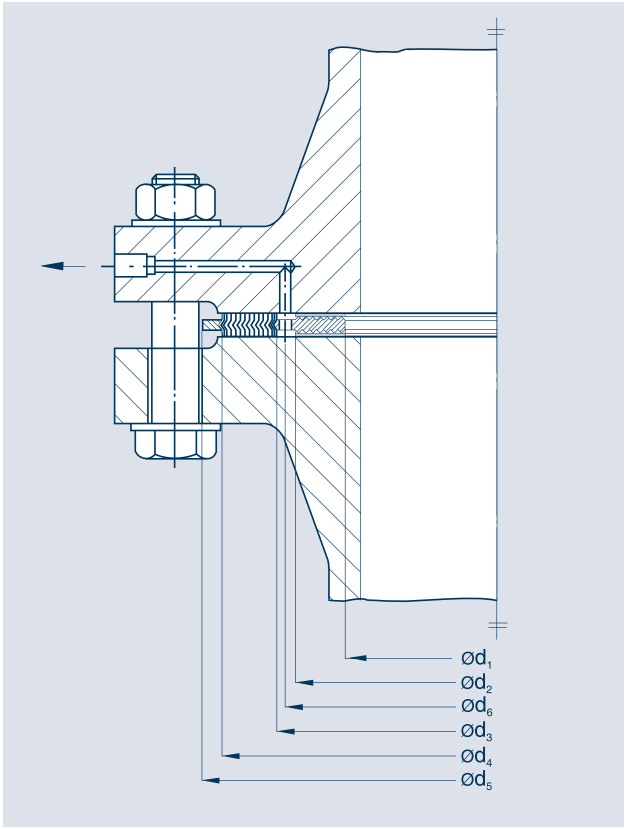
- Plants and pipelines in the chemical industry with carcinogenic, toxic or water-polluting intermediate and end products.
- Tanks with pressurised liquid gases in large-capacity storage tanks e.g. ammonia
- Equipment or pipelines with accompanying heating/cooling
- Nuclear installations

Double sealing gaskets are supplied as a complete set, i.e. the spiral gasket is mounted on the outer ring of the inner gasket. The inner gasket is coated with a layer of PTFE, graphite or silver, depending on the operating conditions. It can also be supplied with an internally sealed PTFE envelope. The filler strip for the outer gasket can be either PTFE or graphite, depending on the operating conditions.



DOUBLE SEALING SYSTEM

KHS/KNS with intermediate exhausting



Works standard 160

Ordering example for a double sealing gasket with layers, Profile HN22A, DN 100, PN 63, works standard 160, made of ...[1]:

Double sealing gasket, HN22A, DN 100, PN 63, works standard 160,1.4541 / graphite

08

For DIN flanges PN 25 to PN 400

					PN	d_5							intermediate exhausting
DN	d_1	d_2	d_3	d_4	25	40	63	100	160	250	320	400	d_6
25	30	47	53	63	71	71	82	82	82	83	92	104	50
32	40	57	63	73	82	82	-	-	-	-	-	-	60
40	46	64	72	82	92	92	103	103	103	109	119	135	68
50	60	78	86	96	107	107	113	119	119	124	134	150	82
65	75	95	105	115	127	127	137	143	143	153	170	192	100
80	90	110	120	132	142	142	148	154	154	170	190	207	115
100	110	130	140	152	168	168	174	180	180	202	229	256	135
125	138	160	170	182	194	194	210	217	217	242	274	301	165
150	162	184	196	208	224	224	247	257	257	284	311	348	190
175	187	209	221	233	254	265	277	287	284	316	358	402	215
200	212	234	246	260	284	290	309	324	324	358	398	442	240
250	262	284	296	310	340	352	364	391	388	442	488	-	290
300	312	334	346	360	400	417	424	458	458	536	-	-	340
350	348	372	388	404	457	474	486	512	-	-	-	-	380
400	396	422	438	454	514	546	543	572	-	-	-	-	430
450	444	472	488	504	-	571	-	-	-	-	-	-	480
500	494	522	538	558	624	628	657	704	-	-	-	-	530
600	600	632	648	668	731	747	764	813	-	-	-	-	640

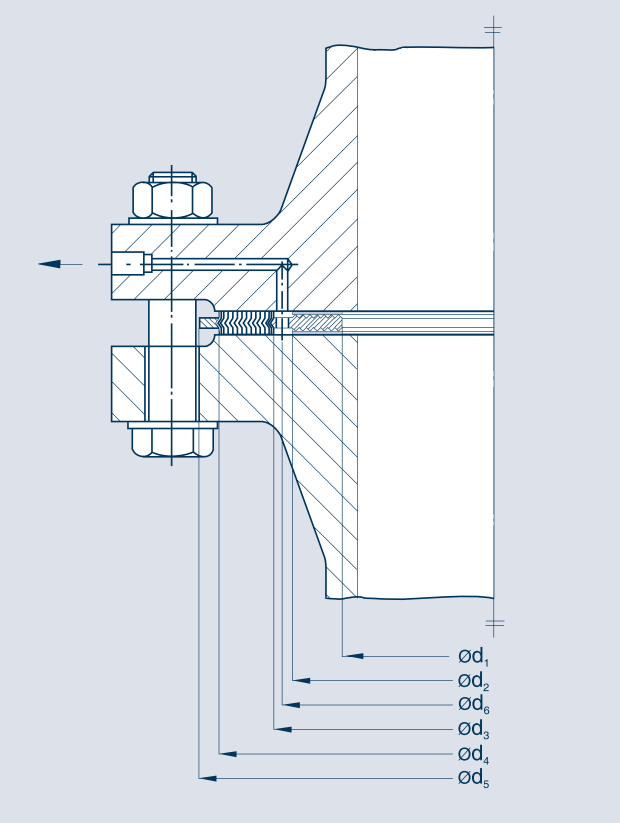
- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order

DOUBLE SEALING SYSTEM

KHS/KNS with intermediate exhausting



Works standard 161

Ordering example for a double sealing gasket with layers, Profile HN22A, NPS 5, Class 600, works standard 161, made of ...[1]:

Double sealing gasket, HN22A, 5", Class 600, works standard 161,1.4541 / graphite

For ANSI flanges Class 150 to Class 2500

DN	d_1	d_2	d_3	d_4	PN / d_5 150 lbs	300 lbs	400 lbs	600 lbs	900 lbs	1500 lbs	2500 lbs	intermediate exhausting d_6
1½	42	56	62	72	82,5	92,1	92,1	92,1	95,2	95,2	114,3	59
2	55	73	79	90	101,6	108,0	108,0	108,0	139,7	139,7	142,8	76
2½	65	83	91	102	120,6	127,0	127,0	127,0	161,9	161,9	165,1	87
3	81	99	111	124	133,4	146,1	146,1	146,1	165,1	171,5	193,7	105
3½	93	111	123	136	158,8	161,9	158,7	158,7	-	-	-	117
4	105	128	139	152	171,5	177,8	174,6	190,5	203,2	206,4	231,7	133
5	131	156	166	178	193,7	212,7	209,5	238,1	244,5	250,8	276,2	161
6	155	183	193	206	219,1	247,7	244,5	263,5	285,8	279,4	314,3	188
8	206	236	247	260	276,2	304,8	301,6	317,5	355,6	349,3	384,1	242
10	258	290	301	314	336,5	358,8	355,6	396,9	431,8	431,8	473,0	296
12	308	342	355	370	406,4	419,1	415,9	454,0	495,3	517,5	546,1	349
14	340	376	388	403	447,7	482,6	479,4	488,9	517,5	574,7	-	382
16	395	433	445	460	511,2	536,6	533,4	561,9	571,5	638,1	-	439
18	445	489	507	524	546,1	593,7	590,5	609,6	635,0	701,7	-	498
20	493	541	557	574	603,2	650,9	644,5	679,5	695,3	752,4	-	549
22	544	598	612	631	657,2	701,7	698,5	730,3	-	-	-	605
24	595	650	662	682	714,4	771,5	765,2	878,4	835,0	898,5	-	656

- Flanges compliant with the standard not available

Dimensions in mm

[1] Specify material when placing order.

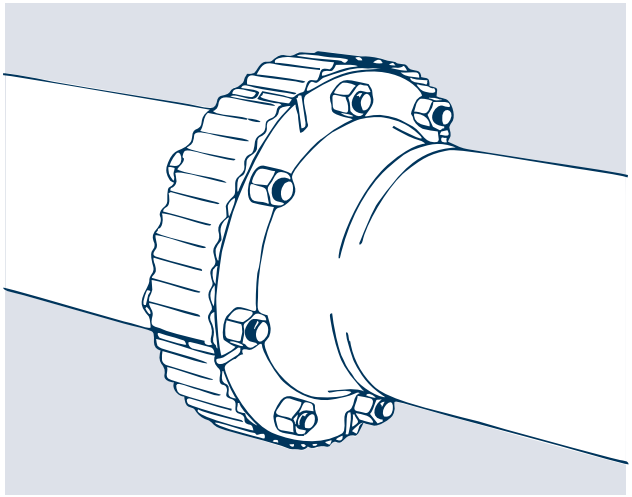
SPLATTER-SHIELD STRIPS

Dangerous, hot or pressurised media are transported through pipelines in many branches of industry. Wherever these pipelines are connected to each other with bolted flanges, there is a danger that a leakage of the dangerous medium will occur, leading to an accident.

This can involve acids or alkalis, high-pressure steam or boiling water, high-pressure hydraulic oil or heat-carrying oil, compressed air or water, to name the most important sources of danger.

Design and operation

Splatter-shield strips in Profile BWQ are made from 0.2 mm thick stainless steel strip of material 1.4541. They are corrugated at right angles to the length. When used with a flange connection, the corrugation along the strip creates many small openings to the outside.



This means that the dangerous medium cannot stream out directly onto a person standing in front of the flange connection. Instead, the stream of acid, alkali or water will hit the interior of the splatter-shield strip and then flow at low pressure through the opening.

Selection criteria for a splatter-shield strip for a 4 mm thick gasket

The strip width b_S as relates to the flange thickness is:					
Flange thickness b [mm]	10-23	24-26	27-39	40-44	45-78
Strip width b_S	40	40 (60)	60	60 (100)	100

The length of the splatter shield strip L_S is determined as follows:		
Single wrap	D < 160 mm	LS = π · D + 50 mm
	D > 160 mm	LS = 1,1 · π · D mm
Double wrap	D < 320 mm	LS = 2 · π · D + 50 mm
	D > 320 mm	LS = 2,05 · π · D mm

Number of security fastener required

To correctly attach the splatter-shield strips you need the following number of security fasteners, as a security fastener must be attached just before the outer end of the wrapping.

Diameter D [mm]	Security fasteners	Diameter D [mm]	Security fasteners
		1194 - 1273	16
10 - 50	2	1274 - 1353	17
65 - 100	3	1354 - 1432	18
125 - 150	4	1433 - 1511	19
175 - 200	5	1512 - 1591	20
225 - 250	6	1592 - 1671	21
275 - 300	7	1642 - 1750	22
350 - 600	8	1751 - 1830	23
635 - 715	9	1831 - 1909	24
716 - 795	10	1910 - 1989	25
796 - 875	11	1990 - 2069	26
876 - 955	12	2070 - 2148	27
956 -1035	13	2149 - 2228	28
1036 -1115	14	2229 - 2307	29
1116 -1193	15	2308 - 2387	30

Installation

For security, a flange of approx. 1,1 · D · π mm, but D · π + 50 mm as a minimum for small flanges, is required, so that there is sufficient overlap. From PN 100, particularly with water or other heavy liquids, there should be a double wrapping of the flange. For this 2,05 · D · π mm. is required. To securely attach it, the splatter-shield strip with security fasteners Profile BWS, which is wrapped around the flange, is secured to the flange in such a way that, starting at the overlap, one end of the security fastener is bent downwards towards the flange plate and one end is bent upwards by 180°.

Supplied as:

We supply splatter-shield strips for all profile sizes in rolls of 25 m each. This includes security fasteners from stainless steel material 1.4541, Profile BWS 40, BWS 60 or BWS 100.

SPLATTER-SHIELD STRIPS

Nominal flange diameter	PN 6		DIN 2527, 2631	DIN 2641			DIN 2527 2632, 2566	PN 10 DIN 2642	DIN 2653, 2673	DIN 2576	DIN 28115
DN	A (Stck.)	L_S (mm)	b_S (mm)	b_S (mm)	A (Stck.)	L_S (mm)	b_S (mm)	b_S (mm)	b_S (mm)	b_S (mm)	b_S (mm)
10	3	290	40	40	3	335	40	40	40 (60)	40	
15	3	305	40	40	3	350	40	40	40 (60)	40	
20	3	335	40	40	3	380	40	40	40 (60)	40	
25	3	365	40	40	3	415	40	40	60	40	40
32	4	430	40	40	4	490	40	40	60	40	40
40	4	460	40	40	4	525	40	40	60	40	40
50	4	490	40	40	4	575	40	40	60	40	40
65	5	555	40	40	5	640	40	40	60	40	40
80	5	660	40	40	5	695	40	40	60	40	40
100	5	730	40	40	6	765	40	40	60	40	40
125	6	830	40	40	6	865	40	40	60	40	40
150	6	920	40	40	7	985	40	40	60	40	40
200	7	1110	40	40	7	1175	40 (60)	40 (60)	60 (100)	40 (60)	40 (60)
250	8	1300	40	40	8	1365	40 (60)	40 (60)	60 (100)	40 (60)	
300	8	1525	40	40 (60)	8	1540	40 (60)		100	40 (60)	
350	8	1700	40	40 (60)	8	1750	40 (60)		100	60	
400	8	1870	40	60	8	1955	40 (60)		100	60	
500	9	2230	40 (60)	60	9	2320	60		100	60	
600	10	2610	40 (60)	60	10	2700	60		100		
700	11	2975	40 (60)	60 (100)	12	3095	60		100		
800	13	3370	40 (60)	60 (100)	13	3510	60				
900	14	3715	40 (60)	100	15	3855	60				
1000	15	4065	40 (60)	100	16	4255	60				
1200	18	4860	60	100	19	5030	60				
1400	21	5635	60		22	5790	60 (100)				
1600	23	6325	60		25	6620	100				
1800	26	7070	60		27	7310	100				
2000	29	7830	60		30	8035	100				

longer fasteners

Nominal flange diameter	PN 16		DIN 2527, 2566 2633	DIN 28115	PN 25		DIN 2527, 2634	DIN 2655	DIN 28115	PN 40		DIN 2527, 2635	DIN 2656	DIN 28115
DN	A	L_S (mm)	b_S (mm)	b_S (mm)	A	L_S (mm)	b_S (mm)	b_S (mm)	b_S (mm)	A	L_S (mm)	b_S (mm)	b_S (mm)	b_S (mm)
10	3	335	40		3	335	40	60		3	335	40	60	
15	3	350	40		3	350	40	60		3	350	40	60	
20	3	380	40		3	380	40	60		3	380	40	60	
25	3	415	40	40	3	415	40	60	40	3	415	40	60	40
32	4	490	40	40	4	490	40	60	40	4	490	40	60	40
40	4	525	40	40	4	525	40	60	40	4	525	40	60	40
50	4	575	40	40	4	575	40	60	40	4	575	40	60	40
65	5	640	40	40	5	640	40	60	40	5	640	40	60	40
80	5	690	40	40 (60)	5	695	40 (60)	60 (100)	40 (60)	5	690	40 (60)	60 (100)	40 (60)
100	6	765	40	40 (60)	6	815	40 (60)	60 (100)		6	815	40 (60)	60 (100)	
125	6	865	40	40 (60)	6	935	40 (60)	100		6	935	40 (60)	100	
150	7	985	40	60	7	1040	60	100		7	1040	60	100	
200	7	1175	40 (60)	60	8	1245	60	100		8	1300	60	100	
250	8	1400	40 (60)		8	1470	60	100		8	1555	60	100	
300	8	1590	60		8	1680	60	100		8	1780	60 (100)	100	
350	8	1800	60		8	1920	60	100		8	2005	100	longer fasterners	
400	8	2005	60		8	2145	60 (100)	longer fasterners		9	2285	100		
500	9	2475	60		10	2525	60 (100)			10	2610	100		
600	11	2905	60		11	2925	100							
700	12	3145	60		13	3320	100							
800	13	3545	60		14	3750	100							
900	15	3890	60 (100)		15	4100	100							
1000	16	4340	60 (100)		17	4565	100							

Nominal flange diameter	*PN 63* DIN 2636			PN 100 DIN 2637				PN 160 DIN 2638				PN 250 DIN 2628			
					single wrap	double wrap			single wrap	double wrap			single wrap	double wrap	
DN	A	L_S (mm)	b_S (mm)	A	L_S (mm)	L_S (mm)	b_S (mm)	A	L_S (mm)	L_S (mm)	b_S (mm)	A	L_S (mm)	L_S (mm)	b_S (mm)
10	3	365	40	3	365	680	40	3	365	680	40				
15	3	380	40	3	380	710	40	3	380	710	40	4	460	870	40 (60)
25	4	490	40 (60)	4	490	930	40 (60)	4	490	930	40 (60)	4	525	995	60
32	4	540	40 (60)	4	540	1025	40 (60)								
40	5	590	40 (60)	5	590	1120	40 (60)	4	590	1120	60	5	640	1215	60
50	5	625	40 (60)	5	675	1280	60	5	675	1280	60	5	695	1310	60
65	5	710	60	5	765	1435	60	5	765	1435	60	6	795	1500	60 (100)
80	5	745	60	6	795	1500	60	6	795	1500	60	6	885	1655	100
100	6	865	60	6	920	1715	60	6	920	1715	60 (100)	7	1040	1935	100
125	7	1020	60	7	1090	2030	60 (100)	7	1090	2030	60 (100)	8	1175	2190	100
150	8	1200	60 (100)	8	1230	2290	60 (100)	8	1230	2290	100	8	1350	2516	100
200	8	1435	60 (100)	8	1490	2770	100	8	1490	2770	100	8	1680	3125	longer fasterners
250	8	1625	100	8	1750	3255	100	8	1780	3320	100	8	2025	3770	
300	8	1835	100	8	2025	3770	100	8	2025	3770	100				
350	8	2075	100	8	2265	4220	100								
400	9	2320	100												

Nominal flange diameter	ANSI Class 150			Raised face blind flange Class 300			Class 400			Class 600				Raised face blind flange Class 900				Class 1500			
										single wrap		double wrap		single wrap		double wrap		single wrap		double wrap	
NPS	A	L_S (mm)	b_S (mm)	A	L_S (mm)	b_S (mm)	A	L_S (mm)	b_S (mm)	A	L_S (mm)	L_S (mm)	b_S (mm)	A	L_S (mm)	L_S (mm)	b_S (mm)	A	L_S (mm)	L_S (mm)	b_S (mm)
½	3	330	40	3	350	40	3	350	40	3	350	650	40	4	430	810	40	4	430	810	40
¾	3	360	40	4	420	40	4	420	40	4	420	790	40	4	460	870	40 (60)	4	460	870	40 (60)
1	3	390	40	4	440	40	4	440	40	4	440	830	40	4	520	990	60	4	520	990	60
1¼	4	420	40	4	470	40	4	470	40	4	470	890	40	4	550	1050	60	4	550	1050	60
1½	4	450	40	4	540	40	4	540	40	4	540	1030	40	5	615	1170	60	5	615	1170	60
2	4	530	40	5	570	40	5	570	40 (60)	5	570	1090	40 (60)	5	750	1410	60	5	750	1410	60
2½	5	615	40	5	660	40 (60)	5	660	60	5	660	1250	60	5	845	1590	60 (100)	5	845	1590	60 (100)
3	5	660	40 (60)	5	725	60	5	725	60	5	725	1370	60	6	925	1730	60 (100)	6	925	1730	100
3½	5	750	40 (60)	6	790	60	6	790	60	6	790	1490	60								
4	6	790	40 (60)	6	880	60	6	880	60	7	945	1770	60	7	1010	1890	60 (100)	7	1075	2005	100
5	6	880	40 (60)	7	965	60	7	965	60	8	1145	2130	60 (100)	8	1210	2250	100	8	1295	2415	100
6	7	970	40 (60)	7	1100	60	7	1100	60 (100)	8	1230	2295	100	8	1320	2455	100	8	1365	2540	
8	8	1190	60	8	1320	60 (100)	8	1320	100	8	1450	2700	100	8	1625	3030	100	8	1670	3110	
10	8	1405	60	8	1540	100	8	1540	100	8	1755	3275	100	8	1890	3520	100	8	2020	3765	longer fasterners
12	8	1670	60	8	1800	100	8	1800	100	8	1935	3600	100	8	2110	3930	100	9	2330	4335	
14	8	1845	60	8	2020	100	8	2020	100	8	2085	3885	100	9	2220	4130	longer fasterners	10	2590	4830	
16	8	2065	60	9	2240	100	9	2240	100	9	2370	4420	100	9	2440	4540		11	2855	5320	
18	9	2195	60 (100)	9	2460	100	9	2460	100	10	2570	4785	longer fasterners	10	2725	5075		12	3160	5890	
20	9	2415	60 (100)	10	2680	100	10	2680	100	11	2810	5235		11	2970	5525		13	3405	6340	strip with lager width
22	10	2590	100	11	2900	100				11	3010	5605									
24	11	2810	100	12	3160	100	12	3160	100	12	3250	6055		14	3600	6710		15	4040	7525	

BAFFLE SEALS T4

Baffle seals T4 for sealing longitudinal baffles in high-performance heat exchangers.

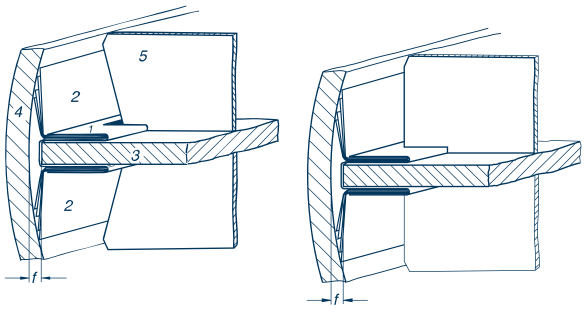
Baffle seal profile T4 is a full metal seal. It is generally made from 1.4571 steel for the lamellae supports and for the lamellas themselves. On request for larger these seals can also be pro-duced from other spring-elastic steels or non-ferrous metals.

We are able to produce precisely adapted separating plate gas-kets for every heat exchanger. Particularly suitable for heat exchangers with large or small gaps, due to construction filters, refurbishment or warping.

The baffle seal plays an important role in effectively sealing the gap between the longitudinal baffle and the heat ex-changer shell in high-performance heat exchangers. In par-ticular, when there are small differences in temperature, even low short-circuit currents cause a significant power loss. This can largely be avoided by using the baffle seal T4. The T4 seal is easily assembled directly onto the longitudinal baffle.

No bolts are required to affix it. This means that there is no need to drill holes or to do any of the usual bolting work during assembly.

The lamellae in the baffle seal profile T4 are spot welded to a lamellae unit with the lamellae support and can be sup-plied in any length. For transport reasons they cannot ex-ceed 6000 mm. We can supply fixed lengths down to the exact millimetre in accordance with your specifications, avoiding the difficult task of cutting the thin lamellas.



Model “A” **Model “B”**

Part 1 Lamellae support, Part 2 Lamellae packet, Part 3 Longitudinal baffle, Part 4 Heat exchanger shell , Part 5 transverse baffle.

Part	1	2
Name	Lamellae support	Lamellae packet
Material no.	1.4571	1.4571
Material thickness	0,50 mm	0,2 mm

The length of the baffle seal corresponds to the length of the heat exchanger bundle.

Model A

In this model the lamellae supports have a corresponding recess.

The necessary slots for the longitudinal baffles should be ground during installation. The slots should only be made as deep as is needed to take the transverse baffles (part 5).

Model B:

With large numbers of longitudinal baffles it is easier to fit the baffle seal continuously. However, it should also be secured, and the first lamellae support (which is the deepest) can be secured with a bolt or pin to the baffle, so that when pulling the bundle, the baffle seal is also securely pulled out.

BAFFLE SEALS T4

For model A, which has recesses for the baffles, this safeguard is not necessary.

Baffle seal profile T4 is not completely leak-proof, especially in the case of gaseous media. With these simple methods, however, a far better seal can be achieved than was previously possible. The full metal finish guarantees safe functioning in a wide range of temperatures.

For particularly high demands on the seal, PTFE sheets can be inserted between the last two lamellae. Baffle seal profile T4 can be supplied in two lamellae widths.

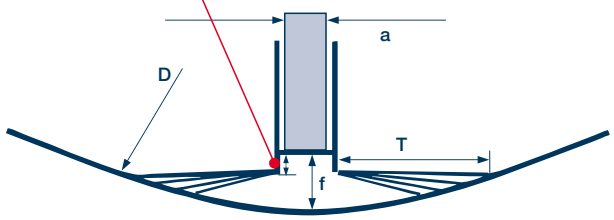
The lamellae width is 30 mm with lamellae support T4.30 and 20 mm with support T4.20. The lamellae supports are available for longitudinal baffles from 4 mm to 25 mm. The type which can be produced in the appropriate thickness can be taken from the following tables.

Ordering example for a baffle seal profile T4, material 1.4571, 30 mm side length, internal heat exchanger diameter D = 1000 mm, baffle thickness a = 10 mm, length = 2000 mm:

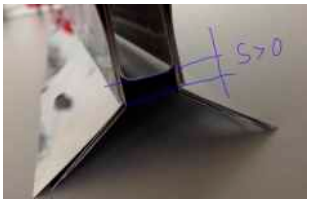
Baffle seal T4.30.10/2000

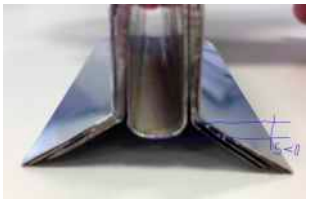
Calculation of the reset measurement of a baffle seal

Description	Index	Value	Comment
Length of lamella	T	30 mm	(T30: 30 mm; T20: 20 mm)
Width of baffle seal	a	20 mm	(usually customer specification)
Internal diameter of vessel	D	500 mm	(usually customer specification)
Number of baffles seal lamellas		4	(usually 4 fins)
Gap between baffle and shell	f	10 mm	(usually customer specification)
Offset for bracket		**6,3 mm**	

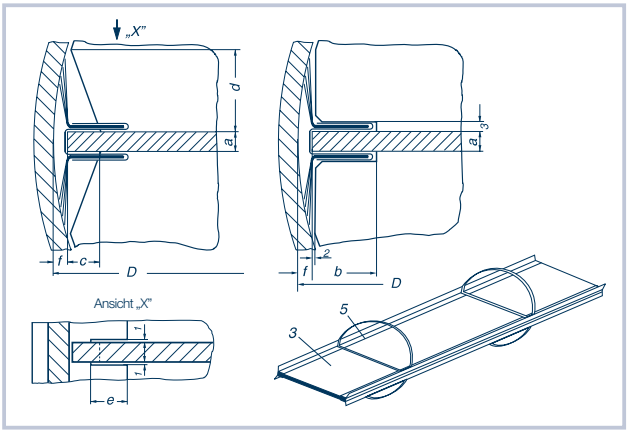


Through the individual specification of measurement “s”, the degree of efficiency of the exchanger is increased significantly and the gasket has a constant contact pressure.





Works standard 124

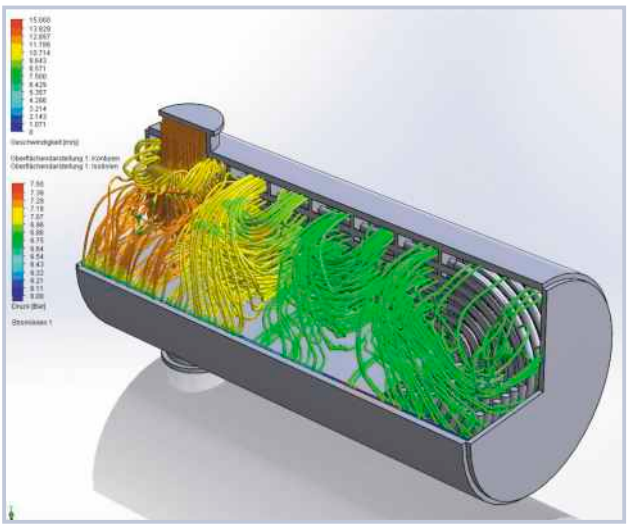


Calculation of internal leakage with / without baffle seals

Description	Index	Value	
Overall Volumen-Flow (shell)	V'g	25,00 m³/h	416,7 l/min
Overall pressure drop	Δpg	0,100 bara	
Number of baffles in one flow direction	z	8,0	
Length of baffle (tubes)	L	3000,0 mm	
gap between baffle and shell	f	2,5 mm	
mean density of medium (shell)	ρ	900,0 kg/m³	
leakage flow without baffle seals	V'	25,00 m³/h	416,7 l/min
flow efficency without baffle seals	η	0,00%	
leakage flow with baffle seals	V'	10,41 m³/h	173,5 l/min
flow efficency with baffle seals	η	58,36%	
delta leakage flow with baffle seals	V'	14,59 m³/h	243,2 l/min
delta flow efficency with baffle seals	η	58,36%	

Computational Fluid Dynamics (CFD) - simulator

The basis for the calculation tool was a CFD simulator



STATIC NEUTRAL GASKET (SNG)

The save sealing of tower segments

Flanges for tower segments are often imperfect. Gaskets in the main force connection are not able to balance the gaps of several millimetres between the tower segments.

Systems should be used which permanently bridge the unevennesses, without having any effect to the static of the tower segments.

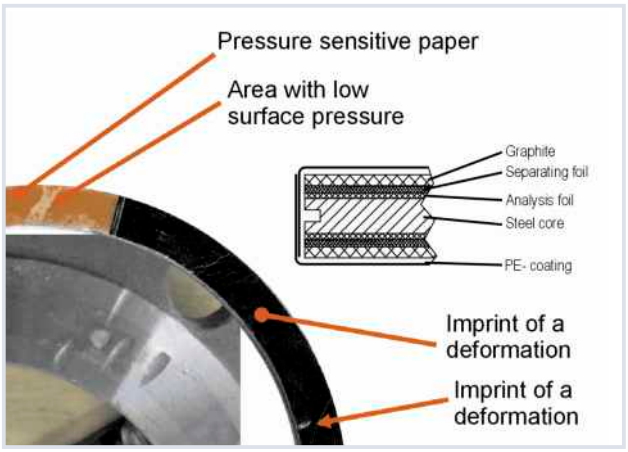
Innovation:

Tensioning of the tower segment with a Static Neutral Gasket (SNG).

- The connection is statically neutral, since the sealing element lies on the secondary force connection.
- In the secondary force connection the elastic sealing element, supported by a special design overcomes the unevennesses of the imperfect flanges.
- The connection has a very good long-term behaviour, since the sealing material is not subject to a contraction.

KEMANALYSIS

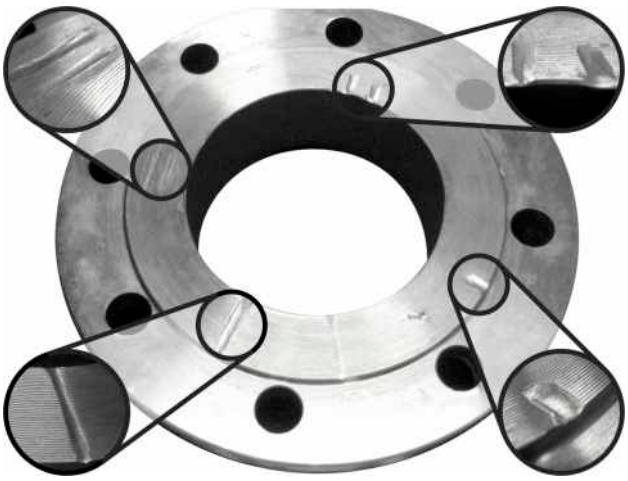
KemAnalysis is a process for the analysis of sealing surfaces and for the estimation of the partial surface pressure distribution.



In practice, flanges are found that demonstrate various faults in the contact surface to the gasket. Whether they constitute severe damage depends upon the impact on the locally present surface pressure.

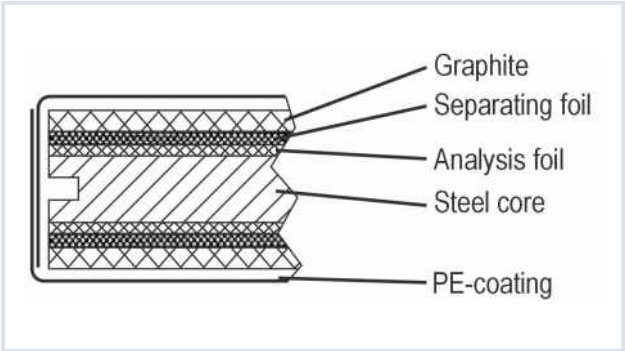
For instance, the following faults can be detected:

- Unevenness in the flange caused by corrosion (planar erosion and/or pitting corrosion)
- Scratches that run from the inside to the outside, e.g. caused by cleaning the flange using scrapers or brushes that are harder than the flange material.
- Depressions in the outer area of the sealing strip, caused by setting tools during the assembly or dismantling of the gasket.
- Partial indentation points in the centre of the sealing surfaces.
- and much more.



KemAnalysis facilitates an estimation of this situation. The connection between the deformation and applicable surface pressure is established by visualising the unevenness as a compression in the graphite layer and simultaneously illustrating the surface pressure by means of pressure-sensitive paper.

KemAnalysis is assembled in the same manner as a normal gasket. The special coating securely holds the measuring device together and protects the sensitive measurement paper against chemical attack. The analysis can then begin immediately. Either by means of a purely visual estimate or with the aid of a software-supported surface analysis.



Amongst other things, **KemAnalysis** supplies:

- An insight regarding the loss of screw force during assembly.
- Insights regarding the deformations of the flange caused by assembly.
- A estimate regarding the impact of unevenness in the sealing surface upon the sealing behaviour.
- A localisation of the position of faults/ damages.
- Insights for the determination of the necessary remedial actions.
- A knowledge basis for the determination of the best-possible sealing configuration.

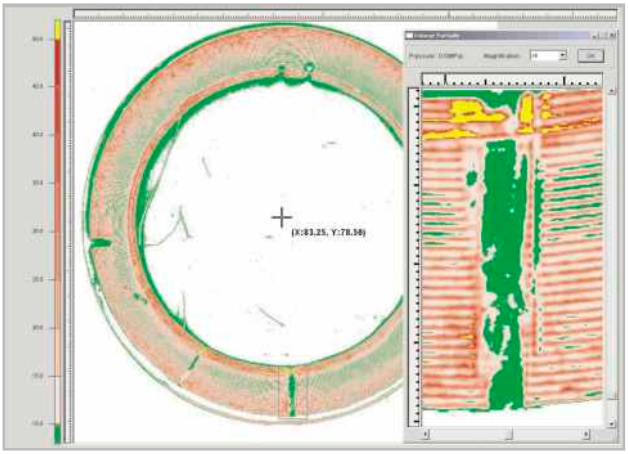
KEMANALYSIS

Thanks to the software-supported evaluation, it is possible to obtain greater insights regarding:

» Partial values in MPa regarding the present surface pressure

» Potential leakage channels

» Necessity of flange reworking



FIRE PROTECTION

In pipeline systems for transporting hazardous substances, considerable hazards can occur in the event of a malfunction.

In addition to complying with current guidelines such as TA-Luft, VDI guidelines, etc., we have not only dealt with the tightness of a flange connection in trouble-free operation, but have also included the case of fire in our considerations.

In relevant regulations in which ”Fire Safe“ requirements are addressed, reference is made to the BS 6755 or ISO 10497 standard and these requirements are also applied to flange connections.

These standards concern the testing of shut-off valves to maintain their tightness when exposed to a temperature of > 650 °C for a period of 30 minutes.

If the requirements are applied to bolted flange connections, the gasket in the braced flange connection must maintain its function under the influence of a flame wall at the specified temperature and for the specified time. The seal can only accomplish this if the flanges and bolts are able to maintain the required surface pressure on the seal during this time.

In order to prevent a corresponding, short-term chain reaction with fatal consequences in the event of a malfunction, we have further developed the following type of seal.

For example, gaskets with an outer ring can be provided with a coating consisting of an intumescent substance on the upper and lower sides.

At high temperatures above 300 °C, this inflates to an insulating carbon skeleton with 10 to 20 times its original volume. The space in front of the seal between the two flanges, i.e. also around the screws, is completely and safely protected against the effects of hot flame gases and radiation.

The reaction or intervention time in the event of a fault is up to 4 times faster than with conventional seals with FS approval. This leaves enough time to prevent a dangerous chain reaction in the case of smaller sources of fire.

ADVANTAGES

- Sealing element is protected against temperature rise in case of fire
- Time to critical accident temperature is increased up to 4 times
- Compound can be removed without residue
- Increased of plant safety
- Environmental protection

At YouTube – **Passive Fire Protection** – you can experience the reaction of FIRE PROTECTION in a simulated fire.

DIN/EN, ANSI/ASME, API AND WORKS STANDARDS (WN) USED

Standard	Type of gasket	Pressure levels	For flange type:	Page
ANSI/ASME B16.5	Flat gasket Form SR	Class 150 to Class 1500	ANSI/ASMEB16.5	38
	Flat gasket Form TG	Class 150 to Class 1500	ANSI/ASMEB16.5	41
	Rubber-steel gasket	Class 150 to Class 300	ANSI/ASMEB16.5	49
	Grooved gasket	Class 150 to Class 1500	ANSI/ASME B16.5 tongue/groove	92
	Grooved gasket	Class 150 to Class 1500	ANSI/ASME B16.5male/female	93
ASME B16.20	Spiral-wound gasket	Class 150 to Class 2500	ANSI/ASME B16.5	79
	Jacketed gasket	Class 150 to Class 2500	ANSI/ASME B16.5	99
	Spiral-wound gasket	Class 150 to Class 900	ANSI/ASME B16.47 Series A	81
	Jacketed gasket	Class 150 to Class 900	ANSI/ASME B16.47 Series A	100
	Spiral-wound gasket	Class 150 to Class 900	ANSI/ASME B16.47 Series B	80
	Jacketed gasket	Class 150 to Class 900	ANSI/ASME B16.47 Series B	99
ASME B16.21	Flat gasket Form FF	Class 150 to Class 300	ANSI/ASME B16.5	46
	Flat gasket Form IBC	Class 150 to Class 900	ANSI/ASME B16.5	35
	Flat gasket Form IBC	Class 150 to Class 600	ANSI/ASME B16.47 Series A	36
	Flat gasket Form IBC	Class 75 to Class 600	ANSI/ASME B16.47 Series B	36
ASME B16.20 **API Std 6A** **EN 12560-5**	Ring joint gasket, Type R		ASME B16.5, ASME B16.47 Series A	110
	Ring joint gasket Type RX		API 6B	111
	Ring joint gasket Type BX		API 6BX	112
DIN 2690	Flat gasket Form IBC	PN 1 to PN 40	DIN/EN	34
	Rubber-steel gasket	PN 6 to PN 40	DIN/EN	50
DIN 2691	Flat gasket Form TG	PN 10 to PN 160	DIN/EN	40
	Grooved gasket	PN 10 to PN 160	DIN/EN tongue/groove	92
DIN 2692	Flat gasket Form SR	PN 10 to PN 100	DIN/EN	38
	Grooved gasket	PN 10 to PN 100	DIN/EN male/female face	93
DIN 2695-2000	Membrane weld ring gasket	PN 63 to PN 400	DIN/EN	121
	Membrane weld ring gasket	Class 150 to Class 2500	ANSI/ASME B16.5	122
DIN 2695-2002	Weld ring gasket Profile A22 and A23	PN 10 to PN 400	DIN/EN	123
	Weld ring gasket Profile A22 and A23	Class 150 to Class 2500	ANSI/ASME B16.5	125
DIN 2696 **1999-08, Series 1**	Lens gaskets	PN 63 to PN 400	DIN/EN	114
DIN 2696 **1999-08, Series 2**	Lens gaskets	PN 63 to PN 320	DIN/EN	114
DIN 28040	Flat gasket		DIN 28031,28032,28034, 28036,28038	47
DIN 7603	Flat gasket Jacketed gasket Convex gasket		DIN 3850, DIN 908, DIN 7601	105
DIN 82331 Series 1	Flat gasket Form FF		DIN 82330	44
DIN 82331 Series 2	Flat gasket Form FF		DIN 82330	44
DIN 86071	Flat gasket Form FF	PN 6 to PN 25	DIN/EN	42
DIN 86072	Flat gasket Form FF		DIN/EN	45

DIN/EN, ANSI/ASME, API AND WORKS STANDARDS (WN) USED

Standard	Type of gasket	Pressure levels	For flange type:	Page
EN 12560-1	Flat gasket Form IBC	Class 150 to Class 900	ANSI/ASME B16.5	34
EN 12560-1	Flat gasket Form SR	Class 300 to Class 900	ANSI/ASME B16.5	37
EN 12560-1	Flat gasket Form TG	Class 300 to Class 900	ANSI/ASME B16.5	39
EN 12560-2	Spiral-wound gasket	Class 150 to Class 2500	ANSI/ASME B16.5	78
EN 12560-4	Corrugated gasket	Class 150 to Class 2500	ANSI/ASME B16.5	65
EN 12560-7	Jacketed gasket	Class 150 to Class 2500	ANSI/ASME B16.5	97
EN 1514-1	Flat gasket Form FF	PN 10 to PN 40	DIN/EN	43
EN 1514-1	Flat gasket Form SR	PN 10 to PN 40	DIN/EN	37
EN 1514-1	Flat gasket Form TG	PN 10 to PN 40	DIN/EN	39
EN 1514-1	Flat gasket Form IBC	PN 2,5 to PN 63	DIN/EN	33
EN 1514-2	Spiral-wound gasket	PN 10 to PN 160	DIN/EN	76
EN 1514-4	Corrugated gaskets	PN 10 to PN 100	DIN/EN	64
WN 100 / EN 12560-6	Grooved gasket	Class 150 to Class 2500	ANSI/ASME B16.5	90
WN 101	Grooved gasket	PN 10 to PN 400	DIN/EN	89
WN 104	Spiral-wound gasket	PN 10 to PN 400	DIN/EN	77
WN 107-1	Jacketed gasket	PN 10 to PN 100	DIN/BS 4504	96
WN 107-2	Jacketed gasket	Class 150 to Class 2500	ANSI/ASME B16.5	98
WN 107-3	Jacketed gasket	Class 150 to Class 2500	ANSI/ASME B16.5	98
WN 108	Lens gaskets	PN 63 to PN 400	DIN	115
WN 110	Weld ring gasket Profile A22 and A23	PN 10 to PN 400	DIN/EN	124
WN 111	Weld ring gasket Profile A22 and A23	Class 150 to Class 2500	ANSI/ASME B16.5	125
WN 126	Weld ring gasket Profile A24	PN 16 to PN 100	DIN/EN	122
WN 131	H-gasket	-	-	117
WN 133	Spacer ring	Class 150 to Class 1500	ANSI/ASME B16.5	41
WN 134	Weld ring gasket Profile A22N and A23N	PN 10 to PN 400	DIN/EN	127
WN 135	Weld ring gasket Profile A22N and A23N	Class 150 to Class 2500	ANSI/ASME B16.5	130
WN 136	Grooved gasket	Class 150 to Class 900	ANSI/ASME B16.47 Series A	91
WN 143	Weld ring gasket Profile A22 and A23	Class 150 to Class 900	ANSI/ASME B16.47 Series A	126
WN 145 DIN/EN 1514-6	Grooved gasket	PN 10 to PN 400	DIN/EN	86
WN 146	Grooved gasket	Class 150 to Class 2500	ANSI/ASME B16.5	87
WN 147	Grooved gasket	Class 150 to Class 900	ANSI/ASME B16.47 Series A	88
WN 157	Corrugated gasket	PN 1 to PN 400	DIN/EN	62
WN 158	Corrugated gasket	Class 150 to Class 2500	ANSI/ASME B16.5	63
WN 160	Double sealing system	PN 25 to PN 400	DIN/EN	138
WN 161	Double sealing system	Class 150 to Class 2500	ANSI/ASME B16.5	139

DIN/EN, ANSI/ASME, API AND WORKS STANDARDS (WN) USED

Standard	Type of gasket	Pressure levels	For flange type:	Page
WN 178	Rubber-steel gasket	PN 10 to PN 160	DIN/EN	55
WN 179	Rubber-steel gasket Profile WL	Class 150 to Class 2500	ANSI/ASME B16.5	55
WN 180	Rubber-steel gasket Profile WL	Class 150 to Class 900	ASME B16.47 Series A (previously MSS SP-44)	56
WN 181	Rubber-steel gasket Profile WL	Class 150 to Class 900	ASME B16.47 Series B (previously API 605)	56
WN 182	Rubber-steel gasket Profile WS	PN 10 to PN 25	DIN/EN	52
WN 183	Rubber-steel gasket Profile WS	Class 150 to Class 300	ANSI/ASME B16.5	52
WN 184	Rubber-steel gasket Profile WS	Class 150 to Class 300	ASME B16.47 Series A (previously MSS SP-44)	53
WN 185	Rubber-steel gasket Profile WS	Class 150 to Class 300	ASME B16.47 Series B (previously API 605)	53
WN 189	Corrugated gasket	Class 150 to Class 900	ANSI/ASME B16.5	69
WN 210	Corrugated gasket	PN 10 to PN 40	DIN/EN	68

MATERIALS COMMONLY USED

Metals

Steel/Iron

Material no. DIN EN 10 027-2	Materialcode designation DIN EN 10 027-1 (DIN 17 006)	Name trade name group	Material designation in accordance with AISI/ASTM/SAE	Hardness HB	R_m Tensile strength N/mm²	Elastic yield N/mm bzw. $R_{p0,2}$ 0,2-creep limit	Temperature range[1] °C from	to	specific weight g/cm³	Code . = grain l = notch
1.0038	S235JRG2	general mild steel	A 570 Gr. 36	130	340-470	215	-40	+450	7,85	
1.0330	DC01[FeP01]	general mild steel	A366	max. 120	270-410	140	-10	+450	7,75	
1.0330	DC01[FeP01]	Zinc-plated steel	A366	max. 120	270-410	140	-60	+500	7,75	
1.0425	P265GH	Pressure vessel steel	-	130-180	410-530	215	-60	+480	7,85	
1.0566	P355NL1	Fine grain mild steel	-	130-180	470-610	315	-110	+400	7,85	
-	Modified Stw24[5]	Soft iron	Soft-Iron	max. 90	170-400[6]	190[6]	-60	+450	7,85	
1.4016	X6CM7	Stainless steel	430	130-170	450-600	240	-20	+350	7,70	l
1.4404	X2CrNiMo17-12-2	Stainless steel	316L	120-170	520-670	220	-200	+550	7,95	
1.4541	X6CrNiTi18-10	Stainless steel	321	130-190	500-700	200	-270	+550[2]	7,90	. . . .
1.4571	X6CrNiMoTi17-12-2	Stainless steel	316Ti	130-190	520-670	220	-270	+550	7,98	III
1.4828	X15CrNiSi20-12	Heat-resistant steel	309	130-220	500-750	230	-110	+800[3]	7,90	. . . . .
1.4876	X10NiCrAlTi32-21	Heat-resistant steel Incoloy 800	B 408, B 409	130-220	500-750	210	-110	+850[4]	8,00	
1.5415	16Mo3	Heat-resistant Pressure vessel steel	A204 Gr. A/4017	140-170	440-590	260	-20	+530	7,85	.
1.7335	13CrMo4-5	Heat-resistant mild steel	F12	150-180	440-590	275	-60	+560	7,85	. .
1.7362	12CrMo19-5	Hydrogen resistant steel	F5	170-220	590-740	390	-40	+650	7,85	l
-	(12CrMo195)	modified	Similar F5	max. 130	590-740[6]	390[6]	-40	+650	7,85	
1.7380	10CrMo9-10	Heat-resistant mild steel	A182-F22	130-180	470-620	270	-40	+590	7,85	

Other metallic materials available on request.

09

Non-ferrous metals

Material no.	Material code designation	Name trade name	Material designation in accordance with AISI/ASTM/SAE	Hardness HB *HV	Tensile strength N/mm²	Elastic yield N/mm² bzw. 0,2-creep	Temperature range[1] °C from	to	Specific weight g/cm³	Code x= x-shaped
(2.0060)	E-Cu 57	Copper	-	35-70	200-250	90	-270	+350	8,93	
(2.0090)	SF-Cu	Copper	-	35-70	200-250	90	-270	+350	8,94	
(2.0321)	CuZn 37	Brass "Ms63"	-	60-100	290-370	140	-200	+300	8,44	
2.4068	Ni 99,0	Nickel 99,0	alloy 200	80-150	380-450	160	-60	+600	8,90	
2.4360	NiCu 30 Fe	Monel400 Niccorros, Silverin	B127, alloy 400	100-160	450-580	200	-60	+500	8,88	XX
2.4816	NiCr15Fe	Inconel 600	B 168	140-200	550-800	200	-60	+600	8,42	
ENAW-1050A	ENAW-AL99.5	Aluminium	-	20-45	65-150	50	-250	+300	2,70	
ENAW-5754	EN AW-AL Mg³	Alu-Leg. Serie 5000	-	52-87	190-290	80	-250	+300	2,70	
3.7025	Ti 99,8	Titan I	B 348 Gr. 1	110-160	290-410	180	-60	+300	4,50	
3.7035	T99.7	Titan II	B 348 Gr. 2	120-180	390-540	250	-60	+350	4,50	
-	Ag 99,97	Fine-grain silver	-	25-45*	150-250	25	-270	+750	10,50	
-	Ag 99,85 Ni 0,15	Fine-grain silver	-	45-65*	180-300	55	-270	+750	10,50	

[1] In assessing the temperature resistance, the action of the medium and the type of load stress is of determinative significance.

[2 - 4] Heat and/or scaling resistant: [2] to 850 °C; [3] to 1000 °C; [4] to 1150 °C.

[5] Modification of the material 1.0335 DD13 in accordance with DIN EN 10111; [6] Maximum value for the given hardness.

MATERIALS COMMONLY USED

Soft material

graphite sheets

Quality	chloride ppm	ash %	density g/cm³	temperature C°
Industrial quality C 99,0	≤ 25	≤ 1	1	-200 +550
Nuclear quality C 99,85	≤ 20	≤ 0,15	1	-200 +550

Rubber / plastic

Material no.	Material code designation	Name trade name	Maximum surface stress at room temperature N/mm²	Shore hardness A *D	Tensile strength N/mm²	Specific weight g/cm³	Temperature range[1] °C from to
501XX.X	NR	Natural rubber	5	40-90	>10	<1,2	-50 +80
502XX.X	NBR	PerbunanN®, BunaN®	5	40-90	>10	<1,2	-30 +100
502XX.X	NBR DVGW/KTW	PerbunanN®, BunaN®	5	80+5	>10	<1,2	-30 +100
502XX.X	HNBR	Therban®, Zetpol®	5	50-80	>10	<1,2	-30 +150
503XX.X	EPDM Peroxid	BunaAP®, Nordel®	5	40-90	>10	<1,1	-40 +130
503XX.X	EPDM Schwefel	BunaAP®, Nordel®	5	40-90	>10	<1,1	-40 +110
503XX.X	EPDM KTW	BunaAP®, Nordel®	5	70+5	>10	<1,2	-40 +110
504XX.X	CR	Baypren®, Neoprene®	5	40-90	>10	<1,2	-40 +100
505XX.X	CIIR	EssoChlorbutyl®	5	40-90	>10	<1,2	-40 +100
506XX.X	CSM	Hypalon®	5	45-90	>10	<1.2	-40 +120
507XX.X	FKM	Viton®, Fluorel®, Tecnoflon®	5	60-85	>10	<2,0	-20 +205
507XX.X	TFEP	Aflas®	5	60-90	>10	<1,5	-10 +205
508XX.X	VQM rot	Silopren®	5	40-80	>10	<1,4	-60 +200
509XX.X	ACM	Polyacrylic rubber, Vamac®	5	45-90	>10	<1,2	-25 +150
	PTFE	Teflon®, Hostafion®	not encasedt 8-10 encased 60	55-60*	20-28	2,14-2,19	-250 +260
	TFM1600			57-60*	30-32	2,14-2,19	-250 +260
TFM 4105 25% fibre glas				61-63*	15-17	2,22-2,25	-250 +260

Technical values for further compounds available on request.

1) In assessing the temperature resistance, the action of the medium and the type of load stress is of determinative significance.
® registered trademarks of the companies: Bayer = HNBR®; Therban®, Perbunan®; Baypren®; Silopren® • Dupont = Neoprene®; Nordel®; Hypalon®; Viton®; Vamac®; Teflon® • Exxon = EssoButyl® • Dyneon = Hostaflon® • Hüls = BunaN®; BunaAP® • Ausimont = Tecnoflon®; Algoflon® • Dyneon-Fluoroelastomer/ Aflas® • Nippon Zeon = Zetpol®

Miscellaneous

Name	Mica	Isolating felt	Cork	Fibre Abil	Merino wool felt	Laminated fabric	Cardboard paper	Vulcan fibre
Maximum temperature °C[1]	1000	-200 to +1000 max. 1200	60 max. 100	80	90	150	80	100

1) In assessing the temperature resistance, the action of the medium and the type of load stress is of determinative significance.

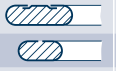
GASKET CHARACTERISTIC VALUES

Type	Profile	Cross-section	Material(s)	R_z* [µm]	R_a* [µinch]	k_0** [mm]	$k_0 \cdot K_D$** [N/mm]	K_1** [mm]	σ_V [N/mm²]	$\sigma_{3(RT)}$ [N/mm²]	E_G*** E_D	y**** [psi]	m [-]	Note
Soft material flat gaskets	A1		Fibre sheets 2 mm	100	800	–	$25 \cdot b_D$	$1{,}1 \cdot b_D$	25	80	500	3.000	2,50	
			Fibre sheets 1,5 mm			–	$30 \cdot b_D$	$1{,}2 \cdot b_D$	30	90	500	4.000	2,75	
			Fibre sheets 1,0 mm			–	$35 \cdot b_D$	$1{,}3 \cdot b_D$	35	100	500	6.500	3,00	
			PTFE 2 mm	100	800	–	$25 \cdot b_D$	$1{,}1 \cdot b_D$	25	60	600	3.500	2,50	
			Rubber 2 mm			–	$2 \cdot b_D$	$0{,}5 \cdot b_D$	2	15	200	300	1,00	
			Graphite with plain metal sheets	100	800	–	$10 \cdot b_D$	$1{,}1 \cdot b_D$	10	120	1	1.600	2,00	
			Graphite with tanged sheet metal (RS) 2 mm	100	800	–	$30 \cdot b_D$	$1{,}4 \cdot b_D$	30	130	1	4.500	3,00	
			Graphite with tanged sheet metal(RSP) 2 mm	100	800	–	$30 \cdot b_D$	$1{,}4 \cdot b_D$	30	130	-	4.500	3,00	
			Graphite with tanged sheet metal (RHD) 2 mm				$30 \cdot b_D$	$1{,}4 \cdot b_D$	30	130	-	4.500	3,00	
	F1		Fibre sheets 2 mm, with inner eyelet	100	800	–	$30 \cdot b_D$	$1{,}3 \cdot b_D$	30	80	-	4.000	2,75	
			Graphite with metal sheets and inner eyelet	100	800	–	$15 \cdot b_D$	$1{,}2 \cdot b_D$	15	120	1	2.200	2,25	
			Graphite with tanged sheet metal (RS) 2 mm and inner eyelet, 2 mm	100	800	–	$35 \cdot b_D$	$1{,}5 \cdot b_D$	35	130	8.000	5.000	3,25	
			Graphite with tanged sheet metal (RSP) 2 mm and inner eyelet, 2 mm	100	800	–	$35 \cdot b_D$	$1{,}5 \cdot b_D$	35	130	8.000	5.000	3,25	
			Graphite with tanged sheet metal (RHD) and inner eyelet, 2 mm	100	800	–	$35 \cdot b_D$	$1{,}5 \cdot b_D$	35	130	8.000	5.000	3,25	
Rubber-steel gaskets	WG		Rubber with encased steel insert	100	800	–	$2 \cdot b_D$	$0{,}5 \cdot b_D$	2	15	200	300	1,00	
	WG2		Rubber with encased steel insert	100	800	–	$2 \cdot b_D$	$0{,}5 \cdot b_D$	2	15	200	200	1,00	
	WG2P		Rubber with encased steel insert	100	800	–	$2 \cdot b_D$	$0{,}5 \cdot b_D$	2	15	200	200	1,00	
	WS		Rubber with steel insert	100	800	–	$2 \cdot b_D$	$0{,}5 \cdot b_D$	2	15	200	200	1,00	
	WL		Rubber with centring ring made from steel	100	800	–	$12 \cdot b_D$	$1{,}0 \cdot b_D$	12	250	200	1.700	2,00	
	WL-HT		Rubber with support ring made from steel	100	800	–	$12 \cdot b_D$	$1{,}0 \cdot b_D$	12	120	200	1.700	2,00	Lip in off load contact
	KNG		Rubber with centring ring made from steel	100	800	–	$12 \cdot b_D$	$1{,}0 \cdot b_D$	12	120	200	1.700	2,00	
Corrugated gaskets	W1		Aluminium	25	250	–	$45 \cdot b_D$	$1{,}4 \cdot b_D$	45	100	-	3.700	2,75	
			Copper / brass	12,5	100	–	$50 \cdot b_D$	$1{,}5 \cdot b_D$	50	150	-	4.500	3,00	
			Iron / carbon steel / nickel	6,3	50	–	$60 \cdot b_D$	$1{,}6 \cdot b_D$	60	180	-	5.500	3,25	
			Monel / steel 4 – 6% Cr	3,2	25	–	$70 \cdot b_D$	$1{,}7 \cdot b_D$	70	200	-	6.500	3,50	
			Stainless steel	3,2	25	–	$80 \cdot b_D$	$1{,}8 \cdot b_D$	80	200	-	7.600	3,75	
	W1A		Steel or stainless steel with layers of graphite or PTFE	100	800	–	$15 \cdot b_D$	$1{,}0 \cdot b_D$	15	180	16.000	2.800	2,25	
	W11A													
	W1A-3													
	W2A		Steel or stainless steel with layers of graphite or PTFE and stabilising metal ring											
	W12A													

This table relates to values that have been measured and / or have proven to provide secure static sealing connections through years of experience.

GASKET CHARACTERISTIC VALUES

Typ	Profile	Cross-section	Material(s)	R_z* [µm]	R_a* [µinch]	k_0** [mm]	$k_0 \cdot K_D$** [N/mm]	K_1** [mm]	σ_V [N/mm²]	$\sigma_{J\,(RT)}$ [N/mm²]	E_G*** E_D	y**** [psi]	m [-]	Note
Spiral-wound gaskets	SpV1		Carbon steel	25	250	–	$50 \cdot b_D$	$1{,}3 \cdot b_D$	50	300	8.000 from graphite 6.000 from PTFE	10.000	2,50	Filler: Graphite or PTFE
			Gas-proof carbon steel									20.000	6,00	
	SpV1J		Monel / stainless steel	12,5	100	–	$55 \cdot b_D$	$1{,}4 \cdot b_D$	55	300		10.000	2,50	
	SpV2J		Gas-proof stainless steel									20.000	6,00	
Grooved gaskets	B7A		Stainless steel with layers of graphite or unsintered PTFE	25	250	–	$15 \cdot b_D$	$1{,}0 \cdot b_D$	15	500	16.000	2.200	2,25	
	B9A													
	B15A		Stainless steel with layers of asbestos-free fibre sheeting			–	$40 \cdot b_D$	$1{,}2 \cdot b_D$	40	500	-	6.500	3,00	
	E7A													
	B27A		Stainless steel with layers of aluminium	12,5	100	–	$70 \cdot b_D$	$1{,}2 \cdot b_D$	70	500	-	8.800	4,00	
	B29A													
	B25A		Stainless steel with layers of silver			–	$100 \cdot b_D$	$1{,}3 \cdot b_D$	100	500	20.000	10.000	4,25	
	E27A													

Typ	Profile	Cross-section	Material(s)	R_z* [µm]	R_a* [µinch]	k_0** [mm]	$k_0 \cdot K_D$** [N/mm]	K_1** [mm]	σ_V [N/mm²]	$\sigma_{J\,(RT)}$ [N/mm²]	E_G*** E_D	y**** [psi]	m [-]	Note
Metal jacketed gaskets	FW3		Aluminium	25	250	–	$45 \cdot b_D$	$1{,}4 \cdot b_D$	45	100	500	3.700	2,75	Graphite insert
			Copper / brass	12,5	100	–	$50 \cdot b_D$	$1{,}5 \cdot b_D$	50	150	600	4.500	3,00	
			Carbon steel / nickel	6,3	50	–	$60 \cdot b_D$	$1{,}6 \cdot b_D$	60	180	800	5.500	3,25	
			Monel / steel 4 - 6% Cr	3,2	25	–	$70 \cdot b_D$	$1{,}7 \cdot b_D$	70	200	800	6.500	3,50	
			Stainless steel			–	$80 \cdot b_D$	$1{,}8 \cdot b_D$	80	200	800	7.600	3,75	
	F3		Aluminium	25	250	–	$50 \cdot b_D$	$1{,}4 \cdot b_D$	50	135	500	5.500	3,25	Insert graphite or compressed mineral fibre sheets
	F4		Copper / brass	12,5	100	–	$60 \cdot b_D$	$1{,}6 \cdot b_D$	60	150	600	6.500	3,50	
	F8		Carbon steel / nickel	6,3	50	–	$80 \cdot b_D$	$1{,}8 \cdot b_D$	80	180	800	7.600	3,75	
	F12		Monel / steel 4 - 6% Cr	3,2	25	–	$90 \cdot b_D$	$1{,}8 \cdot b_D$	90	200	800	8.000	3,75	
	F17		Stainless steel			–	$100 \cdot b_D$	$2{,}0 \cdot b_D$	100	250	800	9.000	3,75	
PTFE-enveloped gaskets	PF18		Soft material insert	100	800	–	$25 \cdot b_D$	$1{,}0 \cdot b_D$	25	60	-	3.500	2,50	Insert graphite or fibre sheet
	PF21													
	PF3													
	PW21		Corrugated ring insert or insert: Corrugated ring with soft-material layers	50	500	–	$25 \cdot b_D$	$1{,}1 \cdot b_D$	25	80	-			Soft material layers of graphite or fibre sheet
	PW5													
	PF27		Grooved metal insert	25	250	–	$25 \cdot b_D$	$1{,}2 \cdot b_D$	25	500	-			Metallic core: Stainless steel

This table relates to values that have been measured and / or have proven to provide secure static sealing connections through years of experience.

* maximum roughness of the flange sealing surfaces.

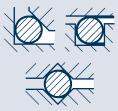
** **k_0-K_D- and k_1**-values applicable according to AD B7 Table 1 for gases and vapours. For fluids the values are 4 ... 5 times smaller.

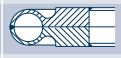
*** **E_G** = The values in accordance with EN 13555 depend on the surface pressure and temperature.
For values see www.klinger-kempchen.de -> Technical Service -> Gasket characteristic values.

E_D = The values in accordance with DIN 28090-1 depend on the surface pressure and temperature.
For values see www.klinger-kempchen.de -> Certificates/Permits -> KSD data sheets. The values in the table are guidelines only.

**** **y** = The y-values currently applicable are defined by $Q_{min(L0,01)}$ (EN 13555) and may differ from values previously used.

GASKET CHARACTERISTIC VALUES

Typ	Profile	Cross-section	Material(s)	R_z* [µm]	R_a* [µinch]	k_0** [mm]	$k_0 \cdot K_D$** [N/mm]	K_1** [mm]	σ_V [N/mm²]	$\sigma_{J\,(RT)}$ [N/mm²]	E_G*** E_D	y**** [psi]	m [-]	Note
Metal flat gaskets	A1		aluminium	12,5	100	b_D	–	b_D + 5	70	140	70.000	8.800	4,00	
			silver	12,5	100				100	190	-	11.500	4,50	
			Copper or brass	6,3	50				135	300	115.000	13.000	4,75	
			Nickel	3,2	25				190	510	-	15.500	5,00	
			Iron or carbon steel	3,2	25				265	525	210.000	18.000	5,50	
			Monel / steel 4 – 6% Cr	1,6	10				300	660	210.000	21.800	6,00	
			Stainless steel	1,6	10				335	750	200.000	26.000	6,00	
Spring gaskets	A10		aluminium	6,3	50	2,0	–	6,0	70	140	-	8.800	4,00	
			Copper or brass	3,2	25				135	300	-	13.000	4,75	
			Iron or carbon steel	1,6	10				265	525	-	18.000	5,50	
Ring joint gaskets	A11		Iron or carbon steel	3,2	25	2,0	–	6,0	265	525	-	18.000	5,50	
	A12		Monel / steel 4 – 6% Cr	1,6	10				300	660	-	21.800	6,0	
	A13													
	A14		Stainless steel	1,6	10				335	750	-	26.000	6,5	

Typ	Profile	Cross-section	Material(s)	R_z* [µm]	R_a* [µinch]	k_0** [mm]	$k_0 \cdot K_D$** [N/mm]	K_1** [mm]	σ_V [N/mm²]	$\sigma_{J\,(RT)}$ [N/mm²]	E_G*** E_D	y**** [psi]	m [-]	Note
Welded ring gaskets	A21		Metal	50	500	0	–	0	0	See metal flat gaskets	-	0	0	
	A22													
	A23													
	A24													
	A24K		Metal, one half grooved, with layer	50	500	See grooved gaskets for values (profiled gaskets								
	A24N		Metal, spiral-wound gasket			See spiral-wound gaskets for values								

This table relates to values that have been measured and / or have proven to provide secure static sealing connections through years of experience.

* maximum roughness of the flange sealing surfaces.

** **k_0-K_D- and k_1**-values applicable according to AD B7 Table 1 for gases and vapours. For fluids the values are 4 ... 5 times smaller.

*** **E_G** = The values in accordance with EN 13555 depend on the surface pressure and temperature.
For values see www.klinger-kempchen.de -> Technical Service -> Gasket characteristic values.

E_D = The values in accordance with DIN 28090-1 depend on the surface pressure and temperature.
For values see www.klinger-kempchen.de -> Certificates/Permits -> KSD data sheets. The values in the table are guidelines only.

**** **y** = The y-values currently applicable are defined by $Q_{min(L0,01)}$ (EN 13555) and may differ from values previously used.

INSTALLATION INSTRUCTIONS FOR FLAT GASKETS

Optimal installation with maximum security.

A guide to successfully installing flat gaskets

» The successful sealing of a flange connection depends on the combination of all individual components into a well designed flange system.

» This document is a guide for maintenance personnel, engineers and pipe fitters, to successfully using flat gaskets and safely fitting a bolted flange connection.

» The guide is an addition to other installation regulations relating to specific plants.

Tools required:

Certain specific tools are required to clean and bolt the connecting elements. In addition, the usual safety equipment and safety standards should be applied.

As well as your own personal protective equipment, ensure that the following equipment is available before installation.

» Calibrated torque wrench

» Wire brush (preferable from brass)

» Lubricant

» Other plant-specific equipment

Cleaning

Remove all dirt from:

» sealing surfaces

» screws or bolts*

» nuts*

» washers*

Take note of specific regulations on dust control

* if reuse is permitted

Check

» Check screws and bolts, nuts and washers for tears or burrs

» Check the flange surface for distortion, radial scratches, tool marks or other damage which could adversely affect safety.

» Replace components if damaged

Aligning the flanges

» Align the flange surfaces and the bolt holes without excessive force

» Correct every critical alignment of the flanges

Installing flat gaskets

» Check that the measurements and material of the gasket conforms to the specification

» Check the gasket to ensure that it is not damaged in any way

» Slide the gasket carefully into the gap between the flanges without damaging them

» Ensure that the gasket is centred between the flanges

» Do not use anti-adhesive materials. If there are any problems with fixed flanges, consult the manufacturer of the gasket

» Tightening the flanges, but ensure that the gasket is not squeezed or damaged

INSTALLATION INSTRUCTIONS FOR FLAT GASKETS

Installation and tightening of bolts

» Only use suitable tools: calibrated torque keys or other tools for controlled tightening

» Consult the gasket manufacturer and/or the technical department of your company in relation to the recommended torque specification

» Always tighten the bolts by the cross

Installation and fastening of the screws

» Use only suitable tools: Calibrated torque wrenches or other tools for controlled tightening.

» Ask the seal manufacturer and/or your company's technical department for advice about the correct torque specification.

» Always tighten the screws crosswise.

Always tighten the bolts in several passes

Pass 1

» Tighten all bolts by hand (larger bolts may require a small hand key)

Pass 2

» Pull each bolt with approximately 30% of the full torque

Pass 3

» Pull each bolt with approximately 60% of the full torque

Pass 4

» Tighten each bolt with full torque, always crosswise (larger diameters may require additional passes)

Pass 5

» Tighten each bolt at least once with full torque clockwise in one pass, (larger diameters may require additional passes)

Retightening

» Warning: Consult the gasket manufacturer and/or the technical department of your company in relation to the recommended retightening

» Never retighten elastomer bonded, asbestosfree gaskets after these have been exposed to high temperatures

» Each retightening may only be carried out at atmospheric temperature and pressure

Other details on installing flat gaskets can be found in the ESA/FSA guide for a secure seal connection on flanges.

You can obtain these from the FSA* and the ESA** in several languages.

* Fluid Sealing Association

** European Sealing Association

Our service:

Assembly as a training certified expert in accordance with DIN EN 1591-4

We will train your employees pursuant to DIN EN 1591 as specialists in the installation of sealing connections in flanges to the standards required by Directive 97/23 EC on pressure equipment and DIN EN 1591-4.

With the coming into force of the fourth part of DIN EN 1591, operators will now have one harmonised standard to apply to the training of assembly fitters. It is possible to select assembly operators according to the individual area of expertise required. Flange gaskets that are subject to Directive 97/23 EC will in the future be expertly fitted by competent staff.

INSTALLATION INSTRUCTIONS FOR PACKING RINGS

For highly-qualitative, permanently tight gland seals the following listed packing systems on the base of graphite have proven to be perfectly reliable. In order that the excellent properties act appropriately some basic things have to be considered when making the choice and during the assembling. This applies especially when next to the tightness, the amount of friction must be reduced, to ensure the proper operation of control valves.

1. Approved packing systems with five packing rings for example

K80S . K80TA . K80TA . K80TA . K80S
K80S . K80C . K80C . K80C . K80S
K80S . K80 . K80 . K80 . K80S
K100 . K95 . K95 . K95 . K100

2. Specifics when compressing gland packings

Gland lid studs in contrast to gland box screwcaps generally allow a much better and precise adjustment of the applied screw forces with the use of a torque spanner. In some cases, due to constructional difficulties, the controlled tightening is only possible when using special spanners which leads to inaccurate result. The instructions given under point 5 account for this.

3. Preparation of the gland room

The gland room must be free from old packings or remains of packings.

The dimensional accuracy of the packing space as well as the execution with the required surface finish have to be checked. The same applies for the state of the shaft or pole.

The tolerance range h9 applies for the stem or shaft. The surface roughness should be Rz 3,2 µm. For the gland room the tolerance range D10 applies. The surface roughness should be Rz 6,3 µm.

The packing or the gland room should generally not be greased, lubricated or dampened at any time.

The threads and the contact surface of the nuts have to greased well in order to ensure a low friction coefficient. This has to be done especially thouroughly with fittings which have be in use for a longer time.

4. The correct amount of the gland lid force

The correct, ideal amount of the gland lid force is the result of a compromise. On the one hand the force should be high on the other hand the stem should be easily movable which is only possible by means of finite rifts. Please ask at the KLINGER-Kempchen-calculation service for a calculation of the correct gland lid force under consideration of the pressure temperature, material properties of the applied packing as well as the geometry. The amount of the screw force is determined by the number of screws and the required tightening torque is determined by the screw size and the state of greasing.

INSTALLATION INSTRUCTIONS FOR PACKING RINGS

5. Assembling of the packing system

It is recommended to insert each ring of the packing system individually and brace individually with the recommended pressure. If this is not possible, because a torque spanner can not be used, a proximity should be tried by estimating the lever arm and the hand force.

If suitable spacer rings are missing or the existing gland lid screws are not long enough, two packing rings can be uptightened. Generally applies:

» The higher the application of force, the quicker and more ideal the shaping of the packing ring in the gland room is reached.

» After each tightening process a few minutes have to pass, so that the packing rings have some time to adopt themselves to the stem or shaft and the gland room.

» After completion of the assembling process the packing system has to be partly relieved from the gland lid force. The stem or shaft has to be operated/moved several times in order to reach a better stress distribution in the whole packing system, even if this requires higher forces than needed for operation. After that you have to brace with the correct calculated force.

» If after the completed assembling the stem friction is too high – or at control valves the hysterisis value is inappropriate- the force has to be firstly reduced by loosening the gland lid screws and then again braced on a lower level.

» This process has to be repeated until a satisfying hysterisis value is reached. In order to reach an optimal tightness, the maximum permissible hysterisis value has to be the target.

» In order to reach a good tightness even with a low hysterisis value, after each bracing correction at the gland lid screws the stem has to be moved over the whole stroke length. This improves the friction values and the tightness.

The application of the correct screw force requires a cautious proceeding and should not be done under time pressure. As mentioned above, packing system of expanded graphite needs some time to adopt itself to the gland room and stem / shaft after each change of tension.

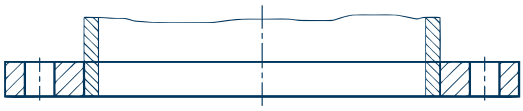
Security advice

The bracing of the packing has to be done on a pressureless plant at room temperature. A retigthening under pressure and temperature load is to be avoided.

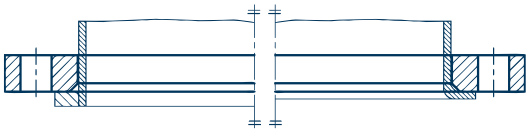
FLANGE AND DIN CLASSIFICATION

Types of flanges and collars

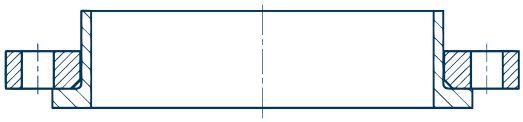
Types of flanges



Typ 01
Plate flange for welding



Typ 02
Loose plate flange with weld-on collar type 32 or lapped pipe end type 33

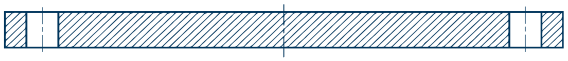


Typ 02
Loose plate flange with weld ring neck collar

Typ 02
Loose plate flange with pressed collar with long neck type 36

Typ 02
Loose plate flange with pressed collar type 37

Typ 04
Loose plate flange with weld-neck collar type 34

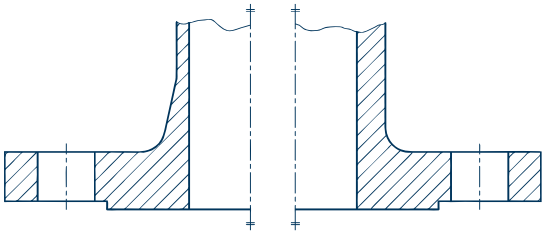


Typ 05
Bind flange

Typ 11
Weld-neck flange

Typ 12
Hubbed slip-on flange for welding

Typ 13
Hubbed threaded flange



Typ 21
Integral flange

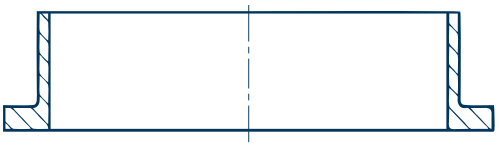
NOTE These sketches are diagrammatic only, in particular no detail is shown for the mating surfaces

FLANGE AND DIN CLASSIFICATION

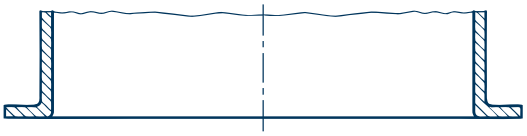
Types of collars 32 to 37

Types of flanges

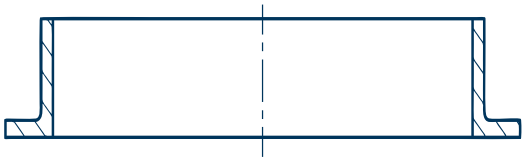
Typ 32
weld-on collar



Typ 35
weld ring neck collar



Typ 33
lapped pipe end



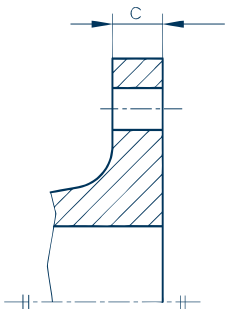
Typ 36
pressed collar with long neck

Typ 34
weld-neck collar

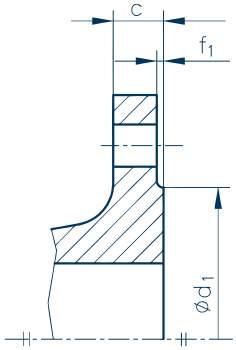
Typ 37
pressed collar

NOTE These sketches are diagrammatic only, in particular no detail is shown for the mating surfaces

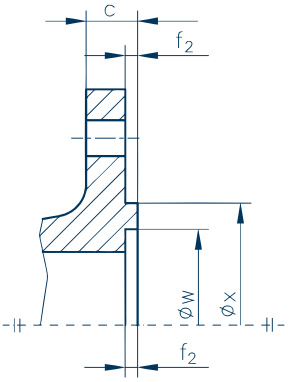
FLANGE FACINGS



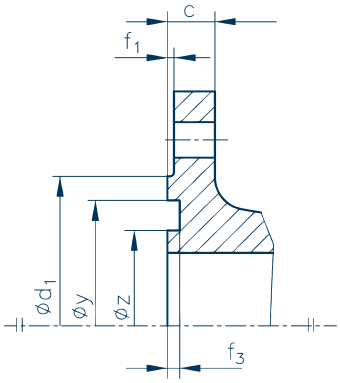
Form/Type A
Flat face



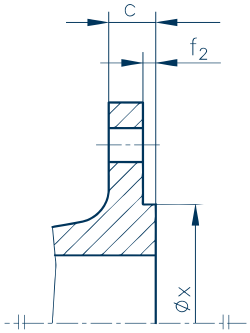
Form/Type B
Raised face (B1 and B2)*



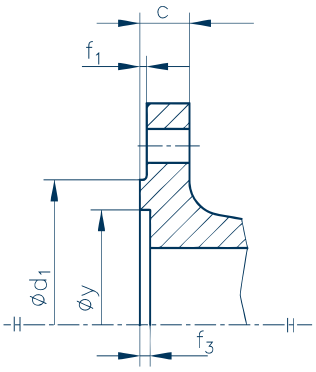
Form/Type C
Tongue



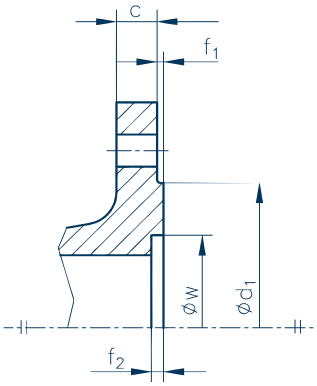
Form/Type D
Groove



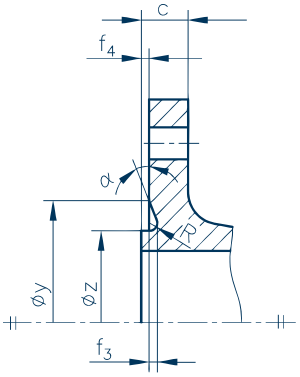
Form/Type E
Spigot (male Face)



Form/Type F
Recess (female Face)



Form/Type G
O-ring spigot



Form/Type H
O-ring groove

* B1 and B2 are raised face type B for different applications.

If not otherwise agreed between the purchaser and the supplier type 01 and type 05 up to PN 40 and collars (except types 33, 36 and 37) shall have type A facing, other flanges shall have standard facing type B1 for all PN numbers.

For facings types B, D, F and G, the transition from the edge of the raised face to the flange shall be a radius, or a chamfer at the choice of the flange manufacturer.

All flange and collar jointing faces, except types 33, 36 and 37, shall be machine finished and shall have a surface finish in accordance with the values given in Table 2 when compared with reference specimens by visual or tactile means.

It is not intended that instrument measurements be taken on the faces themselves; the Ra and Rz values as defined in EN ISO 4287 relate to the reference specimens.

NOTE: For certain applications, e.g. low temperature gases, it may be necessary to stipulate closer control to the surface finish.

For flanges and collars (except types 33, 36 and 37) with facing types A, B1, E and F, turning shall be carried out with a round nosed tool in accordance with following table.

FACING TYPES

Facing types	Method of machining	Radius of round nosed tool [mm] min.	R_a [a] [µm] min.	R_a [a] [µm] max.	R_z [a] [µm] min.	R_z [a] [µm] max.
A, B1[b], E, F	Turning [c]	1,0	3,2	12,5	12,5	50
B2[b], C, D, G, H	Turning [c]	—	0,8	3,2	3,2	12,5

[a] Ra and Rz are defined in EN ISO 4287

[b] Types B1 and B2 are raised face (type B) flanges with different specified surface roughness values.

B1: Standard facing for all PN numbers.

B2: Only if agreed between the purchaser and the flange manufacturer.

[c] The term 'turning' includes any method of machine operation producing either serrated concentric or serrated spiral grooves.

Comparison of Designations DIN - EN

Denotation	Type										
previous DIN	A	B	C	D	E	F	N	V 13	R 13	R 14	V 14
DIN EN 1092-1	**A**		**B1**		**B2**	**C**	**D**	**E**	**F**	**G**	**H**

Face Dimensions

(For Face Dimensions type B (B1 and B2) see Tables for Flanges Type 11)

DN	f_1		f_2		f_3		f_4		w		x		y		z		α	R
10	2	0 -1	4,0	+0,5 0	4,0	*	2,0	+0,5 0	24	+0,5 0	34	-0,5	35	+0,5 0	23	0 -0,5	—	
15									29		39		40		28			
20									36		50		51		35		41°	2,5
25									43		57		58		42			
32									51		65		66		50			
40	3	0 -2,0							61		75		76		60			
50									73		87		88		72			
65									95		109		110		94			
80									106		120		121		105			
100			5,0		4,5		2,5		129		149		150		128		32°	3
125									155		175		176		154			
150									183		203		204		182			
200									239		259		260		238			
250									292		312		313		291			
300	4	0 -3							343		363		364		342			
350									395		421		422		394			
400									447		473		474		446			
450									497		523		524		496			
500			5,5		5,0		3,0		549		575		576		548		27°	3,5
600	5	0 -4							649		675		676		648			
700									751		777		778		750			
800									856		882		883		855			
900									961		987		988		960			
1000			6,5		6,0		4,0		1062		1092		1094		1060		28°	4
1200									1262		1292		1294		1260			
1400									1462		1492		1494		1460			
1600									1662		1692		1694		1660			
1800									1862		1892		1894		1860			
2000									2062		2092		2094		2060			
>2000			—		—		—		—		—		—		—		—	—

* Tolerance f3 Types D and F: +0,5 / 0 | Type H: +0,2 / 0

Flange facing types C, D, E, F, G and H according to Figure 4 are not used for PN 2,5 and 6.

Flange facing types G and H according to Figure 4 are only used for PN 10 to PN 40.

The flanges can also be provided with reduced raised face diameter d4 for diaphragm-weld packing or with facing for lense shaped gaskets according to DIN 2696.

STANDARDS IN PIPELINE CONSTRUCTION

Standards in Pipeline Construction Standard	Norm
Directives, Laws, Regulations	
Directives for pressure equipment	DGRL 97/23/EG | RL2014/68/EU
Pressure Equipment Regulation (14th change to the ProdSG)	Druckgeräte V
Technical Basics	
Graphic symbols for technical drawings, pipelines	
General	DIN 2429-1
Functional diagram	DIN 2429-2
Manual for the procurement of equipment for power plants, pipelines and fittings	
High pressure pipelines	DIN EN 45510-7-1
Boiler and pipeline armatures	DIN EN 45510-7-2
Pipeline components, definitions and selection of DN (nominal width)	DIN EN ISO 6708
Fluid technology, nominal pressures	ISO 2944
Designation of pipelines by transported substance	DIN 2403
Metallic Industrial Pipelines	
General	DIN EN 13480-1
Materials	DIN EN 13480-2
Computation and construction	DIN EN 13480-3
Assembly and relocation	DIN EN 13480-4
Testing and inspection	DIN EN 13480-5
Additional testing on underground pipelines	DIN EN 13480-6
Instructions for use of the conformity assessment process	DIN EN 13480-7
Additional requirements for pipelines of aluminum and aluminum alloys	DIN EN 13480-8
Technical Basic Standards	
Explanation of terms for introduction of steel DIN EN 10020	
Designation system for steels Symbols	DIN EN 10027-1
Designation system for steels Numerical system	DIN EN 10027-2
Designation system for steels, additional symbols	CR 10260
Dimensions and longitudinally related mass for seamless and welded steel pipes	DIN EN 10220
Iron and steel materials, types of testing certifications	DIN EN 10204
Publicly Available Specifications	
Classes of pipe for processed equipment	
Basic principles for the development of pipe classes on the basis of EN 13480	PAS 1057-1
Pipe fittings - special designs	PAS 1057-5
Technical delivery conditions for pipe components made from alloyed and unalloyed steels with fixed properties at high temperatures, group 1.1 and 1.2 (CR ISO 15608)	PAS 1057-10
Technical delivery conditions for pipe components made from austenitic stainless steels, group 8.1 (CD ISO 15608)	PAS 1057-11
Standard pipe classes PN 10 to PN 100 pipe components made from unalloyed and alloyed steels with fixed properties at high temperatures group 1.1 and 1.2 and austenitic stainless steels, group 8.1 (CR ISO 15608)	PAS 1057-100
Seamless compressive stressed Pipes	
Made from unalloyed steels with fixed properties at room temperature	DIN EN 10216-1
Made from unalloyed and alloyed steels with fixed properties at elevated temperatures	DIN EN 10216-2
Made from alloyed fine grain steels	DIN EN 10216-3
Made from unalloyed and alloyed steels with fixed properties at low temperatures	DIN EN 10216-4
Made from stainless steels	DIN EN 10216-5
Welded compressive stressed Pipes	
Made from unalloyed steels with fixed properties at room temperature	DIN EN 10217-1
Made from electrically welded unalloyed and alloyed steels with fixed properties at elevated temperatures	DIN EN 10217-2
Made from fine-grained steels	DIN EN 10217-3
Made from electrically welded unalloyed and alloyed steels with fixed properties at low temperatures	DIN EN 10217-4
UP-welded pipes made from unalloyed steels with fixed properties at elevated temperatures	DIN EN 10217-5
UP-welded pipes made from unalloyed steels with fixed properties at low temperatures	DIN EN 10217-6
Made from stainless steels	DIN EN 10217-7

STANDARDS IN PIPELINE CONSTRUCTION

Standards in Pipeline Construction Standard	Norm
Sheet Material and Forgings	
Forgings made of steel for pressure vessels (general requirements, ferritic and martensitic steels, nickel steels, fine grain steels, martenistic, austenitic compound steels)	**DIN EN 10222-1 to-5**
Flat products made from pressure vessel steel	**DIN EN 10028-1 to-6**
Pipes for Gas and Flammable Liquids	
Petroleum and natural gas industries - Steel pipes for pipeline transportation systems	**DIN EN ISO 3183**
Pipes for flammable mediums - requirement class C	**DIN EN 10208-3**
Pipe Accessories	
Steel fittings with threading	**DIN EN 10241**
Malleable iron fittings	**DIN EN 10242**
Pipe fittings for welding made from unalloyed and alloyed C-Steels for interior pressure load	**DIN EN 10253-2**
Pipe fittings for welding made from stainless steels for interior pressure load	**DIN EN 10253-4**
Pipework - Corrugated metal hoses and hose assemblies	**DIN EN ISO 10380**
Corrugated metal hose assemblies for pressure applications	**DIN EN 14585**
Compensators with metallic bellows for pressure application	**DIN EN 14917**
Manual for the Ordering and Production of Pressure Equipment per the DGRL	
General requirements	**PAS 1010-1**
Unlighted vessels	**PAS 1010-2**
Industrial pipelines	**PAS 1010-3**
Pressurizing equipment parts	**PAS 1010-4**
Equipment parts with a safety function	**PAS 1010-5**
Components	**PAS 1010-6**
Flanges and their Joints	
Round flanges per PN	
Made from steel	**DIN EN 1092-1**
Made from cast iron	**DIN EN 1092-2**
Made from copper alloys	**DIN EN 1092-3**
Made from aluminum alloys	**DIN EN 1092-4**
Gaskets for flanges with PN-Designations	
Flat gaskets made from non-metallic material with and without inserts	**DIN EN 1514-1**
Spiral-wound gaskets for steel flanges	**DIN EN 1514-2**
Non-metallic soft-material gaskets with PTFE envelope	**DIN EN 1514-3**
Made from metal with corrugated, flat or crenated profile for steel flanges	**DIN EN 1514-4**
Grooved gaskets for steel flanges	**DIN EN 1514-6**
Metal-jacketed gaskets with layers for steel flanges	**DIN EN 1514-7**
O-ring seals	**DIN EN 1514-8**
Bolts and nuts	
Selection of bolts and nuts	**DIN EN 1515-1**
Classification of bolt materials, by PN, for steel flanges	**DIN EN 1515-2**
Classification of bolt materials, by class	**DIN EN 1515-3**
Selection for use within the DGRL for steel flanges	**DIN EN 1515-4**
Rules for the construction of flange joints with round flanges and gaskets	
Methods of computation	**DIN EN 1591-1**
Background information	**DIN EN 1591-1 Beibl. 1**
Gasket characteristic values	**DIN EN 1591-2**
Methods of computation for off-load	**DIN CEN/TS 1591-3**
Qualification of personnel in the assembly of screw joints in the DGRL	**DIN EN 1591-4**
Calculation method for full face gasketed joints	**DIN CEN/TS 1591-5**
Round flanges for pipes, fittings, pipe fittings and accessory parts, identified by class	
Steel flanges, NPS ½ up to 24	**DIN EN 1759-1**
Flanges made from copper alloys	**DIN EN 1759-3**
Flanges made from aluminum alloys	**DIN EN 1759-4**
Gaskets for flanges with class designation	
Flat gaskets made from non-metallic materials with and without inserts	**DIN EN 12560-1**
Spiral-wound gaskets for steel flanges	**DIN EN 12560-2**
Non-metallic soft-material gaskets with PTFE envelope	**DIN EN 12560-3**
Made from corrugated, flat or crenated profile for steel flanges	**DIN EN 12560-4**
RTJ gaskets made from metal for steel flanges	**DIN EN 12560-5**
Grooved gaskets for steel flanges	**DIN EN 12560-6**
Metal jacketed gaskets with layers for steel flanges	**DIN EN 12560-7**
Gasket parameters and test procedures relevant to the design rules for gasketed circular flange connections	**DIN EN 13555**
Quality assurance testing and testing of gaskets according to the standards of series EN 1514 and 12560	**DIN EN 14772**

HIGH-QUALITY SEALS IN TERMS OF TA-LUFT

The current version of the Technical Instructions for Air Quality Control (TA-Luft) dates back to 2002 and should actually be published as a new version in 2017. Currently there is a draft bill from April 2017, which shows a lot about the expected new version.

On the one hand, it is to be expected that TA-Luft will have to be applied to many more plants in the future than has been the case up to now. In some cases, the reference to VDI guideline 2440 for test specifications is omitted. Instead, corresponding specifications are now included directly in the TA-Luft.

In the following, only passages in connection with flange connections with flat gaskets are considered.

First of all, it should be made clear that a seal alone cannot be of high quality. Even if many people – including experts – previously considered a so-called TA-Luft certificate to be sufficient, which certifies the high quality of a gasket based on an initial component test in accordance with TA-Luft. The component test can only prove that the seal meets certain requirements under laboratory conditions and thus has the potential to contribute to the high quality of a seal joint. However, this test can only be used to make a preselection of seals. Overall, high quality is only achieved when the flanges, bolts and gasket interact properly and ensure the required tightness under all operating conditions. It can be expected, however, that with certain seals the proof of high quality is easier to fulfil than with others. Whether the high quality is really achieved, however, also depends on the circumstances that prevail during assembly and later in operation.

In Chapter 5.2.6.3, Flange connections of TA-Luft, it will be stated literally: “Flanged joints should normally only be used if they are necessary for process engineering, safety engineering or maintenance. In this case, technically tight flange connections must be used. For the selection of the seals and the design of technically tight flange connections, seal class L0.01 with the corresponding specific leakage rate $\leq$ 0.01mg/(s-m) must be used for the test medium Helium.”

New in TA-Luft is a reference to VDI Guideline 2290, which must be observed for the first time. This stipulates that tightness verification according to the calculation regulations DIN EN 1591-1 with characteristic values according to DIN EN 13555 must be provided. In addition, the suitability of the seal (tightness) must be proven, as before, by means of a component test in accordance with VDI Guideline 2200. Only flange connections with welded seals are considered technically tight for design reasons. Calculations according to other, up to now still customary regulations, as for instance the AD-Merkblatt 2000, are no longer permissible, because with these proof of tightness cannot be furnished.

At the same time, however, this statement means that metal seals, such as ring joint seals and other purely metallic seals, which were previously considered technically tight, are no longer automatically considered technically tight. For these, characteristic values must then be determined in accordance with DIN EN 13555 so that corresponding sealing connections can be calculated in accordance with DIN EN 1591-1.

This finally stipulates that the calculated proof of tightness and strength is mandatory for proof of high quality. The result of the component test merely restricts the selection of the gaskets in question and proves that the gasket can be of high quality. Whether this is really the case depends on the calculation and – of course – on the installation.

It should also be noted that DIN EN 1591-1 bears the title: "Flanges and their connections – rules for the design of flange connections with round flanges and gaskets". This means that a different procedure must be followed for sealed connections with flanges which are not round or which for other reasons do not fall under this designation. In future, the tightness must be proven with a component test. How this is to be done has so far been left completely open. It merely means that the test is to be oriented as far as possible to the component test according to VDI 2200 (June 2007 edition). This formulation offers a wide scope for interpretation.

While the seal manufacturers were usually held responsible for the determination of characteristic values according to DIN EN 13555 and for the standard proof of high quality in component tests, the operators or manufacturers themselves may be required at this point, because here it is a matter of component tests on sealing joints that are concerned directly with constructions of which high quality has to be proven. The operator and/or manufacturer will probably perform the component test with one or two seal types and the design will then be limited to these, unless another seal manufacturer is interested in also being able to state his product as permissible. In this case, he will probably have to contribute to the costs.

Component tests will also be necessary for plastic flanges and enamelled steel flanges, because these behave quite differently from steel flanges for various reasons. We know, for example, that plastic flanges tend to creep more than the seals. Especially with plastic flanges, the leakage test would be difficult to pass if it were to be performed with the reference medium Helium.

Another innovation is that the leakage rate from the component test is no longer to be specified as the volume leakage rate with the physical unit mbar-l/(s-m) but as the mass leakage rate with the physical unit mg/(s*m).

It remains to be seen when the new version of TA-Luft will come into force and how to deal with old plants that do not comply with the current version of TA-Luft.

APPROVALS, PERMISSIONS/TESTS, TA-LUFT CERTIFICATION

Gasket Type	Authority/ Testing Party	Approval / certification
GASKETS		
Soft-material gaskets		
graphite		
RivaTherm HD	DVGW DVGW TÜV TÜV TÜV FH Münster FH Münster	DIN 3535-6 Certificate (gas supply) VP 401 Certificate IS0 10497 Firesafe Certificate Blow out safety Certificate Customer authorization for the Hoechst industrial park TA-Luft - without internal metal band rim TA-Luft - with internal metal band rim
RivaTherm-Super-Plus	DVGW DVGW TÜV TÜV TÜV FH Münster FH Münster	DIN 3535-6 Certificate (gas supply) VP 401 ISO 10497 Firesafe Certificate Blow out safety Certificate Customer authorization for the Hoechst industrial park TA-Luft - without internal metal band rim TA-Luft - with internal metal band rim
RivaTherm-Super		
RS2S110I	InfraServ TÜV	Producer Certification ISO 1049 Firesafe Certificate
RSK	DVGW DVGW TÜV	DIN 3535-6 Certificate (gas supply) VP 401 Certificate (HTB) Firesafe
RSE	DVGW DVGW	DIN 3535-6 Certificate (gas supply) VP401 Certificate (HTB)
WavelineWLP	Amtec	TA-Luft Certificate Sigraflex
soft material		
NBR 50219.5	DVGW	EN 682 Gas supply
EPDM 50324.1	TZW TZW	DVGW W 270 ELL
KLINGERSIL	VDI VDI VDI VDI VDI	C-4400 TA-Luft Certificate C-4430 TA-Luft Certificate C-4433 TA-Luft Certificate C-4500 TA-Luft Certificate V-8200 TA-Luft Certificate

You can download all approvals and tests from our website www.klinger-kempchen.de.

APPROVALS, PERMISSIONS/TESTS, TA-LUFT CERTIFICATION

Gasket Type	Authority/ Testing Party	Approval / certification
GASKETS		
Soft-material gaskets		
PTFE		
PTFETFM4105	VDI	TA-Luft Producer Certification
KLINGER topchem		
2000	TÜV	Firesafe
	Amtec	TA-Luft Certificate
	Hygiene-Institut	KTW
	Hygiene-Institut	W270
	DVGW	DIN 3535-6
2003	Amtec	TA-Luft Certificate
	Hygiene-Institut	KTW
	Hygiene-Institut	W270
	DVGW	DIN 3535-6
2005	Amtec	TA-Luft Certificate
	DVGW	DIN 3535-6
2006	Amtec	TA-Luft Certificate
	DVGW	DIN 3535-6
Dyneon (TM		
TF1620	DYNEON	FDA-Permission (applicable to foodstuffs)
TF1641	DYNEON	FDA-Permission (applicable to foodstuffs)
TF5032	DYNEON	FDA-Permission (applicable to foodstuffs)
TFM1600	DYNEON	FDA-Permission (applicable to foodstuffs)
TFM4101	DYNEON	FDA-Permission (applicable to foodstuffs)
TFM4105	DYNEON	FDA-Permission (applicable to foodstuffs)
KLINGER topchem	FDA	Producer Certification
KLINGER Softchem	FDA	Producer Certification
Gore	FDA	Producer Certification
Gylon	FDA	Producer Certification
Flex-O-Form	safety	Producer Certification
Sigraflex	Infraserv	Inspection Report
WLP Steelflon	Amtec	TA-Luft Producer Certification
Flat sealing strip	GORE	Test Report
Metal/Soft-material gaskets		
Rubber-steel gaskets		
WG	VDI2440	TA-Luft Producer Certification NBR 50219.5
WG2	Infraserv	Report
WL-HT	DVGW	Vp401 Certificate
general	Rhenag	technical release

You can download all approvals and tests from our website www.klinger-kempchen.de.

APPROVALS, PERMISSIONS/TESTS, TA-LUFT CERTIFICATION

Gasket Type	Authority/ Testing Party	Approval / certification
GASKETS		
Corrugated gaskets		
W1A	Amtec	TA-Luft Certificate
	TÜV	Firesafe Certificate
	TÜV	TRD401 Certificate
	VDI2440	TA-Luft Producer Certification CrNi-Steel with 0,5 mm graphite layers
	VDI2440	TA-Luft Producer Certification CrNi-Steel with 1 mm graphite layers
	VDI2440	TA-Luft Producer Certification with layers of unsintered PTFE
W1AF1	TÜV	Firesafe Certificate
	VDI2440	TA-Luft Producer Certification
W1A-3	Amtec	ISO 10497 Firesafe Certificate
	VDI2440	TA-Luft Producer Certification
	DVGW	DIN 3535-6 Certificate (gas supply)
	DVGW	VP 401 Certificate
W1A-3F1	VDI2440	TA-Luft Producer Certification
W11A	Amtec	TA-Luft Certificate
	MPA	TA-Luft Certificate thickness 2,5 mm
	MPA	TA-Luft Certificate thickness 3,5 mm
W11AF1	MPA	TA-Luft Certificate thickness 2,5 mm
	MPA	TA-Luft Certificate thickness 3,5 mm
Spirale-wound gaskets		
SpV1	VDI2440	TA-Luft Producer Certification graphite
	VDI2440	TA-Luft Producer Certification PTFE
SpV2l	MPA	TA-Luft Certificate graphite
	MPA	TA-Luft Certificate PTFE
	TÜV	Firesafe Certificate graphite
	VDI2440	TA-Luft Producer Certification graphite
	VDI2440	TA-Luft Producer Certification PTFE unsintered
SpZ2l	VDI2440	TA-Luft Producer Certification graphite/PTFE
Grooved gaskets		
B9A	TÜV	Firesafe Certificate
	VDI2440	TA-Luft Producer Certification graphite*
	VDI2440	TA-Luft Producer Certification Sigraflex
	VDI2440	TA-Luft Producer Certification PTFE*
	DVGW	DIN 3535-6 Certificate (gas supply)
	DVGW	VP 401 Certificate
B29A	MPA	TA-Luft Certificate
	VDI2440	TA-Luft Producer Certification graphite*
	VDI2440	TA-Luft Producer Certification PTFE*
B29A-F1	VDI2440	TA-Luft Producer Certification graphite
B45A	TÜV	Firesafe Certificate
general	PCK	report

*also for B7A, B15A and E7A

You can download all approvals and tests from our website www.klinger-kempchen.de.

APPROVALS, PERMISSIONS/TESTS, TA-LUFT CERTIFICATION

Gasket Type	Authority/ Testing Party	Approval / certification
GASKETS		
Metal jacketed gaskets		
F8	VDI2440	TA-Luft Producer Certification
F7	VDI2440	TA-Luft Producer Certification
PTFE-enveloped gaskets		
PW1A-3	KLINGER Kempchen	Manufacturer information Firesafe
	TÜV	Certificate Firesafe graphite
	TÜV	Certificate Firesafe Sigraflex
	VDI2440	TA-Luft Producer Certification graphite
PW5	VDI2440	TA-Luft Producer Certification fibre material
	VDI2440	TA-Luft Producer Certification graphite
	VDI2440	TA-Luft Producer Certification soft-material
PW21	VDI2440	TA-Luft Producer Certification
	VDI2440	TA-Luft Producer Certification fibre material
	VDI2440	TA-Luft Producer Certification graphite
	VDI2440	TA-Luft Producer Certification modified shell
	VDI2440	TA-Luft Producer Certification
PF-PW	VDI2440	TA-Luft Producer Certification for PF2 / PF18 / PF20 / Pf21 / PW4 / PW4S / PW5 / PW5L
PF3	VDI2440	TA-Luft Producer Certification graphite
	VDI2440	TA-Luft Producer Certification Sigraflex
	VDI2440	TA-Luft Producer Certification Sigraflex Email
PF29	VDI2440	TA-Luft Certificate

You can download all approvals and tests from our website www.klinger-kempchen.de.

APPROVALS, PERMISSIONS/TESTS, TA-LUFT CERTIFICATION

Gasket Type	Authority/ Testing Party	Approval / certification
GASKETS		
Special gaskets		
HN21H Spiral stainless steel / PTFE unsintered; grooved stainless steel with PTFE envelope	VDI2440	TA-Luft Producer Certification
HN21H Also representative HN21A, NH22A, HN41A, HN42A und HN42H	VDI2440	TA-Luft Producer Certification
HN22A Spiral stainless steel/graphite; grooved stainless steel with graphite layer	VDI2440	TA-Luft Producer Certification
HN22H Leak check gasket with PTFE envelope	VDI2440	TA-Luft Producer Certification

	Authority/ Testing Party	Approval / certification
PACKINGS		
K36SL	FDA	Conformity Certificate
K80S TA-HT	MPA	TA-Luft Certification

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You can download all approvals and tests from our website www.klinger-kempchen.de.

PACKING OVERVIEW, CLEARANCES AND TOLERANCES

Type	Mechanical Properties: Max. Pressure [bar]	Maximum Speed [m/s]: rotating	Maximum Speed [m/s]: oscillating	Temperature Resistance [°C]: from	Temperature Resistance [°C]: to	Drinking water, foodstuffs	Water, Sewage, Boiler Feed Water	Gasses, Air, Nitrogen	Diluted Acids, inorg./org., Saline Solutions	Concentrated acid	Diluted lyes / alkalies	Concentrated ayes / alkalies	Oils, greases	Heat transfer mediums	Solvents	organic compounds	Adhesives, Bitumen	abrasive mediums	Colors, varnishes	page
K80S	1500	0,2	2	-200	+550	●	●	●	❍	❍	❍	❍	●	●	●	●	●	●	●	177
K100	500	5	2	-200	+550	●	●	●	❍	❍	●	❍	●	●	●	●	●	❍	●	181
K80	300	5	2	-200	+550	●	●	●	●	❍	●	●	●	●	●	●	❍	❍	●	176
K68	2	-	-	-200	+550	X	X	❍	X	X	X	X	❍	❍	❍	❍	❍	❍	❍	175
K80S TA-HT*	1500	5	2	-200	+550	●	●	●	❍	❍	❍	❍	●	●	●	●	❍	❍	●	183
K95	300	30	10	-200	+450	●	●	●	●	❍	●	●	●	●	●	●	❍	❍	●	180
K450G	20	-	-	-40	+450	X	❍	❍	❍	X	❍	X	●	❍	●	●	❍	❍	X	181
K80C	300	5	2	-200	+280	●	●	●	●	●	●	●	●	●	●	●	●	❍	●	177
K91	200	20	3	-200	+280	❍	●	●	●	X	●	X	●	●	●	●	●	❍	●	180
K90	200	10	10	-200	+280	❍	●	●	❍	X	❍	X	●	●	●	●	●	●	X	179
K36	200	0,5	2	-200	+280	❍	●	●	●	●	●	●	●	●	●	●	●	X	●	174
K75	200	8	6	-200	+260	X	●	●	●	X	●	X	●	●	●	●	●	X	●	176
K81	100	20	3	-100	+280	X	●	●	●	X	●	X	●	●	●	●	●	●	X	178
K89	50	15	15	-100	+280	❍	●	●	❍	X	❍	X	●	●	●	●	●	●	X	179
K40	30	20	5	-100	+280	❍	●	●	●	❍	●	❍	●	●	❍	❍	X	X	X	174
K83	100	15	2	-100	+250	X	●	●	●	X	●	X	●	●	●	●	●	●	X	178
K41	60	10	4	-20	+120	❍	●	●	❍	X	❍	X	●	X	❍	❍	X	❍	X	175

● = applicable, ❍ = conditionally applicable, **X** = not applicable

Temperature at the packing. The temperature of the medium can be higher.

10

Size of the Gap between Spindle, Gland Packing and Housing

If we designate the outer diameter of the spindle as d1 and the interior diameter of the gland or of the bottom ring as d2, then $t = (d_2 - d_1)/2$ is valid for the median radial gap between the spindle and the spacer or the bottom ring. In the case of an off-center position of the spindle or rod, the gap can double to one side to $2t = d_2 - d_1$.

The table shows reference values for the maximum permitted size of the gap t in reference to the packing material. The influence of the operating pressure to be sealed was taken into account in this respect, as generally the smaller packing widths are inserted for the higher pressures.

Tolerances and the Composition of the Surface Area

For the rod or spindle, the accuraey degree should be h9. The surface area roughness should be $R_z \leq 2{,}5$ µm or alternatively $R_a \leq 0{,}6$ µm.

For the gland, the tolerance accuraey degree D10 was proven. The surface area roughness should be $R_z \leq 6{,}3$ µm or alternatively $R_a \leq 2{,}5$ µm.

* For the packing set K80S TA-HT other tolerances and Oberfachenangaben apply. See page 183.

Permitted radial Gap t in mm between Spindle and Gland or Housing

Nominal width of packing in mm	Packing: K36 K75 K80C K95C	Packing: K80 K95	Packing: K80S K100
3	0,08	0,20	0,35
4	0,10	0,22	0,40
5	0,10	0,24	0,45
6	0,12	0,28	0,50
8	0,12	0,32	0,55
10	0,14	0,36	0,60
12	0,14	0,40	0,65
15	0,16	0,45	0,70
20	0,16	0,50	0,75
25	0,18	0,55	0,80

PACKINGS

RivaLon-Packing K36

PTFE-Multifilament with PTFE Dispersion

- ✓ static applications
- ✓ for pumps
- ✓ for valves

Mechanical Properties

Maximum Pressure	[bar]		200
Maximum Speed	[m/s]	rotating oscillating	0,5 2
Temperature Resistance	[°C]	from to	-200 +280

Standard Width approx. mm													
3	4	5	6	8	10	12	14	15	16	18	20	22	25
16	29	45	65	115	180	260	353	405	460	583	720	871	--
Weight per meter in g													

Notes:
K36S by application of oxygen (fibers BAM-examined)
K 39 for pumps (with silicon oil impregnation)

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	○
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	●
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	●
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	X
Colors, Varnishes	●

RivaFlex-Packing K 40

PTFE-Fiber with incorporated graphite and silicon oil (100% Gore GFO®)

- static applications
- ✓ for pumps
- for valves

Mechanical Properties

Maximum Pressure	[bar]		30
Maximum Speed	[m/s]	rotating oscillating	20 5
Temperature Resistance	[°C]	from to	-100 +280

Standard Width approx. mm													
4	5	6	8	10	12	14	15	16	18	20	22	24	25
26	40	58	102	160	230	325	360	410	518	640	774	920	1000
Weight per meter in g													

Notes:
K40E PTFE-Fiber with incorporated graphite, without lubricant, for valves (100% Gore G2 ®)

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	○
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	○
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	○
Oils, greases	●
Heat transfer mediums	●
Solvents	○
Organic compounds	○
Adhesives, Bitumen	X
Abrasive mediums	X
Colors, Varnishes	X

PACKINGS

RamiVal-Packing K41

Ramie-Fiber with PTFE Dispersion and Silicon Oil Impregnation

- ☐ static applications
- ☑ for pumps
- ☐ for valves

Mechanical Properties

Maximum Pressure	[bar]		60
Maximum Speed	[m/s]	rotating oscillating	10 4
Temperature Resistance	[°C]	from to	-20 +120

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
13	23	36	52	93	145	209	284	326	371	470	580	702	835	906
Weight per meter in g														

Notes:
K41P with paraffin oil

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	○
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	○
Concentrated acids	X
Diluted lyes/alkalies	○
Concentrated lyes/alkalies	X
Oils, greases	●
Heat transfer mediums	X
Solvents	○
Organic compounds	○
Adhesives, Bitumen	X
Abrasive mediums	○
Colors, Varnishes	X

RivaStat-Packing K68

Calcium Silicate Fibers

- ☐ static applications
- ☑ for pumps
- ☐ for valves

Mechanical Properties

Maximum Pressure	[bar]		2
Maximum Speed	[m/s]	rotating oscillating	- -
Temperature Resistance	[°C]	from to	-200 +550

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	18	29	41	74	115	166	225	259	295	373	460	557	662	719
Weight per meter in g														

Notes:
K68G with special graphite impregnation
K68C with special CKP impregnation.

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	X
Water, Sewage, Boiler Feed Water	X
Gasses, Air, Nitrogen	○
Diluted acids, inorg./org. saline solutions	X
Concentrated acids	X
Diluted lyes/alkalies	X
Concentrated lyes/alkalies	X
Oils, greases	○
Heat transfer mediums	○
Solvents	○
Organic compounds	○
Adhesives, Bitumen	○
Abrasive mediums	○
Colors, Varnishes	○

PACKINGS

RivaNorm-Packing K75

Calcium Silicate Fibers intensively impregnated with PTFE dispersion

- ☑ static applications
- ☐ for pumps
- ☑ for valves

Mechanical Properties

Maximum Pressure	[bar]		200
Maximum Speed	[m/s]	rotating oscillating	8 6
Temperature Resistance	[°C]	from to	-200 +260

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	22	33	49	86	135	195	265	304	346	438	540	653	775	844
Weight per meter in g														

Notes:
K75Ö for pumps (with PTFE dispersion and lubrication)

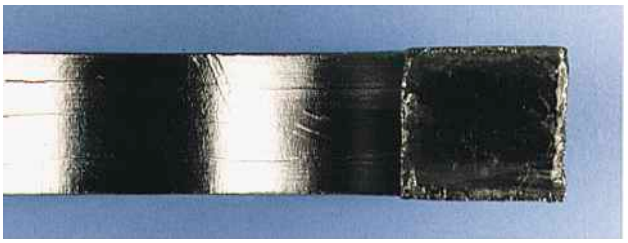
Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	X
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	X
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	X
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	X
Colors, Varnishes	●

RivaTherm-Packing K 80

Packing ring wound from flexible graphite foil and pressed in moulds



- ☐ static applications
- ☐ for pumps
- ☑ for valves

Mechanical Properties

Maximum Pressure	[bar]		300
Maximum Speed	[m/s]	rotating oscillating	5 2
Temperature Resistance	[°C]	from to	-200 +550

Dieformded Packing Ring
Seamless, slotted or split

Notes:
In connection with K80S, pressure load up to 1500 bar.
With steam up to a maximum of 650 °C.

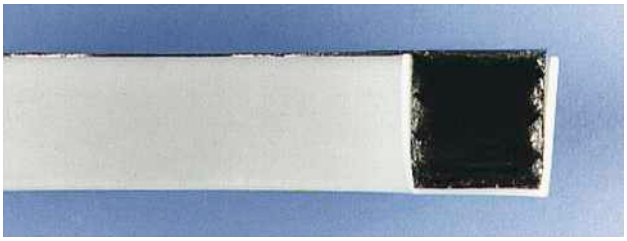
Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	●
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	○
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	●
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	○
Abrasive mediums	○
Colors, Varnishes	●

RivaTherm K 80 C

Graphite foil wound and pressed in moulds, U-formed envelope of sintered PTFE



- ☐ static applications
- ☐ for pumps
- ☑ for valves

Mechanical Properties

Maximum Pressure	[bar]		300
Maximum Speed	[m/s]	rotating oscillating	5 2
Temperature Resistance	[°C]	from to	-200 +280

Dieformded Packing Ring
Seamless

Notes:
For uses consistent with TA-Luft. When graphite is permissible, we recommend K80S rings as antiextrusion rings

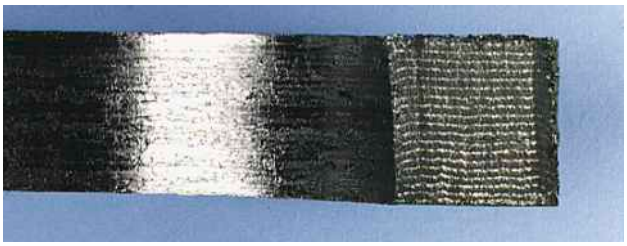
Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	●
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	●
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	●
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	○
Colors, Varnishes	●

RivaTherm K 80 S

RivaTherm-Packing ring Stainless steel, graphite laminate layered and pressed in moulds



- ☐ static applications
- ☐ for pumps
- ☑ for valves

Mechanical Properties

Maximum Pressure	[bar]		1500
Maximum Speed	[m/s]	rotating oscillating	0,2 2
Temperature Resistance	[°C]	from to	-200 +550

Dieformded Packing Ring
Seamless, slotted or split

Notes:
With steam up to a maximum of 650 °C. Only intended as antiextrusion ring.

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	●
Water, Sewage, Boiler Feed Water	
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	
Concentrated acids	○
Diluted lyes/alkalies	
Concentrated lyes/alkalies	○
Oils, greases	
Heat transfer mediums	●
Solvents	
Organic compounds	●
Adhesives, Bitumen	
Abrasive mediums	●
Colors, Varnishes	

PACKINGS

RivaMid-Packing K81

Aramide continuous filament (TWARON®) with PTFE dispersion and silicon oil

- ☐ static applications
- ☑ for pumps
- ☐ for valves

Mechanical Properties

Maximum Pressure	[bar]		100
Maximum Speed	[m/s]	rotating oscillating	20 3
Temperature Resistance	[°C]	from to	-100 +280

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	23	36	52	93	145	209	284	326	371	470	580	702	835	906
Weight per meter in g														

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	X
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	X
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	X
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	●
Colors, Varnishes	X

RivaMid-Packing K83

Aramide staple fibers with PTFE dispersion and silicon oil

- ☐ static applications
- ☑ for pumps
- ☐ for valves

Mechanical Properties

Maximum Pressure	[bar]		100
Maximum Speed	[m/s]	rotating oscillating	15 2
Temperature Resistance	[°C]	from to	-100 +250

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
14	23	36	52	93	145	209	284	326	371	470	580	702	835	906
Weight per meter in g														

Notes:
K83P made of aramide staple fibers with silicon free lubricant

Uses

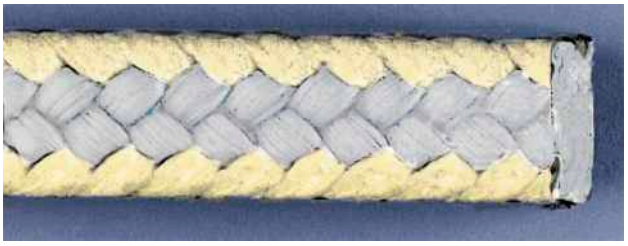
● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	X
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	X
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	X
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	●
Colors, Varnishes	X

PACKINGS

RivaKomb-Packing K89

PTFE Multifilament fiber with aramide-reinforced edges and lubricant



- ☐ static applications
- ☑ for pumps
- ☐ for valves

Mechanical Properties

Maximum Pressure	[bar]		50
Maximum Speed	[m/s]	rotating oscillating	15 15
Temperature Resistance	[°C]	from to	-100 +280

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	26	40	58	102	160	230	314	360	410	518	640	774	922	1000
Weight per meter in g														

Notes:
Predominantly intended for piston pumps.
K86 without lubricant.

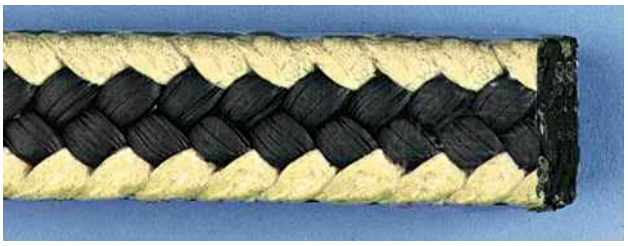
Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	○
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	○
Concentrated acids	X
Diluted lyes/alkalies	○
Concentrated lyes/alkalies	X
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	●
Colors, Varnishes	X

RivaKomb-Packing K90

PTFE with incorporated graphite, anti-friction lubricant and aramide-reinforced edges



- ☐ static applications
- ☑ for pumps
- ☐ for valves

Mechanical Properties

Maximum Pressure	[bar]		200
Maximum Speed	[m/s]	rotating oscillating	10 10
Temperature Resistance	[°C]	from to	-200 +280

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	25	40	58	102	160	230	313	360	409	518	640	774	920	1000
Weight per meter in g														

Notes:
Predominantly intended for piston pumps.
K90E without anti-friction lubricant.

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	○
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	○
Concentrated acids	X
Diluted lyes/alkalies	○
Concentrated lyes/alkalies	X
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	●
Colors, Varnishes	X

PACKINGS

RivaBrid-Packing K91

TWARON®- und GFO®-fiber manufactured in hybrid braiding

- ☐ static applications
- ☑ for pumps
- ☐ for valves

Mechanical Properties

Maximum Pressure	[bar]		200
Maximum Speed	[m/s]	rotating oscillating	20 3
Temperature Resistance	[°C]	from to	-200 +280

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	25	40	58	102	160	230	313	360	409	518	640	774	920	1000
Weight per meter in g														

Notes:
Other material combinations are available for delivery as hybrid braiding:
K92 of PTFE Multifilament-GFO fiber;
K93 of PTFE Multifilament fiber and TWARON fiber

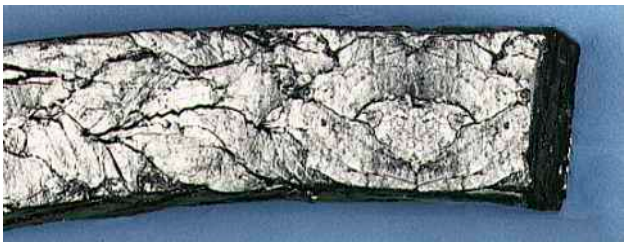
Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	○
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	X
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	X
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	○
Colors, Varnishes	●

RivaTherm Packing K 95

Made of flexible graphite



- ☐ static applications
- ☑ for pumps
- ☑ for valves

Mechanical Properties

Maximum Pressure	[bar]		300
Maximum Speed	[m/s]	rotating oscillating	30 10
Temperature Resistance	[°C]	from to	-200 +450

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	16	25	36	64	100	144	196	225	256	324	400	484	576	625
Weight per meter in g														

Notes:
With steam up to 650 °C. Regarding the pressure load, we recommend the series of antiextrusion rings from **K99, K100** or **K80S**. **K95i** with chrome-nickel supporting wires.

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	●
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	●
Concentrated acids	○
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	●
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	○
Abrasive mediums	○
Colors, Varnishes	●

PACKINGS

RivaTherm Packing K 100

Flexible graphite with high-temperature-tolerant metal reinforcement

- ☐ static applications
- ☐ for pumps
- ☑ for valves

Mechanical Properties

Maximum Pressure	[bar]		500
Maximum Speed	[m/s]	rotating	5
		oscillating	2
Temperature Resistance	[°C]	from	-200
		to	+550

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	19	30	43	77	120	173	235	270	307	389	480	580	690	750
Weight per meter in g														

Notes:

With steam up to a max. 650°C.
Specially intended as antiextrusion ring.

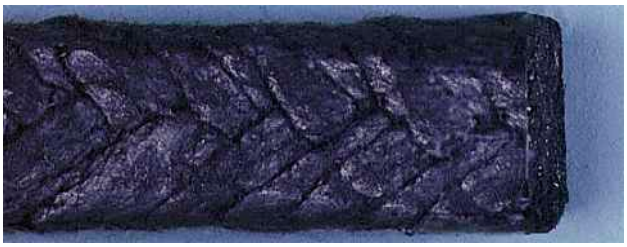
Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	●
Water, Sewage, Boiler Feed Water	●
Gasses, Air, Nitrogen	●
Diluted acids, inorg./org. saline solutions	○
Concentrated acids	○
Diluted lyes/alkalies	●
Concentrated lyes/alkalies	○
Oils, greases	●
Heat transfer mediums	●
Solvents	●
Organic compounds	●
Adhesives, Bitumen	●
Abrasive mediums	○
Colors, Varnishes	●

RivaGlas-Packing K450G

Glass fiber with a special graphite impregnation



- ☑ static applications
- ☐ for pumps
- ☐ for valves

Mechanical Properties

Maximum Pressure	[bar]		20
Maximum Speed	[m/s]	rotating	-
		oscillating	-
Temperature Resistance	[°C]	from	-40
		to	+450

Standard Width approx. mm														
3	4	5	6	8	10	12	14	15	16	18	20	22	24	25
-	22	33	49	86	135	195	265	305	346	438	540	653	775	844
Weight per meter in g														

Bemerkungen:

K550 with a special glass fiber and chrome-nickel core, up to 550 °C.
Also deliverable graphitated as **K550G**.
K1000 also special glass-silicate fiber, up to 1000 °C.

Uses

● = applicable ○ = conditionally applicable X = not applicable

Drinking water, Foodstuffs	X
Water, Sewage, Boiler Feed Water	○
Gasses, Air, Nitrogen	○
Diluted acids, inorg./org. saline solutions	○
Concentrated acids	X
Diluted lyes/alkalies	○
Concentrated lyes/alkalies	X
Oils, greases	●
Heat transfer mediums	○
Solvents	●
Organic compounds	●
Adhesives, Bitumen	○
Abrasive mediums	○
Colors, Varnishes	X

PACKINGS

Braided Packing Rings

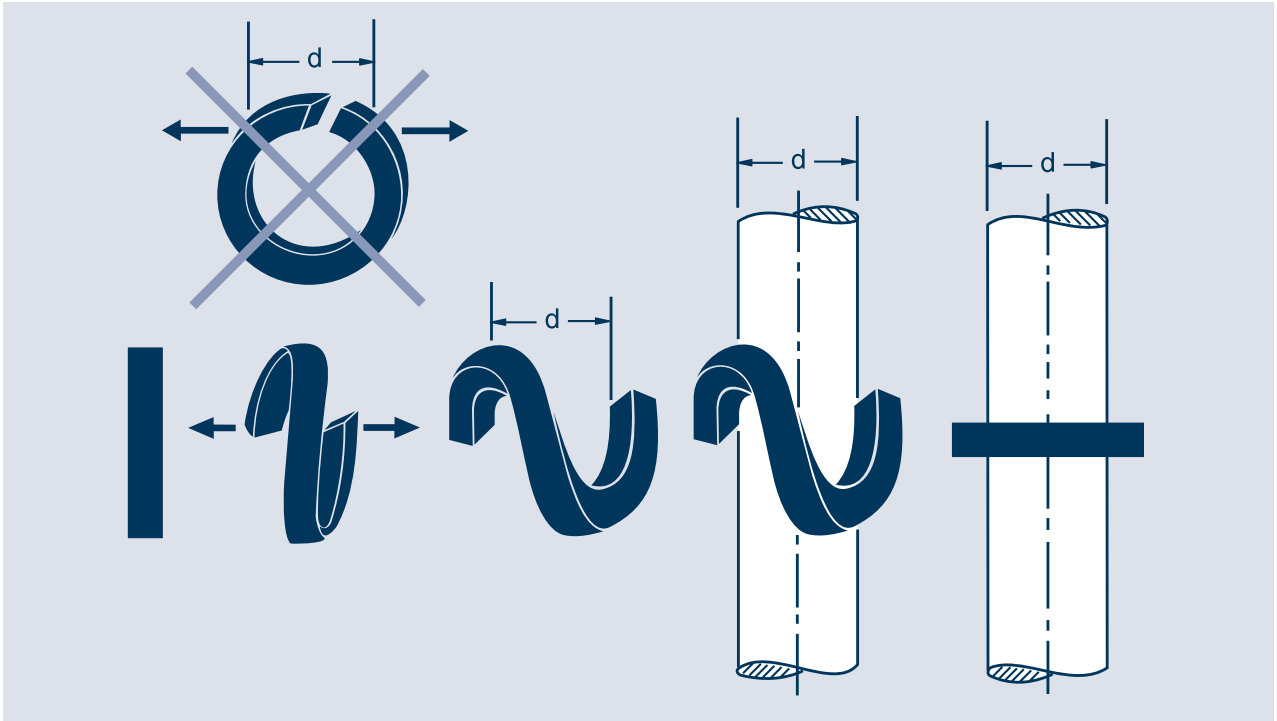
Compression molded packing rings provide the technically best solution and are, in addition, a good value. Through our compression machines, each ring for different operating conditions is optimally precompressed.

Several thousand forms are available in increments of a few tenths of a millimetre, so that an appropriate tool is generally available for packing rings for reground spindles, rods or shafts.

Advantages of the compression molded packing rings

- Less material, Avoidance of cutting mistakes, No waste with bulk stock
- small gland packing strengths with little friction and a long lifetime
- quick assembly: therefore small assembly costs and less downtime
- highest possible dimension accuracy

With the assembly of precompressed, slotted packing rings, you have to be careful that the ring never gets bent. It is in axial position in order to open the diameter of the shaft cross section.



BLOW-OUT PROOF TA-LUFT K80S TA-HT PACKING UNIT

TA-Luft demands the ”use of high-quality gaskets“. This high level of quality for flanges and fittings is defined in the VDI 2440 ”Emissions Reduction in Petrol Refineries“ Directive. Alongside high-quality seals for control and shut-off devices such as metal bellows with a down-stream safety stuffing box, sealing systems such as the TA-Luft K80S TA-HT Packing can be used.

The first criterion for the equivalence is that the design layout of the sealing system permanently produces the intended function under operating conditions.

The packing unit is characterised, among other things, by an extremely low friction coefficient so that the lifting power is correspondingly low. A spring assembly with disk springs is not necessary in order to meet the TA-Luft leakage rate criterion of VDI Directive 2440 10^{-2} [mbar·l·s-1·m-1]. The containment rings reliably prevent the extrusion of the sealing rings. Consequently, a sudden failure of the sealing unit is prevented.

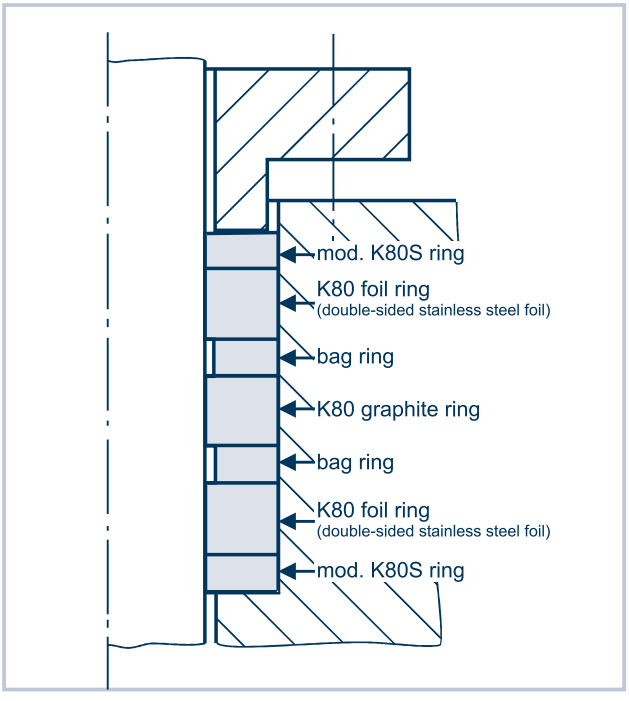
The K80S TA-HT Packing Unit is blow-out proof. The blow-out resistance was tested and verified at MPA Stuttgart with 400 °C supercritical steam at 300 bar.

Secondly, the specific leakage rates must meet the following limits:

» 10^{-4} mbar-l/(s-m) at sealing system temperatures below 250 °C or 10^{-2} mbar-l/(s·m) at sealing system temperatures greater than or equal to 250 °C.

The requirements placed upon these sealing systems are as varied as the applications, meaning that selection is performed according to prescribed criteria. In doing so, the application parameters such as temperature, pressure, medium, type of movement and maximum applicable lifting force as well as the number of expected lifts during the entire period of operation must be taken into account.

K80S TA-HT is a packing unit with a total of seven rings. They partly consist of rings manufactured from graphite with stainless steel sheet inserts and partly consist of rings manufactured using flexible graphite as well as stainless steel foils located in between. The K80S TA-HT was classified as high-quality packing within the meaning of the TA-Luft for temperature ranges greater than or equal to 250 °C by the MPA in Stuttgart with certificate no. 0005/2012.



BLOW-OUT PROOF TA-LUFT K80S TA-HT PACKING UNIT

Mechanical properties:

Maximum temperature on the packing: (the medium temperature can be substantially higher)	550 °C
Pressure:	up to 1500 bar
Oscillating movement	2 m/s
Rotating movement	5 m/s
Extremely low friction between spindle and packing:	μ < 0,05
Diameter (other dimensions are possible):	6/12 mm up to 340/360 mm

Media resistance

Abrasive media	○
Paints, carnishes	●
Gasses, air, nitrogen	●
Adhesives, bitumen	○
Concentrated alkalies	○
Diluted lyes/alkalies	○
Solvents	●
Oils, greases	●
Organic compounds	●
Concentrated acids	○
Diluted acids, inorg./org. saline solutions	○
Drinking water, foodstuffs	●
Heat transfer media	●
Water, waste water, boiler feed water	●

● = applicable ○ = conditionally applicable

For the rod or spindle, the tolerance range applies h7. The roughness should be ≤ 0,3 µm Ra. For the stuffing box, the tolerance range H8 applies. The roughness should be ≤ 1 µm Ra.

MPA STUTTGART
Otto-Graf-Institut
Universität Stuttgart

DAkkS

Zertifikat

Nr. 0005/2012

Der Armaturendichtsatz Type Rivatherm Super K80S TA-HT aus Graphit bestehend aus
7 Ringen
der Kempchen Dichtungstechnik GmbH
Im Waldteich 21, D-46147 Oberhausen
wurde von uns nach den Vorgaben der VDI-Richtlinie 2440 (Ausgabe November 2000) geprüft. Die wesentlichen prüftechnischen Randbedingungen sind:
Vorverformung mit 50 MPa Pressung (3 mal); Montage 40 MPa; 400 °C (Temperatur der Packung); ohne Tellerfedern. Nachspannen auf 40 MPa nach dem Aufheizen.
500 Zyklen mit Spindelhub 40 mm; 20 bar Helium.
Nach den Spindelbewegungen wurde bei Betriebstemperatur mittels Helium-Massenspektrometrie eine Leckagerate von
$1{,}0 \cdot 10^{-2}$ mbar l / (s·m) gemessen.
Das Leckageratenkriterium der VDI-Richtlinie 2440
$1{,}0 \cdot 10^{-2}$ mbar l / (s·m) (bei Temperaturen größer 250 °C)
ist erfüllt und der Packungssatz gilt damit als hochwertig im Sinne der TA Luft.
Dieses Zertifikat gilt nur in Verbindung mit unserem Prüfungsbericht
902 2898 001 /Os/Hh vom 06. März 2012
erstellt für die Firma Kempchen Dichtungstechnik GmbH und den dort niedergelegten Prüf- und Randbedingungen.
Stuttgart, den 07.03.2012
Dipl.-Ing. R. Hahn
Leiter Referat Dichtungstechnik

MPA STUTTGART
Otto-Graf-Institut
Universität Stuttgart

DAkkS

Zertifikat

Nr. 0007/2012

Der Armaturendichtsatz Type Rivatherm Super K80S TA-HT aus Graphit bestehend aus
7 Ringen
der Kempchen Dichtungstechnik GmbH
Im Waldteich 21, D-46147 Oberhausen
wurde von uns hinsichtlich Ausblassicherheit geprüft. Die wesentlichen prüftechnischen Randbedingungen sind:
Vorverformung mit 60 MPa Pressung (3 mal); Montage 60 MPa; 400 °C (Temperatur der Packung); ohne Tellerfedern. Prüfmedium war Wasserdampf bei 300 bar.
Nach der Montage wurde bei Betriebstemperatur und entstehendem Innendruck die Flächenpressung 3 mal kontrolliert mit ca. 6 MPa/s und einmal schlagartig entlastet. Dabei ließ sich die Flächenpressung bis 26 MPa (durch den Innendruck induzierte Pressung) absenken.
Es war weder Ausblasen noch eine Erhöhung der Leckagerate festzustellen.
Der Packungssatz gilt sowohl als hochwertig im Sinne der TA Luft (siehe Prüfungsbericht 902 2898 001 vom 6. März 2012) und bietet zudem eine hohe Sicherheit gegen Ausblasen. Nach der Demontage waren keinerlei Beschädigungen am Packungssatz festzustellen.
Dieses Zertifikat gilt nur in Verbindung mit unserem Prüfungsbericht
902 3649 001 /Os/Hh vom 05. April 2012
erstellt für die Firma Kempchen Dichtungstechnik GmbH und den dort niedergelegten Prüf- und Randbedingungen.
Stuttgart, den 06.05.2012
Dipl.-Ing. R. Hahn
Leiter Referat Dichtungstechnik

PACKING INSTALLATION KIT

Packing Installation Kit

The Kempchen Packing Installation Kit is suitable for removing old packings from stuffing boxes of, valves, pumps, agitators, etc. It is delivered in an impact resistant case with a foam rubber insert. The case is equipped with the most commonly used packing extractors, the corresponding replacement tips as well as a packing cutter. Each tool has its own place in the case due to the separate spaces in the foam insert.

With the Kempchen Packing Installation Kit in the case, the assembler has a universal and indispensable help aid at hand.

Packing Cutting Equipment

The Kempchen Packing Cutting Equipment allows for the cut-out of entire packing rings made from bulk stock. Many advantages arise from its simple handling, such as cutting without waste and scrap, high reliability and time savings. The Kempchen Packing Cutting Equipment is designed for ring averages up to 150 mm and a packing width up to 25 mm.

Shipment Package	ID No.
1 Piece Packing Extractor, flexible, size F-1 Ø 6,35 x 180 mm	20 / 79838
1 Piece Packing Extractor, flexible, size F-2 Ø 8 x 270 mm	20 / 79842
1 Piece Packing Extractor, flexible, size F-3 Ø 10 x 365 mm	20 / 79845
1 Piece Packing Extractor-Tip, Size C-1, fitting F-1	20 / 79848
1 Piece Packing Extractor-Tip, Size C-2, fitting F-2	20 / 79853
1 Piece Packing Extractor-Tip, Size C-3, fitting F-3	20 / 79855
1 Piece Packing Cutter in Leather Sheath	20/1520
1 Piece Tool Case	

Shipment Package	ID No.
1 Piece complete set	30 / 2799
1 Piece Packing Cutting Equipment including Cutter	20/123929

FABRIC COMPENSATORS

Contents

FABRIC COMPENSATORS

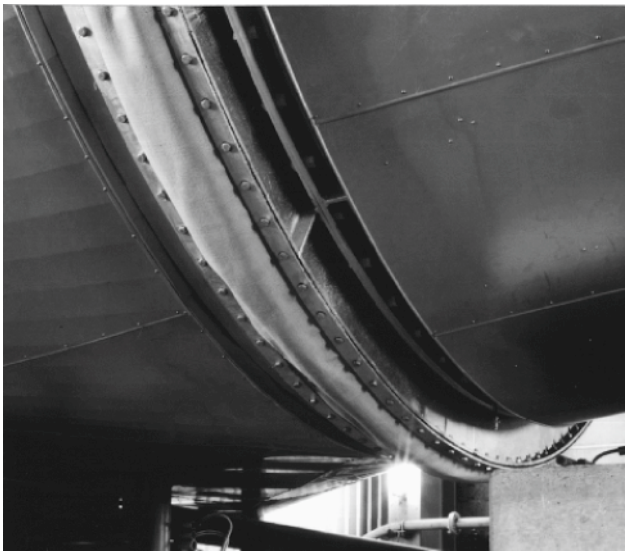
1.0 General Information

Several decades ago, when Kempchen first began producing soft-material compensators, metal compensators were still predominantly being used in the field of power plants and chemicals.

Today, KLINGER Kempchen soft-material compensators have found a solid range of applications. Without these versatile assembly parts, modern industrial plants would not be possible. Without the use of soft-material compensators, the costs of such plants would be considerably greater.

The main advantage of soft-material compensators is their multidimensional absorption of movement despite having very low reaction force. Their superior movement absorption allows for cost-effective piping, while their low reaction force perwiths cost-effective fix point construction.

KLINGER Kempchen has developed a patented method for sintering PTFE sheets onto all types of fabrics. This has brought significant improvements to the properties of soft-material compensators.



KKLINGER Kempchen compensators in flue gas distributing main

1.1 Range of application

Soft-material compensators have been proven to withstand:

- in pipes and ducts for gaseous media such as air, flue gas, exhaust gas
- temperatures of up to 700 °C and higher
- pressures of up to 500 mbar
- major axial movement and - often concurrently - lateral or angular loads
- all industry sectors such as thermal power plants, gas turbine plants, the chemicals industry, flue gas desulphurisation plants, chimney and flue construction, ship construction, stationary diesel generator sets, waste incineration plants, flue gas treatment plants, dedusting plants, metallurgical industry.

Only materials that pass our quality inspection are used for the production of soft-material compensators and other assembly parts. The requirements profiles for our material properties are based on decades of experience, and serve as the criteria for purchase and incoming goods inspection.

RAL GÜTEZEICHEN

Weichstoff-Kompensator

Quality brand for
fabric compensators

KLINGER Kempchen makes the distinction between the groups of components used in the assembly of soft-material compensators and/or the necessary steel constructions:

Soft-materials compensators:

Insulation layers, insulation packs,
sealing foils, sealing layers
supporting layers,
protective layers, reinforced edges

Compensator protection components:

Internal pass tube,
pre-insulation,
external protective grating or equiv,
outlet nozzle,
sash frame

Compensator connection:

Bolted counterflanges,
clamping flanges, band clamps

FABRIC COMPENSATORS

2.0 Materials

2.1 Kempchen soft-material compensators and their construction

Soft-material compensators are generally made up of several layers. In most cases, these layers are not glued or sewn together. In the clamping area, however, the individual layers of the soft-material compensator are always connected for transport reasons.

As is explained in greater detail in Section 6.0 'The sealing of soft-material compensators and impermeability testing", superstructures with multiple layers, such as those necessary for controlling high temperatures, are more difficult to assess with respect to impermeability than are soft-material compensators consisting of just one or two layers.

If impermeability is a particularly important concern, it can be achieved by using special heat-dispelling constructions of one- or two-layer Kempchen soft-material compensators.

2.1.1 Insulation layers, insulation packs

Insulation layers are necessary if the temperature of the media is higher than the maximum allowable sustained temperature of the sealing layers. The different types of insulation layers vary widely in their mechanical stability and their resistance to temperature and chemicals. They are therefore selected based on conditions in which they will be used.

Insulating felts are used as insulation packs. Due to their low resistance, these are wrapped in stabler, more heat-resistant fabrics or bound in high-grade steel wire mesh. In the case of larger movements, at least two such insulation packs are located so as to be moveable in front of the sealing layer.

2.1.2. Sealing foils, sealing layers

Depending on the temperature range, various types of synthetic rubber, metal foils, and plastics are used either on their own or as a fabric coating

The sealing layer is of major importance, as soft-material compensators are always part of leak-proof piping or duct systems. Three aspects are of particular significance:

2.1.2.1

The pressure differential acting at the sealing layers, causing strain. For this reason, supporting layers are placed in the direction of the decrease in pressure behind the sealing layers for support: they are located outside for internal pressure and inside in front of the sealing layers for low pressure.

2.1.2.2

Since condensation may collect in front of the sealing layers, the resistance of the insulation and any insulating fabric layers must be taken into consideration.

2.1.2.3

It is important to note that rubber and plastic foils and laminated fabrics are not entirely gas-tight. Only metal foils may be used as a gas barrier. One disadvantage of metal foils is their relatively high sensitivity, e.g. to flue gas condensation; another is their low expandability.

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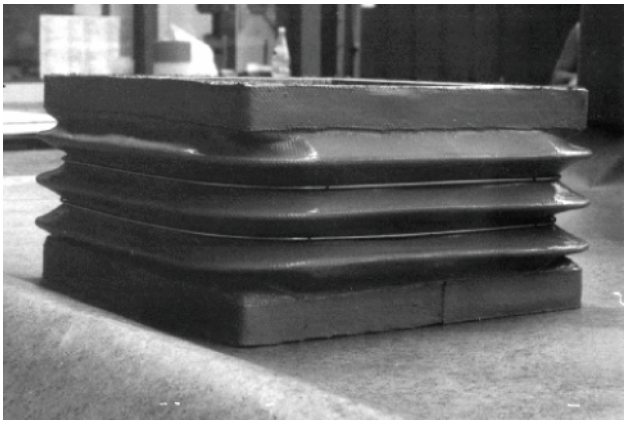
2.1.1.1 Temperature and media resistance

Conditions for use	Sustained temperature resistance		Short-term peak temperature		Acid-proof	Base-proof	Solvent-proof
Fabric and mats	**°C**	°F	**°C**	°F			
Aramid	**180**	356	**250**	482	**0**	**0**	**+**
Glass fibre weave	**400**	752	**450**	842	**+**	**0**	**+**
Glas felt mats	**500**	932	**650**	1202	**+**	**0**	**+**
Rock wool mats	**700**	1292	**750**	1382	**0**	**0**	**+**
Silicate felt mats	**1200**	2192	**1350**	2462	**+**	**0**	**+**
Silicate fibre weave	**1200**	2192	**1350**	2462	**+**	**0**	**+**

+ = yes | 0 = conditional | - = no

FABRIC COMPENSATORS



Rectangular pleat compensator

2.1.2.4 Temperature and media resistance

The table shows the resistance to sustained and temporary temperatures of various foils and coated fabrics used in soft-material compensators. Resistance to acids, bases and solvents can only be given in this catalogue in terms of tendencies.

In the event of a thermal load greater than the sustained temperature resistance indicated in Table 2.1.2.4., both constructive and insulation-related measures must be taken (see 2.2.).

2.1.2.5

The sealing layers in the compensator's clamping area must be tightly screwed to the clamping flanges. To achieve this, we recommend that a surface pressure of 5 N/mm² always be present between the fabric and steel flange.

This can be easily attained at temperatures up to and including the sustained temperature resistance of the sealing layers.

However, if the flange temperature is higher than the sustained temperature resistance in the sealing layer area, the porosity of the insulation layers will make sealed closure more difficult.

There are three ways to solve this problem:

a) Impregnate the insulation layers in the flange area with the appropriate impregnation agents to create internal impermeability. The resulting slight reduction in the insulation effect is compensated by the corresponding thickness. At higher temperatures, a certain acceptable amount of permeability is inevitable both after assembly and after a long period of operation.

2.1.2.4 Temperature and media resistance

		for FGD, FGC, WI plants*	Sustained temperature resistance		Short-term peak temperature		Acid-proof	Base-proof	Solvent-proof
Foils			**°C**	°F	**°C**	°F			
PTFE			**260**	500	**280**	536	+	+	+
Aluminium			**500**	932	**550**	1022	-	-	+
High-gradesteel				**600**	1112	**850**	1562	+	++
Coating Fabric									
PVC	Polyester		**60**	140	**65**	149	+	+	-
EPDM	Fibre glass	*	**100**	212	**120**	248	+	+	0
Silicon	Fibre glass		**220**	428	**230**	446	-	-	0
FKM	Fibre glass	*	**205**	401	**250**	482	+	+	0
PTFE[1)]	Fibre glass	*	**260**	500	**290**	554	+	+	+
Single-later composite material									
EPDM	with 1.45393[3)]	*	**100**	212	**130**	266	+	+	-
FKM	with 1.45393[3)]	*	**180**	401	**>250**[2)]	>572[2)]	+	+	0

[1)] sintered

[2)] temporary peak temperature; please contact KLINGER-Kempchen concerning insulation

[3)] also available with fibre glass

® registered trademark, DuPont

+ = yes | 0 = conditional | - = no

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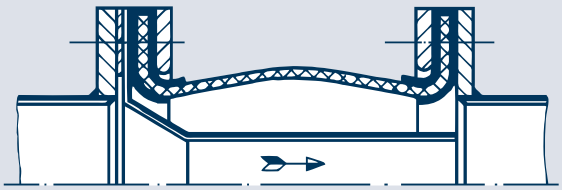
b) Another option is to fold in the outer protective layer and seal it at the flange; or wrap an additional fabric casing, for instance one which is coated with silicon rubber, all the way around the compensator flange as shown in Figure 2.1.2.5.1. This measure yields a suitably air-tight construction. After a long period of operation, however, greater permeability results with this measure than with solution a) above.

c) Another solution is construction according to 3.4.6.

2.1.2.5.1



2.1.2.6 Pulsation

High-frequency pulsating pressures such as exist in exhaust systems must be viewed extremely critically. Gaps in the compensator area must be kept as small as possible, and there must be sufficient amounts of firmly stuffed pre-insulation so as to prevent the fabric from fluttering.

2.1.2.7 Vibration

Vibrations are harmful to glass weave and quartz fabric (and to all other fabric as well). For this reason, compensators for shaking trough, for instance, should use sealing layers made of rubber foils or plastic foils, preferably without fabric if possible, or with polyester, nomex or Kevlar fabrics, which are more resilient.

2.1.3 Supporting layers

Chacteristic properties of supporting layers are their lesser expandability and greater stability in comparison to the sealing layers. The following reductions can be made if several supporting layers of equal expandability are arranged consecutively:

2 layers at k = 0.8

3 layers at k = 0.7

4 layers at k = 0.6

As a rule, the operating temperature must be below the sustained temperature resistance. If temporary peaks in temperature may be anticipated, please confer with our engineering consultants about the duration of these peaks and their potential reduction of stability and temperature resistance.

The supporting layers are always arranged behind the sealing layers in the direction of the decreasing pressure. The choice of the appropriate supporting layer in terms of temperature resistance and stability greatly depends on the proper pre-insulation, the reduction in pressure and the allowable sustained temperature resistance of the sealing foils.

Variations in expandability of the supporting layers are to be avoided, as the expandability of the least expandable layer will count.

KLINGER Kempchen uses the following supporting layers for the various temperature and operating conditions:

	Sustained temperature resistance		Short-term peak temperature	
Supporting layer, e.g.	°C	°F	°C	°F
Polyester fabric	**150**	302	**160**	320
Aramid fabric	**180**	356	**250**	482
Fibre glass	**400**	752	**450**	842
High-grade steel wire mesh	**600**	1112	**850**	1562
Silicate fabric	**1200**	2192	**1350**	2462

2.1.4 Protective layers, reinforced edge

2.1.4.1 Protective layers

The outer layer of the soft-material compensator serves to protect against environmental impact factors such as sun, rain, dust, industrial climate, sandstorms, etc. In order to provide adequate protection, the outer layer must also be mechanically resistant.

Protective layers made of fabrics laminated with materials such as neoprene/hypalon, viton, silicon, and PTFE have proven to be satisfactory in this regard.

It is important that heat-resistant protective layers made from glass weave sintered with PTFE foil allow surface temperatures up to 260 °C. The sealing layer, which might for instance also be made of PTFE, can then reach temperatures greater than the dewpoint and the formation of condensation can be reduced or prevented.

2.1.4.2 Internal flange sealing

Proper training in flange sealing is of major significance for the total concept of soft-material compensators.

Flange sealing on the heated inner surface serves the following purposes:

a) secures the insulation required of the other layers, particularly the sealing layer, and

b) ensures the functioning of the sealing in the flange area

This gives rise to somewhat of a conflict of interests; on the one hand, the flange sealing should be porous in order to retain heat in the flange; on the other hand, however, the sealing should be impermeable. KLINGER Kempchen uses the following materials for flange sealing depending on the temperature range and permeability requirement:

Materials for edge reinforcement	Sustained temp. resistance approx. °C	approx. °F
Fabric strips from Aramid thread	**180**	350
Fluorelastomer	**200**	400
PTFE strips	**260**	500
Fibre glass strips, non-impregnated	**450**	850
Fibre glass strips, impregnated	**450**	850
Quarz fabric strips, non-impregnated	**1000**	1800
Quarz fabric strips, impregnated	**1000**	1800

As an additional means of sealing the flange area, KLINGER Kempchen has developed a sintered PTFE flange barrier (DBP).

2.1.4.3 Reinforced outer edqe

The same materials are used here as described above. It is important that the outer edge reinforcement of bellied form

compensators be wide enough to prevent contact between outer protective layer and the counterflange, which is often at a high temperature, and the screw.

2.1.5 Materials for FGD* plants

Depending on the intended use, we recommend our ReaFlex and ReaTex compensators for FGD plants, see page 213.

* flue gas desulphurisation (German: REA)

FABRIC COMPENSATORS

2.2 Compensator protection components

2.2.1 Internal pass tube

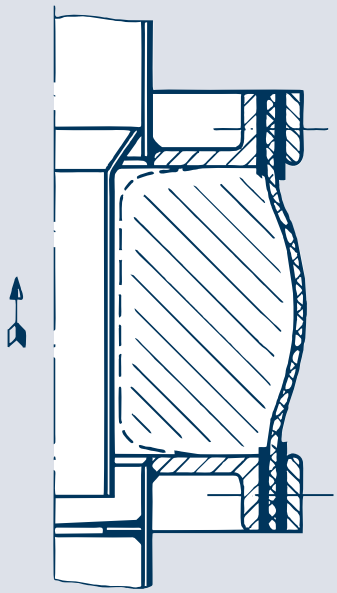
Pass tubes should always be used to protect fabric compensators.

Pass tubes prevent abrasion in dust-laden gas flows, protecting the fabric compensator from becoming damaged.

In clean gas flows, the use of a pass tube reduces the loss of pressure by allowing for more favourable operation in terms of flow technology. The temperature at the compensator is also reduced by using a pass tube. The space between the pass tube and the compensator can be used for insulation when filled with a heat-absorbing material, see 2.2.3.

In horizontal ducts, the pass tube should always be placed in the direction of the flow. In vertical or inclined ducts, it may be beneficial to arrange the pass tube against the direction of the flow in order to prevent the area between the compensator and the pass tube from filling with dust or condensation, etc. When the pass tube is placed against the direction for the flow, a pass tube plate should be placed at a short distance from the open end of the pass tube, see below. 2.2.1.3.1

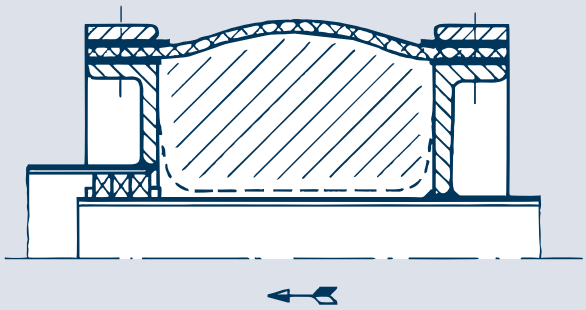
2.2.1.3.1



2.2.2 Protective devices and constructive measures for high dust incidence

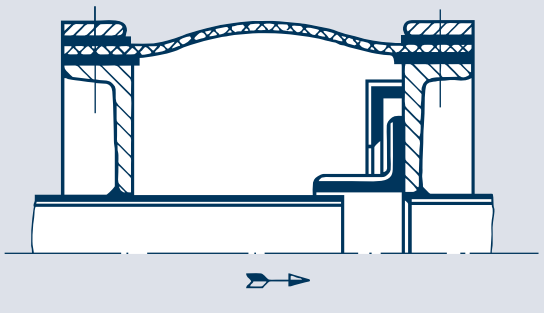
KLINGER Kempchen recommends the use of pass tubes as a general rule. However, in some cases it may be advantageous to refrain from using a pass tube. One such situation is a high incidence of dust that may accumulate as a result of humidity and/or temperature. Given the movement to be executed by the compensator in an axial or lateral direction, the compensator would be destroyed by the presence of a pass tube and the accumulation of dust. It is better to omit the inclusion of a pass tube so that the accumulated dust or mud formed can be released by the movement of the compensator unit itself. For dry dust, for instance that which can be found in cement factories, metallurgical plants or lime industry, a packing box with coarse packing cord is used for predominantly axial movement, as in Figure 2.2.2.2.1.

2.2.2.2.1



A design with a sash frame as shown in Fig. 2.2.2.3.1 has proven suitable for the absorption of both axial and lateral movements. The sash frame should sit with as little slackness as possible between the ducting flange and the pass tube so that the it can be moved both in the axial and lateral movement direction

2.2.2.3.1



Although sealing using sash frames does not yield a dust-tight seal, it will serve as a major barrier to the rapid penetration of dust into the space between the pass tube and the compensator.

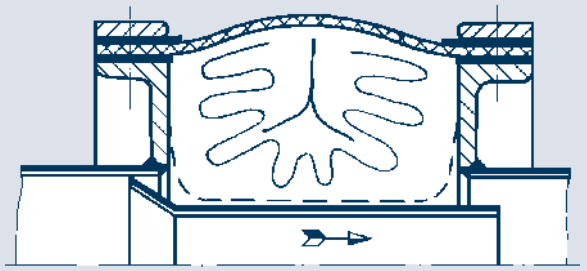
It may occasionally be necessary to remove part of the compensator to remove any dust that has penetrated.

2.2.3 Pre-insulation

High temperatures may necessitate that the space between the compensator and pass tube be used for housing pre-insulation, provided that there is sufficient room. In the event of high movement absorption, mineral fibre mats or quartz fabric mats may be wrapped in high-grade steel wire fabric for pre-insulation. Several such pre-insulation packs can be relocatably positioned so as to inhibit radiation exchange and partially prevent convective heat transfer.

A U-shaped folded insulation mat suffices for lesser movement absorption.

2.2.3.1



Proper design of the pre-insulation (including the parallel case design, see 3.4.6) is particularly essential in high temperatures. Another advantage of the aforementioned parallel case design is that the actual gap between the end of the ducts is only slightly larger than is necessitated by axial movement. In the operating state, this gap is closed save for a small safety distance. The pre-insulation housed in the space resulting from the staggered compensator connector flanges can be properly led and can absorb relatively large movements. Gas flows that are highly dust-laden require pre-insulation less for thermotechnical reasons than for preventing or at least reducing the penetration of dust by padding the space between the compensator and the pass tube. In the event of a very high incidence of dust, a proper pre-compensator may be necessary.

2.2.4 Outer protective grating, outer insulation

The customer may wish to use a protective grating or plate to protect the soft-material compensator against mechanical damages from falling parts - especially during installation - or from rain, snow- or sandstorms or other detrimental effects. When adding such protective mechanisms, a measure which is often taken retroactively, the potential effects on the insulation must be taken into consideration alongside the intended protective effects. Protective shields made from aluminium, for example, may alter the radiation exchange between the compensator's surface and the environment, an effect which must be taken into account. Even if spacers are used to ensure adequate convection, a non-allowableheating of the compensator's surface may occur.

The same applies to protective grating or rain hoods, particularly if they are affixed too tightly, thus preventing the necessary corrective cooling of the compensator's surfaces.

Soft-material compensators may only be insulated from the outside if the media temperature roughly corresponds to the hightest allowable temperature of the sealing layers. For compensators equipped with sealing layers made from silicon rubber or silicon-coated fabric, this means a temperature limit of 150 °C or 200 °C (see 2.1.2.4). For those equipped with sealing layers made from PTFE or glass weave, for instance, the temperature limit is 260 °C (see 2.1.2.4).

In the event of media temperatures in excess of these limits, the soft-material compensators may not be insulated from the outside, coated with paint, etc.

2.2.5 Protective devices and constructive measures for high condensation incidence, for FGD plants

At flue gas desulphurisation plants - and at other types of plants in all sectors of industry - condensation may occur in sufficiently large amounts as to require special measures. In horizontal ducting systems, the fluid may collect inside the compensator on the lower side of the duct and be released in the flange area. In order to prevent this undesirable occurrence, KLINGER Kempchen has developed special outlet nozzles made of PTFE as shown in Figure 2.2.5.1.1.

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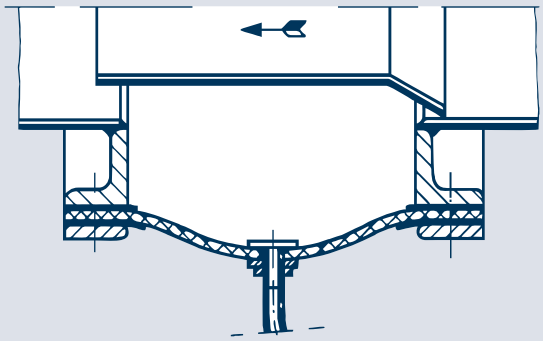
Using plastic piping strainlessly affixed at all direction levels, the fluid can be led away without any problem.

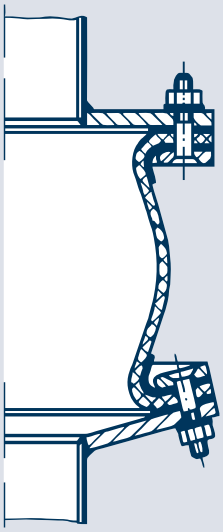
In the event of low pressure, please confer with us regarding the appropriate constructive measures.

2.2.5.1.1



In order to avoid fluid accumulation in vertical ducts, KLINGER Kempchen recommends setting the lower duct reinforcement, which generally also serves as a compensator flange, at an incline, as shown in Figure 2.2.5.2.1. The fluid can thus be led away from the clamping area.

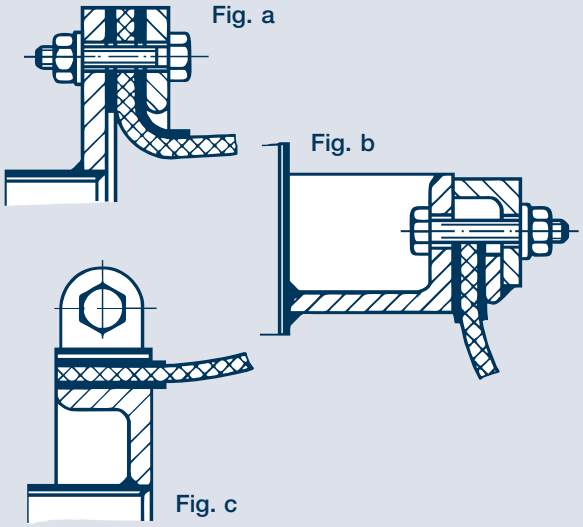
2.2.5.2.1



2.3 Compensator connection design

Fastening of the compensator can be achieved in the following ways:

1) using a through bolt and a screwed counterflange, Fig. a
2) without a through bolt, using a strap clamp, Fig. b
3) with band clamps, Fig. c

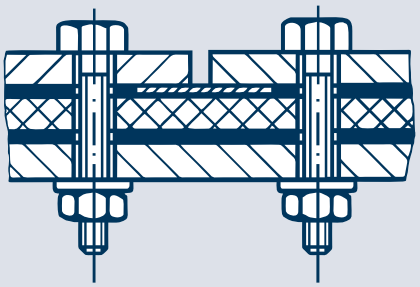


2.3.1 Screwed counterflanges

Through bolts are typically used for screwed flanges. The duct flange and compensator flange are equipped with through bolt holes for this purpose. In the event of greater pressure and installation lengths, which may be necessitated by greater movement absorption, screwed flanges are advantageous. One disadvantage of screwed flanges is the possibility that they may complicate the sealing process in the flange area. Further details on this topic can be found in Chapter 6.0.

As shown in Fig. 2.3.1.2.1, a partitioned execution is often chosen for counterflange frames. The gaps are bridged by placing thin sheets (0.5 mm thick) underneath. Particularly for smaller dimensions, however, non-partitioned frames are also common.

2.3.1.2.1



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It is important to note that the radii will decrease by approx. 25 % due to the compressability of the soft-material compensator flange, when the screws are tightened into place. Given a thickness of 16 mm for the soft-material compensator flange, and a compressability of 25 %, the circumference of a quarter circle changes corresponding to the change in radius of

$$\Delta U = \Delta r \cdot \frac{\pi}{2} = 6{,}28mm$$

In terms of the flanging radii, long slots in the steel clamping flange are therefore necessary for band compensators due to the change in thickness. The constructing engineer must take this into account when constructing the flanges. Therefore it is necessary to determine the design of the soft-material compensator, and with it, the compressibility of the soft-material compensator flanges. If the cross-section of the pipes is round, sufficient slackness for the screw can be achieved in the screw hole by partitioning the entire flange into a sufficient number of sections.

The thickness of the screwed counterflange is calculated according to the following table, which assumes a required surface pressure of 5 N/mm². The second criterion is the allowable deflexion of the counterflange, which is assumed to be a through beam with a distributed load. For flanges or counterflanges with an angle profile instead of the basic square profile, a narrower flange thickness may be chosen that corresponds to the greater moment of inertia.

Information on the required torque and determination of thickness for the counterflanges

1) Compensator and edge reinforcement made from elastomers (FKM, EPDM)
2) Fabric compensator with edge reinforcement made from FKM, EPDM
3) Fabric compensator with edge reinforcement made from fabric

Sometimes prescribed in construction, sometimes may be chosen. Please avoid dimensions in brackets! Bolt quality 5,6	Design	This torque is necessary to produce adjacent bolt force. Torque [Nm]* from	to	The chosen bolt creates the required sealing pressure in the range from l [mm]· b [mm] Bolt force [kN]**	The distance between the bolts may not be too large for two reasons: 1.) So that the surface pressure of 5 N/mm² for fabrics and 2 N/mm² for rubber can be attained Bolt distance l [mm]	2.) So that the deflexion and thereby the reduction in surface pressure are not too large. Bolt distance l [mm]	Typical measurements that have tested and proven suitable may serve as indicators. Flange width b [mm]	Bolt distance l [mm]	Flange thickness h [mm]
M 10	1	7	9	4,8	$l \le \frac{2370}{b}$	$l \le 3{,}7 \cdot h \cdot \sqrt[3]{b}$	30	80	8
	2	11	13	7,2					
	3	18	21	12,0					
M 12	1	12	14	7,2	$l \le \frac{3460}{b}$	$l \le 3{,}3 \cdot h \cdot \sqrt[3]{b}$	40	90	10
	2	18	21	10,8					
	3	30	35	17,6					
(M 14)	1	19	22	9,6	$l \le \frac{4760}{b}$	$l \le 3{,}0 \cdot h \cdot \sqrt[3]{b}$	40	120	12
	2	29	34	14,4					
	3	48	56	24,0					
M 16	1	29	34	13,0	$l \le \frac{6540}{b}$	$l \le 2{,}7 \cdot h \cdot \sqrt[3]{b}$	50	130	15
	2	44	51	19,5					
	3	73	85	32,5					
(M 18)	1	40	48	16,0	$l \le \frac{7940}{b}$	$l \le 2{,}5 \cdot h \cdot \sqrt[3]{b}$	50	160	18
	2	60	72	24,0					
	3	100	120	40,0					
M 20	1	56	66	21,0	$l \le \frac{10220}{b}$	$l \le 2{,}3 \cdot h \cdot \sqrt[3]{b}$	60	175	20
	2	84	99	31,5					
	3	140	165	51,5					
(M 22)	1	74	88	25,2	$l \le \frac{12760}{b}$	$l \le 2{,}2 \cdot h \cdot \sqrt[3]{b}$	60	210	25
	2	111	132	37,8					
	3	185	220	63,0					
M 24	1	96	114	28,8	$l \le \frac{14720}{b}$	$l \le 2{,}1 \cdot h \cdot \sqrt[3]{b}$	60	240	30
	2	144	172	43,2					
	3	240	285	72,0					

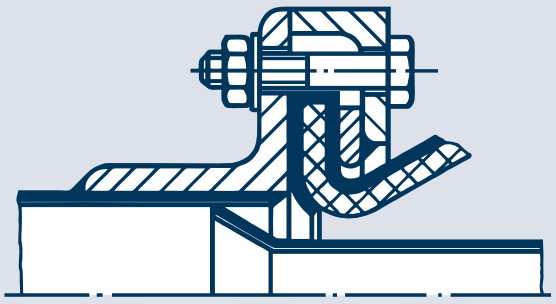
* The lower torque is to be used with well-lubricated screws, the higher with screws with poor lubrication. The indicated torques may be exceeded by a maximum of 50 %.

** The bolt forces indicated are based on the adjacent flange width and screw distance as well as the surface pressure required for the material.

2.3.2 Clamping flanges

For certain areas of application - for instance, in the presence of poisonous or combustible gases - the use of flanges with strap clamps are recommended instead of screwed flanges with through holes, as the former provide for a more air-tight seal. See also the typical design illustrated in Fig. 2.3.2.1.1. However, this special design is only advantageous for ducts with square cross-sections. In the case of round cross-sections, the strap clamps would need to be partitioned into numerous individual pieces to produce an evenly distributed clamping effect.

2.3.2.1.1

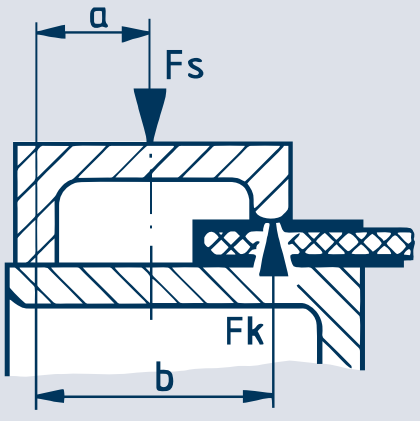


Although this type of connection has many advantages, including improved sealing possibilities, it cannot be used universally: due to its one-armed lever design, it requires more than twice as much bolt force than an ordinary through bolt to achieve the required surface pressure of 5 N/mm² in the soft-material compensator region.

As is shown in Fig. 2.3.2.2.1, the required bolt force $a \cdot F_S = b \cdot F_K$ is calculated based on the relationship as follows:

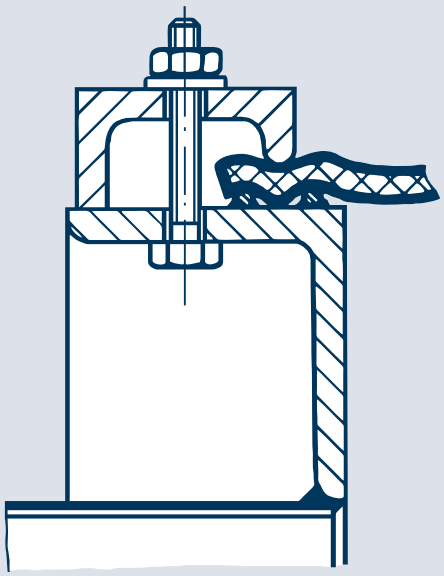
$$F_S = \frac{b}{a} \cdot F_K$$

2.3.2.2.1



An additional disadvantage of this design is its low retention force, even when measures are taken to increase the clamping force, for instance by soldering round wires onto the flange surfaces, as is shown in Figure 2.3.2.3.1.

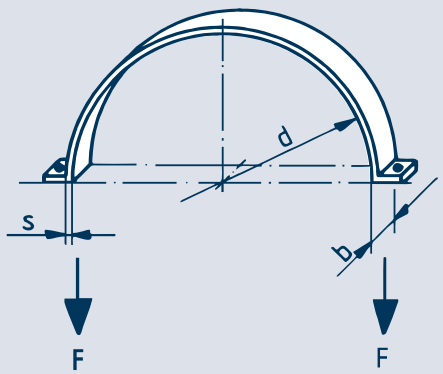
2.3.2.3.1



2.3.3 The band clamps

In certain limited situations, it may be advantageous to use band clamps to affix round compensators having a Type 120 hose connection or Type 110 elbow connection. Two factors determine the limitations for use: first, the fact that any band clamps used must be thin in order to function properly, as they are predominantly meant to transmit tensile stress rather than shear stress. Second, the clamping force is limited by the stability of the band clamps‘ material. A diameter of 800 mm yields a surface pressure of under 5 N/mm², or the amount of pressure required for screwed flanges (see Fig. 2.3.3.1.1).

2.3.3.1.1



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An ordinary band clamp gauge of s = 1,5 mm and a allowable band stress of σ_{zul} = 400 N/mm² result in a maximum diameter of only d = 400 mm if a surface pressure of σ_D = 3 N/m² is to be achieved. Greater diameters and band clamps with less resistance - or clamping screws not adequately tightened in relation to the resistance of the band clamp - therefore yield surface pressures significantly less 5 N/mm² and the proper impermeability is thus not achieved.

For safety reasons, it may be necessary to place two narrow band clamps (see Fig. 2.3.3.4.1) next to each other on the angle flange, so that in the event of failure of one band clamp - e.g. due to corrosion - the compensator is at least held in place by an additional band.

Example:

$$d \cdot b \cdot \sigma_D = 2F$$

$$b \cdot s \cdot \sigma_{zul} \geq F$$

$$d \leq \frac{2 \cdot b \cdot s \cdot \sigma_{zul}}{b \cdot \sigma_D} = 2 \cdot s \frac{\sigma_{zul}}{\sigma_D}$$

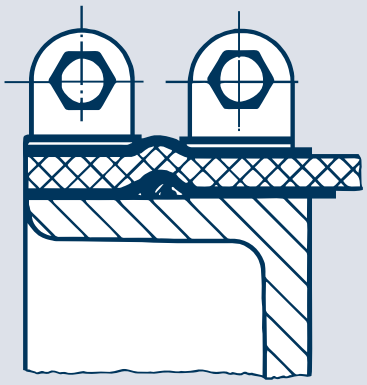
σ_{zul} = 400 N/mm²

s = 1,5 mm

d = 800 mm

$$\sigma_D \leq \frac{2 \cdot 1{,}5 \cdot 400}{800} = 1{,}5 N / mm^2$$

2.3.3.4.1



Another disadvantage of band clamps are the problems that arise from their use on flanges at higher temperatures. Because the flange of the soft-material compensator is a poor conductor of heat, a considerable temperature differential may arise between the band clamp and the duct flange. This will lead to either an overextension of the band clamp or an unallowable compression of the compensator flange, leading to a loss of impermeability after one or more instances of temperature change.

If in such cases there are particular reasons that require the use of band clamps rather than more advisable types of connections using screwed counterflanges, the use of clamp screws with disk spring sets of corresponding strength is strongly recommended.

When using band clamps, one must also take into account the fact that the clamping force of the turnbuckle will only yield the required surface pressure when in the immediate vicinity of the latter depending on the embrace friction. For this reason, band clamps have a maximum length of 1000 to 1500 mm. In the event of a greater diameter, two or more band clamps must be affixed consecutively. In such cases, the turnbuckles are to be moved accordingly, depending on the number of bands.

It can be said in summary that band clamps can be used only in relatively cool pipes (media temperature t < 200 °C) with a relatively small diameter (d ≤ 1000 mm) at relatively low pressure, (medium pressure p ≤ 0,1 bar)

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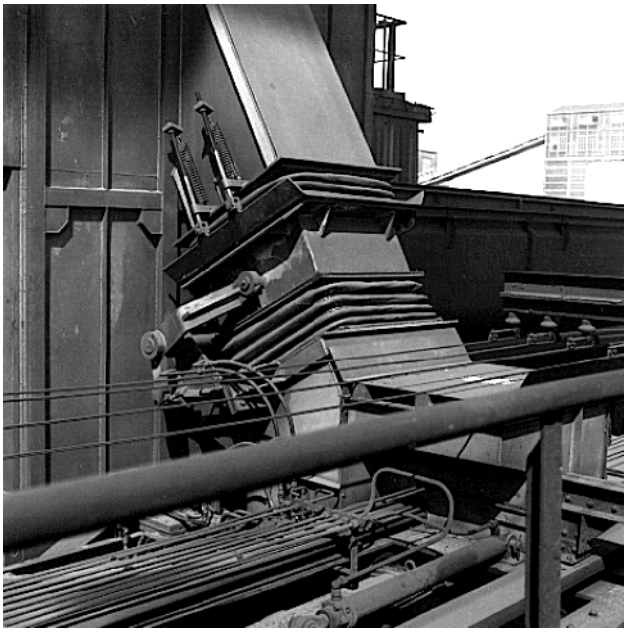
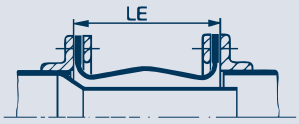
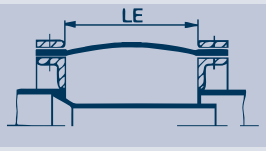
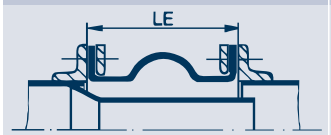
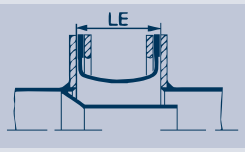
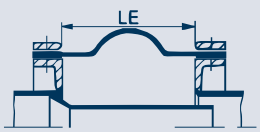
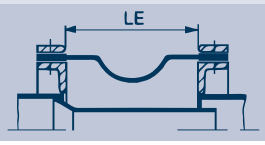
3.0 Compensator Models

Because of their universal utilisability and multi-dimensional movement absorption, soft-material compensators are not differentiated according to axial, lateral and angular capacities, as is the case with metal or rubber compensators. Rather, they are defined according to their degree of movement absorption and their type of connection, as is shown in the table below.



Compensator at hood truck of a coking plant

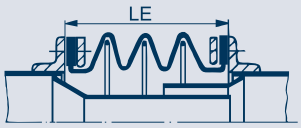
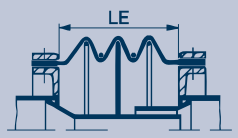
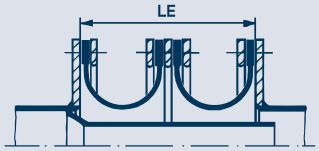
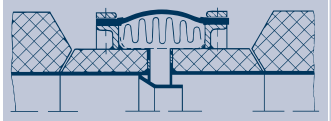
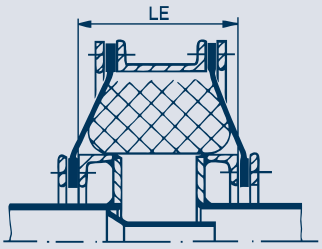
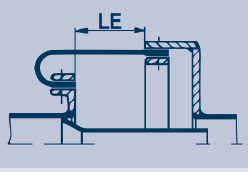
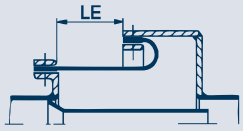
3.1 Overview table

	Type	Description	Bewegungs-aufnahme 1)	Comments Recommended LE dimensions
	110	U-shaped compensator	ΔI axial (0,1 to 0,3) LE ΔI lateral (0,05 to 0,2) LE	U-shaped and band compensators are the best value standard units for the majority of applications in circular and rectangular ducting. Type 110: LE = 150 to 400 mm Type 120: LE = 100 to 400 mm
	120	Band compensator		
	211	U-shaped compensator for overpressure	ΔI axial (0,2 to 0,5) LE ΔI lateral (0,1 to 0,2) LE	Particularly suitable for ducting with square or rectangular cross-section as a special corner construction if possible Type 211: LE = 200 to 400 mm Type 212: LE = 150 to 400 mm
	212	U-shaped compensator for low vacuum	ΔI axial (0,2 to 0,5) LE ΔI lateral (0,15 to 0,2) LE	
	221	Band compensator for overpressure	ΔI axial (0,2 to 0,5) LE ΔI lateral (0,1 to 0,2) LE	With rectangular compensators, the corners should be shaped by the height of the angular profile. LE = 150 to 400 mm
	222	Band compensator for low vacuum		

1) The movement values indicated are temperature-dependent. Our technical consultants can provide further information.

FABRIC COMPENSATORS

3.1 Overview table

	Type	Description	Movement-absorption [1]	Comments Recommended LE dimensions
	310	Pleat compensator with flange connection	ΔI axial (0,4 to 0,7) LE ΔI lateral (0,1 to 0,2) LE	Pleat compensators are particularly suitable for circular duct cross-section in the smaller sizes (up to about 2,000 mm diameter). With larger diameters only low pressures possible. LE = 200 to 800 mm
	320	Pleat compensator with band ends		
	412	Multipleshaped compensator with intermediate flanges and hinged trellis support. Also in single u-shaped design possible.	ΔI axial (0,4 to 0,7) LE ΔI lateral (0,1 to 0,3) LE	Multiple shaped compensators can be applied to large rectangular or circular duct cross-sections and are particularly suitable for large axial movement. The intermediate flanges can be supported by hinged trellis guides or special suspension systems. LE = 200 to 450 mm per u-turn
	120 GT	Parallel case design	ΔI axial (0,1 to 0,3) LE ΔI lateral (0,05 to 0,2) LE	The parallel case design was developed for rapidly increasing high temperatures, as among others common in gas turbines. See also 3.4.6.
	510	Membrane compensator	ΔI axial (0,4 to 0,7) LE ΔI lateral (0,1 to 0,2) LE	Membrane compensators are particularly suitable for large diameters, large axial movements and high temperatures. Compensators of this type require supporting or suspension systems. LE-dimension by agreement
	621	Tuck up band compensator for overpressure	ΔI axial (0,6 to 0,8) LE ΔI lateral (0,1 to 0,2) LE	Tuck up band compensators have proved particularly useful in conjunction with steel chimney liners, as they can absorb very large axial and lateral movements. LE-dimension by agreement
	622	Tuck up band compensator for low vacuum		

[1] The movement values indicated are temperature-dependent. Our technical consultants can provide further information.

FABRIC COMPENSATORS

3.2 Explanation of overview table

3.2.1

Types 110 and 120 are suitable for the absorption of small changes in length, as they are designed without bulges and thus without a special corner construction. They are therefore inexpensive to produce and can perform in a large range of applications.

3.2.2

Types 211, 212, 221 and 222 have a built-in bulge which doubles their capacity for axial and lateral movement absorption. The corner can be constructed as a mitre with a joint in the supporting layer or as a segment corner with two joints, see Fig. 3.2.2.1.

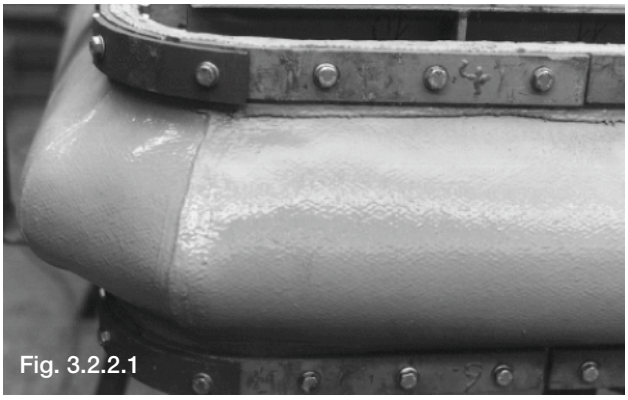


Fig. 3.2.2.1

3.2.3

The pleat compensator (type 310 and 320) or the multiple shaped compensator with intermediate flanges (type 412) absorb larger movements, particularly axial movements. Pleat compensators are specially designed for ducting with a round cross-section and smaller dimensions under approx. 2000 mm in diameter. Larger diameters are only allowable at low pressures.

Instead of the support wires ordinarily found in round pleat compensators, rectangular designs require flat iron support frames.

3.2.4

The type 412 multiple compensator in particular provides interesting possibilities for application, as long as the intermediate flanges required for types 412 and 510 can be suspended or supported. KLINGER Kempchen's hinged trellis supports for vertical and horizontal pipelines were developed for this purpose. See Figs. 4.3.1.1 and 4.3.1.2.

3.2.5

Tuck up band compensators can be designed for over pressure (type 621) or low vacuum (type 622). They are particularly suited for steel chimney liners. Tuck up band compensators are the preferred choice for use with large diameters. They absorb large axial and radial movements as may arise in conjunction with thermal striping in collector chimneys. They are connected via angle flange or hose connections.

3.2.6

The LE-dimension must be met during assembly, with the following tolerance: + 0 / -10 mm.

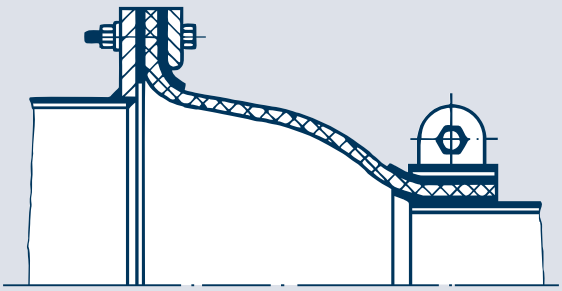
The lateral of the connector ends alignment must not exceed 10 mm during assembly.

3.3 Special models

Because of the diversity of demands placed on soft-material compensators, KLINGER Kempchen has developed a series of special models in addition to the standard models depicted in overview table 3.1. These special models include:

3.3.1 Compensators with different types of connections on each side - Fig. 3.3.1.1

3.3.1.1



3.3.2 Conical and truncated conical compensators

3.3.3 Compensators for wall ducts

FABRIC COMPENSATORS

3.3.4 Special compensators for rotary air pre-heaters

3.3.5 Special compensators for diesel engines, exhaust systems, Fig. 3.3.5.1

Fig. 3.3.5.1

3.3.6

These special models of our vulcanised rubber fabric compensators for flue gas purification plants (FGD) can be found in our special brochure on REA (meaning: FGD flue gas desulphurisation plant) compensators. Please see pages 211/ 212 for a thorough description of our solutions for sealing of lining joints in chimneys.

3.4 Notes on selecting and dimensioning a soft-material compensator.

3.4.1

We recommend selecting a compensator from the overview table if possible because of the price advantage of these standard models.

The maximum allowable movement absorption can be found in overview table 3.1. Please note that the smaller number applies in higher temperatures due to the thicker construction, while the larger number characterises the movement absorption of a thinner construction.

The dimensions for movement absorption presuppose that axial compression and lateral movement take place simultaneously. If this is not the case, it is important that you make mention of this when enquiring.

Reference values for the temperature-based elongation of attached duct cross-sections

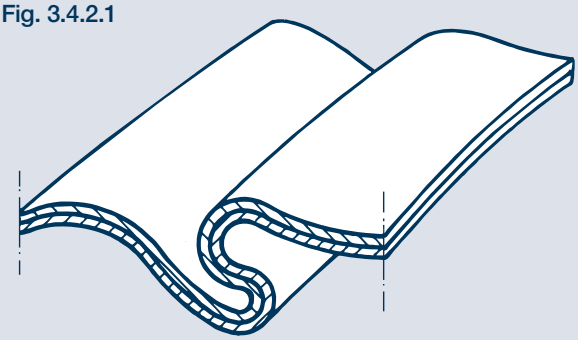
Extension dimensions in mm/m at temperatures from 20° C to

Temperature °C	50	100	150	200	250	300	350	400	500	600
Ferritic Steel	0,32	0,89	1,51	2,18	2,87	3,61	4,35	5,12	6,66	-
Austenitic Steel	-	1,34	2,08	2,97	3,76	4,75	5,69	6,64	8,62	11,2

3.4.2

It is important that the soft-material compensator's parallel construction of its insulating layer, sealing layer, wire layer and protective layer remain intact during the anticipated movement, no matter what kind of compensator is chosen. Puckering and buckling are to be avoided, particularly in the outer skin, as this may lead to overheating due to an obstruction of heat output. See Fig. 3.4.2.1.

Fig. 3.4.2.1



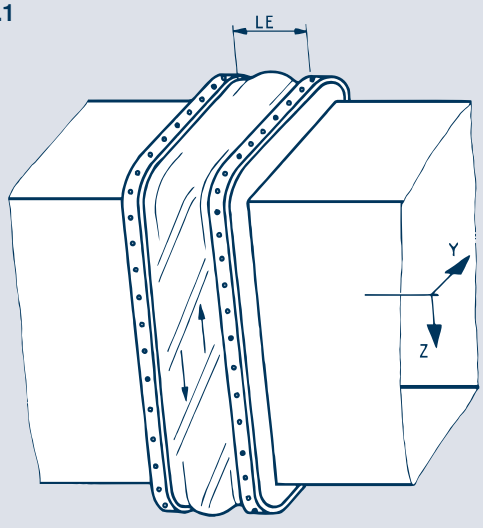
3.4.3

Lateral movement absorption is determined not only by the installation length LE of the flange distance, but also by the length of the side in which the lateral movement takes place. As shown in Fig. 3.4.3.1, a smaller lateral movement is possible in direction Z as in direction Y.

long side ≙ smaller lateral movement absorption

short side ≙ larger lateral movement absorption

3.4.3.1



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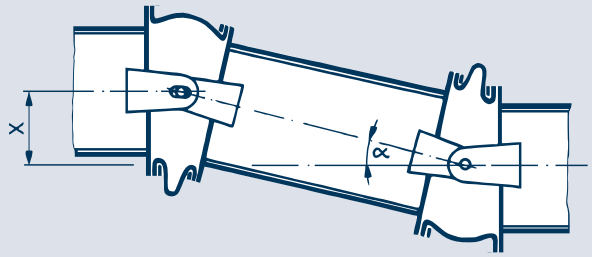
3.4.4

Constructive measures can be taken for particularly large lateral movements. A flexibly suspended section of ducting is one possible solution. The compensators are then loaded as shown in Fig. 3.4.4.1 and function as angular compensators.

3.4.4.1



3.4.5

Soft-material compensators intended for use as angular compensators must be equipped with a built-in bulge. They should be somewhat pre-loaded so that absorption of not only compression movement but also expansion can take place without the compensator becoming overloaded.

3.4.6 Parallel case design for reduction of compensator flange temperatures

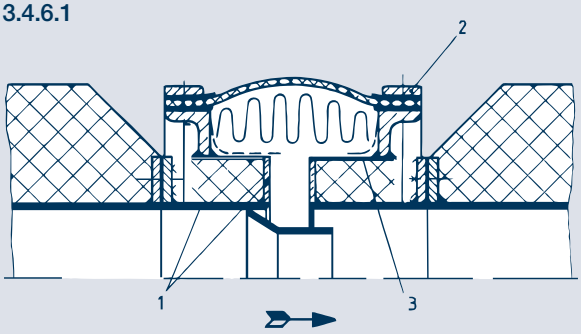
The flange construction in Fig. 3.4.6.1 demonstrates that the hot ducting sections (1) and the cold ducting sections (2) are separated by ducting sections (3), which are made from thin ferritic / austenitic steel with a thickness of only 1.5 to 3 mm.

Gas turbine plants have been designed with a daily start-stop cycle and thermal strain of approx. 600 °C, rising and falling in 6 minutes.

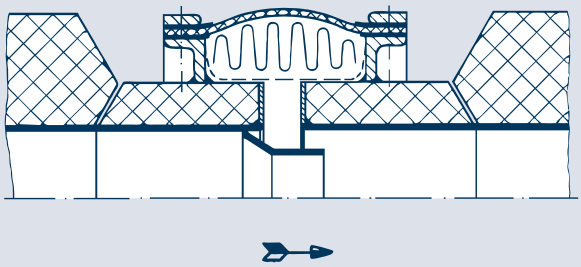
Other parallel case constructions have been designed in accordance with Fig. 3.4.6.2. The parallel case design is available as a screw-in unit or weld-in unit.

The advantage of these designs is the considerably lower temperature of the connection and compensator flange as well as the near closure of the gap between the ducting ends in operating condition.

3.4.6.1



3.4.6.2



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4.0 Connection options

The following descriptions of types of connections are intended to demonstrate the options available and their limits.

The temperature restrictions given depend to a large extent on the construction of the compensator. As an example, please keep in mind that these limits are approximately 100 °C lower for use on silicon or viton-coated fabrics than on fabrics coated with PTFE. PTFE-coated fabric can be used for sustained temperature ranges up to 260 °C, while silicon- and viton-coated fabrics can only be exposed to sustained temperatures of up 150 °C to 180 °C.

The options for attaching soft-material compensators are given in point 2.3.

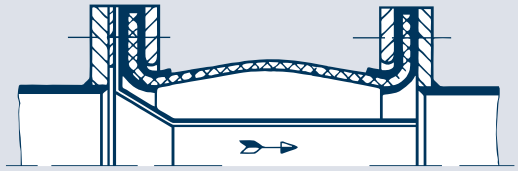
Only flanges with a flat face should be used as welding flanges or welding neck flanges, such as DIN 2526 Form B or DIN 28032 DIN 28034 Form D.

4.1 Flange connection design

Pipelines and ducting are often have angle steel or flat steelframe reinforcement, so that a flange connection already exists for the compensator. This very simple type of connection is possible at media temperatures between 350 °C and 400 °C, see Fig. 4.1.1. This connection also produces an optimal seal.

compensator in a pipe in of a blast-furnace

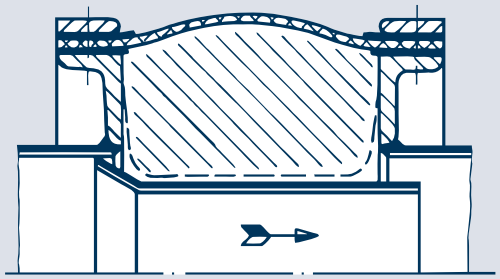
4.1.1



4.2 Designs for hose compensator connections

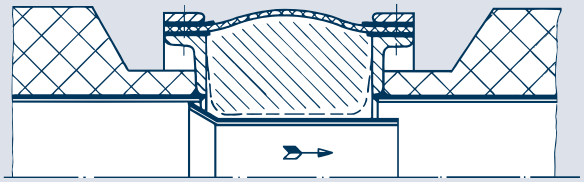
For media temperatures of approx. 400 °C and above, a reinforcement of the ducting ends using an angle or U-profile is recommended, so that compensators can be mounted with a hose connection (see Fig. 4.2.1).

4.2.1

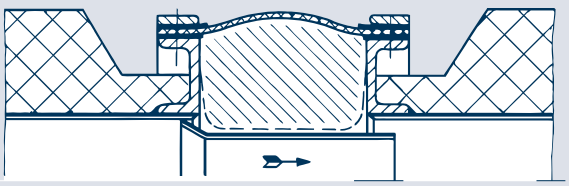


By selecting one of the designs shown in Figs. 4.2.2 and 4.2.3, and setting back the insulation somewhat in the flange connection area, flange temperatures can be reached that are approximately 100 °C than would otherwise be attained.

4.2.2



4.2.3



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Using band clamps for attachment (see 2.3.3) at diameters up to 1000 mm offers the advantage of avoiding screw holes. An additional advantage is the excellence of the seal attained. At diameters over 1000, screwed counterflanges are the preferred option. These offer a satisfactory sealing capacity.

4.3 Hingend trellis support / bar guides

Fig. 4.3.1.1

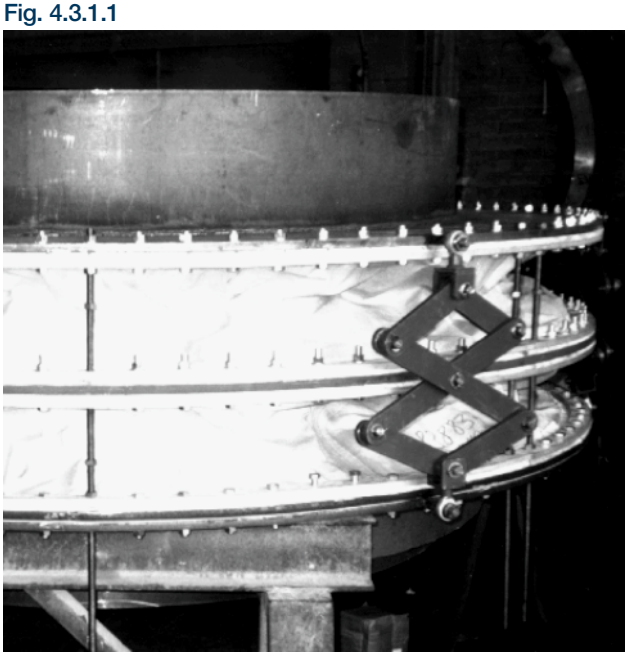
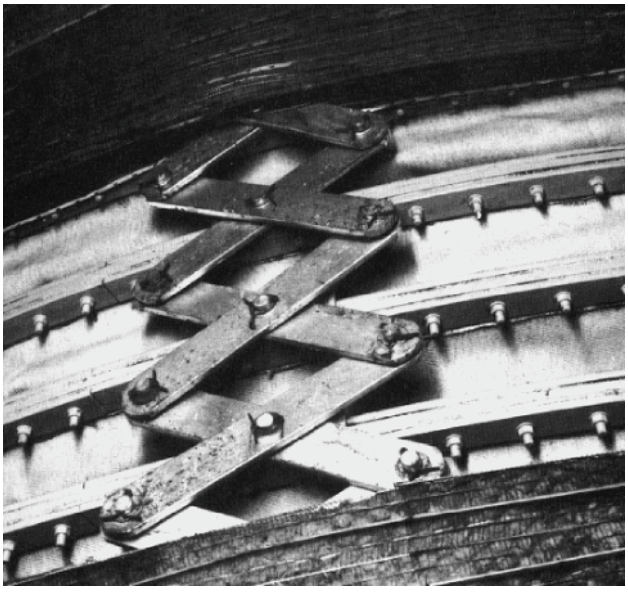


Fig. 4.3.1.2

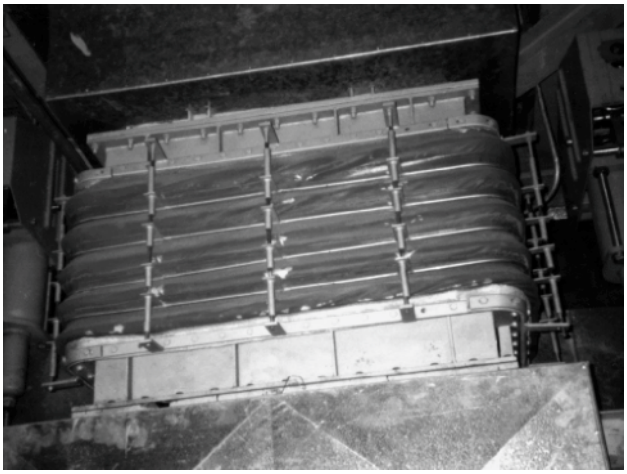


Compensator in the chimney of a coal power plant

As indicated in 3.2.4., the multiple shaped compensator can be used with an intermediate flange and hinged trellis support on large ducting cross sections and large axial movements in vertical and horizontal conductings.

The number of compensators and intermediate flanges necessary is determined by the size of the large axial movements to be absorbed. In order to avoid sagging or drooping in a horizontal or vertical direction, Kempchen has developed a hinged trellis support for this purpose (Figs. 4.3.1.1 and 4.3.1.2). The intermediate flanges are supported by hinged trellis and an even distribution of axial movement is carried over the entire multiple shaped compensator, without lateral step aside Bar guides have proven suitable for use in pleat compensators without intermediate flanges (Fig.4.3.1.3).

Fig. 4.3.1.3



Compensators at the entrance to a heat recirculation pipe at a sintering plant

5.0 Thermal calculation of compensator construction

The foils shown in Table 2.1.2.4 are used as sealing layers.

The highest allowable sustained temperature in the foil(s) or outer coating installed as a sealing layer represents the critical point in the temperature-dependent construction of the compensator. For this reason, these sealing layers serve as the thermal calculation criteria for the compensator's construction.

There are two main areas which must be distinguished: the free area between the two flanges and the loaded area of the compensator between the flange and the counter flange.

5.1

Constructive design of the soft-material compensator for ducting with round, square or other types of cross sections results in different behaviours for heat conduction and heat transfer.

In practice, there may be parallel layers in the free clamping area, to which the theoretical approach and simplifying assumptions (Point 5.3) may apply very well. However, in the pleat area there may be complicated ratios which are not easy to detect by calculation.

Heat transfer takes place through convection or radiation. However, heat transfer is to a large degree dependent on the temperature level and the temperature differential of the ambient air for convection, and on the surfaces standing in the radiation exchange.

Flow ratios also play a major role in heat transfer both inside the compensator and on its external protective layer.

Thus there is considerable variation among the outer surface temperatures of the protective layers of compensators in horizontal ducting. The highest outer surface temperatures occur as a result of thermally determined flow ratios in the middle of the underside and topside of the compensator. These areas are thus particularly vulnerable.

5.2

As is it nearly impossible to detect all of these operating conditions and limiting terms, the following simplifying assumptions are made:

1. We assume the soft-material compensator to be constructed from plane parallel heat insulation layers which allow heat to flow vertically to the two adjacent surfaces.
2. We consider the stationary condition to be that which is reached after a certain amount of time.
3. We assume that the temperature differential that causes the heat output from the surface into the ambient air via convection to be same as the temperature differential that causes heat transfer via radiation.

The following assumptions are made:

1. That the capacity for heat conduction depends on the temperature.
2. That the plane-parallel layer is thinner in the clamping area than in the free area.
3. That when stationary, the heat flow of the compensator through the individual layers may be assumed to be constant, allowing for computation of the temperatures on the parts of the soft-material compensator's individual layers in question.

5.3

The following are two typical temperature diagrams of standard superstructural parts.

In example 5.3.1., the critical point, which serves as the basis for thermal computation, is the external silicon layer 6.

In example 5.3.2., the critical point, which serves as the basis for thermal computation, is the PTFE foil 4.

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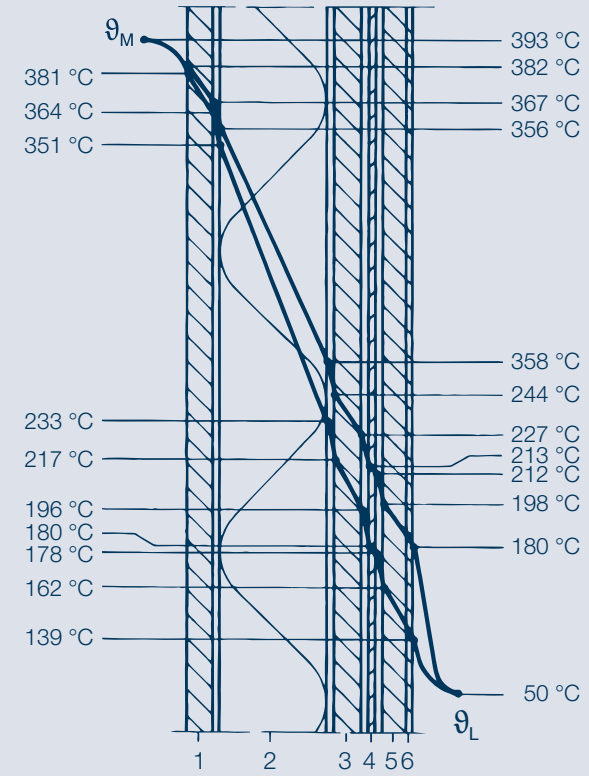
Temperature Curves

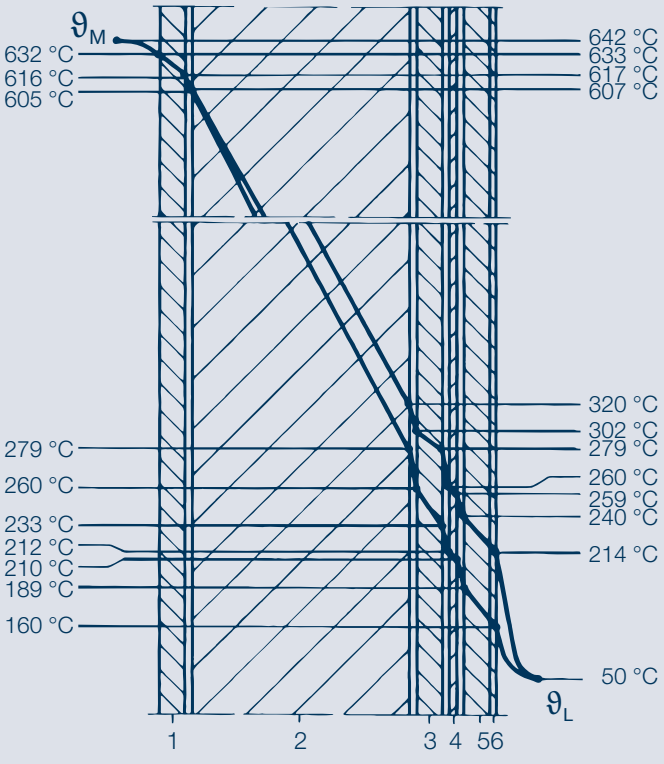


Example of Design

5.3.1 Temperature curve of a fabric Compensator with external silicon-coated layer.

1 Glass weave
2 Glass fibre mat
3 Glass weave
4 PTFE foil
5 Glass weave
6 External silicon coating

The upper/lower curve shows the temperature for restricted/free convection and radiation.



5.3.2 Temperature curve of a fabric Compensator with external PTFE layer.

1 Silicatex
2 Kerlane
3 Glass weave
4 PTFE foil
5 Glass weave
6 Outside PTFE coating

The upper/lower curve shows the temperature for restricted/free convection and radiation.

11

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6.0 On Impermeability in soft-material compensators and testing.

The impermeability required of a soft-material compensator varies widely by

» temperature range

» type of compensator

» medium.

Single-layer, compact rubber compensators, fabric compensators with flange sealings made of rubber, and fabric compensators with textile flange sealings can be used in increasingly greater temperatures. The demands for gas-tightness are to be reduced with increasing temperature stress.

6.1 Single-layer rubber compensators

The greatest level of impermeability can be attained with compact rubber compensators made from e.g. EPDM, butyl rubber or fluorelastomer. These compensators have a flange area and compensator bellows made of vulcanised rubber. The compensator bellows is equipped with a vulcanised metallic or non-metallic textile reinforcement. This type of compensator passes the Nekal test at surface pressure of approx. 2 N/mm².

In conformance with the quality and test specifications RAL-GZ 719 Section 2.2.6 ”Impermeability“, no bubbles may appear in the bellows area or clamping area, as a qualitative demonstration of the Nekal test. Depending on the type of rubber used, rubber compensators can be used at temperatures up to 205 °C. Below the dewpoint, these types of compensators are also impermeable when condensation is present.

6.2 Multi-layer fabric compensators with flange sealings made from rubber

For temperatures up to 260 °C we prefer to use fabric compensators with an internally sintered PTFE foil up to 0.5 mm thick. These compensators have been tested and shown to last for many years at both higher temperatures and incidences of greater condensation. They also pass the Nekal test due to the flange sealing, made of fluor rubber or PTFE, which is tightly attached to the PTFE coating

6.3 Multi-layer fabric compensators with textile flange sealings

This type of compensator is used at temperatures over 260 °C. The bellows area can be sealed using gas-tight rubber, plastic or metal foils. In the flange area, however, no gas-tight materials may be used at temperatures over 260 °C. The glass-oder ceramic weave stripes do not pass the Nekal test at high temperatures, but are flue gas tight.

Flue gas tightness refers to impermeability that meets technical standards. In the Nekal test, individual bubbles that appear via diffusion across the heat-insulating flange sealings are allowed in the flange area.

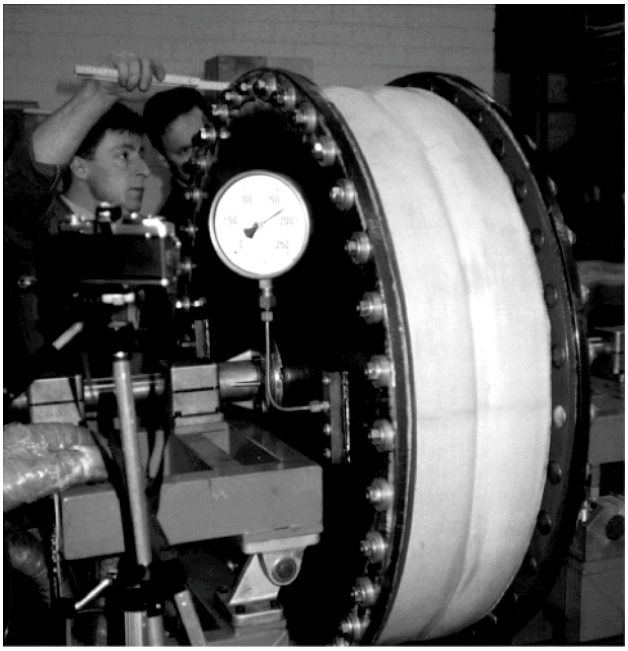
6.4 Conditions for impermeable soft-material compensators

The flange area is the weakest spot of the soft-material compensator. For this reason, the surface pressure and the attainable surface pressure and the actual surface pressure are of great importance during assembly.

Instructions for the proper thickness of the counterflanges depending on the width of the counter flange and the distance between the holes are given in 2.3.1.4. One precondition is that the ducting or piping flange is designed to be rigid, e.g. owing to the choice of an adequate thickness or due to elbowing.

The flange screws are to be tightened in accordance with the capacity and the relaxation properties of the compensator's various superstructural parts. Table 2.3.1.5 also provides instructions for this.

The screws should be re-tightened to the target moment one hour after completion of assembly.



Employees pressure testing a compensator
at the Kempchen compensator testing station

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7.0 Assembly and repair instructions

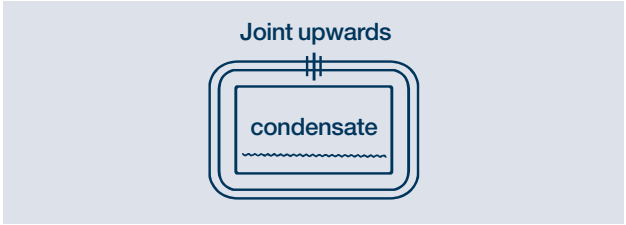
7.1 General instructions for closing a prepared site joint

» Take out the compensator and check which side is the inside. The outside is marked as such.

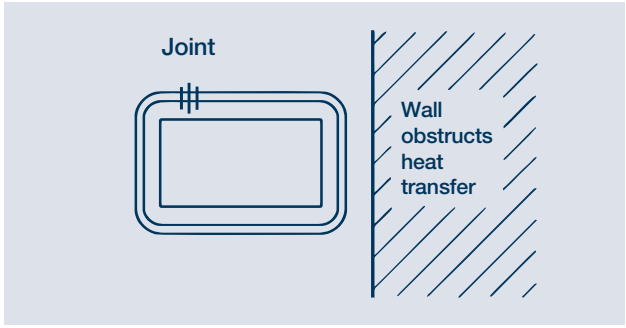
» Make sure the pass tube has no sharp edges. Any sharp edges must be refinished.

» Because the joint is naturally the weakest spot on the compensator, it should be placed in an area that can be expected to be exposed to low mechanical and thermal stress.

In horizontal piping and ducting at risk for condensation formation, the joint should be placed upwards

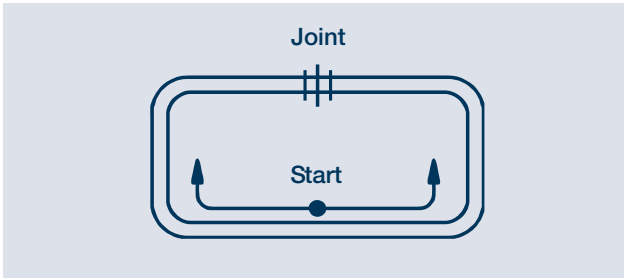


If you anticipate trapped heat because unfavourable arrangement of objects obstructs free convection, or a radiation exchange is taking place, the joint should be place on the area of the compensator which can be expected to remain coolest.



Check to make sure that the counterflanges are properly rounded.

» Begin assembly a compensator with a joint with screwed flanges in the middle of the compensator on the side across from area where the joint is to be placed, and continue to the open ends.

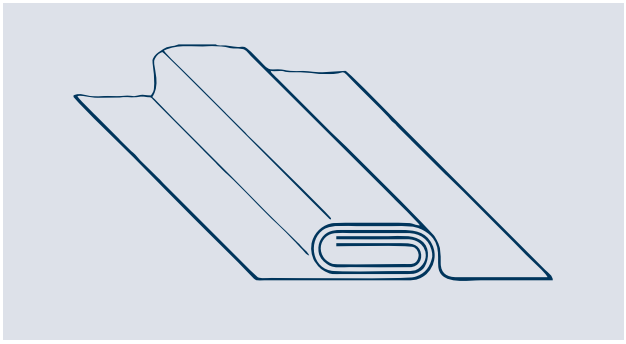


We recommend leaving approx. ½ m unscrewed to allow for proper freedom of movement.

» Now overlap the fabrics alternatingly. Sew the fabrics together, beginning from the inside. Do the same for any wire weave or rock wool layers.

Be especially careful when sewing together the sealing layers.

a) Glue the PTFE foil with Siemapren 1500 F(N) according to the illustration, fold, and interlock or weld in place

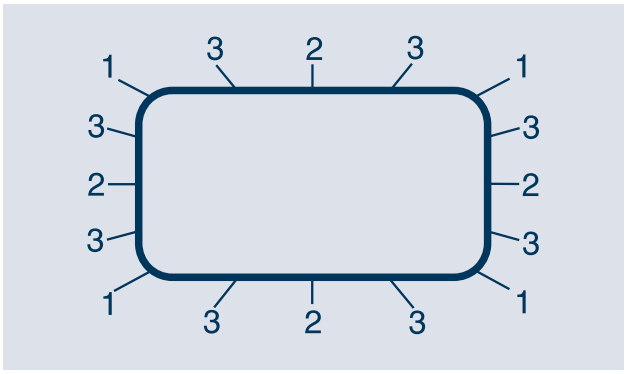


b) Glass fibres with a sintered PTFE layer and polyester fibres with viton coating are painted with viton solution B and sewn together.

Silicon-coated glass or polyester fibres are painted with silicon paste and sewn together. Finally, all stitches are sealed with viton solution and the compensator is mounted.

When assembly is performed by a Kempchen technician, the PTFE foils are professionally welded, and the sealing layers are welded with sintered PTFE foils using special site joint preparations.

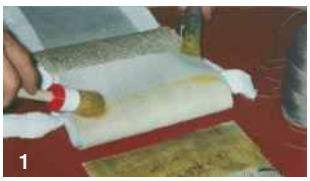
» The continuous band compensator should be mounted according to this sketch:



Begin assembly on corners. 1. Tighten one screw in the middle of each corner 2. Then each in the same way 3 etc. This method eliminates small waves or folds.

FABRIC COMPENSATORS

7.2 Special instructions for closing a prepared site joint and repairing the compensator of a type 110 or 120



Fibre construction:
1 Fibre glass layer with sintered PTFE foil
1 PTFE-foil layer, loose
1 Fibre glass layer with sintered PTFE foil

Inner and outer edge reinforcement, fibre glass strip

1. Loosen approx. 200 mm of the edge reinforcement. Cut the first inner layer to the proper length, leaving a 100 mm overlap. Apply adhesive to both sides and let dry approx. 4-5 minutes (1 + 2). Apply pressure with a hand roller if necessary (3).

2. Place a bent needle with thread approx. 20 mm from the edge. Make stitches 20 mm wide 10 mm apart across the entire width. Tie the ends of the thread into knots, create 2 seams (4 to 7).

3a. Stack the PTFE foils atop one another, staple the end and make multiple folds, approx. 20 mm wide, staple the final fold on both sides to prevent the foil from sliding (8 to 10).

3b. Weld the foil with a welding apparatus, if a foil welding apparatus is available on site, attach welding film to the ends of the foil (11).

Line up the other side without the welding foil precisely and staple. Set the welding tongs to 60 with the control device, press the button wait 20 seconds, release the tongs. Trim off any remaining welding film. Fold the welded foil once again (12+ 13).

4. Outer layer: with the outer layer turned away from the inner layer, paint both sides with adhesive and glue like the inner layer (14)

Important for the outer seam: A guard or thick PTFE foil or similar material must be inserted between the fabric layer and the PTFE foil to prevent the PTFE foil from being damaged by the needle (15).

Press over the glued portions with a roller (16).

Create seams as in the inner layer. Paint the seams with multiple layers of viton preparation to close the stitch holes of the seam. Make multiple paints until a closed film accumulates (17)

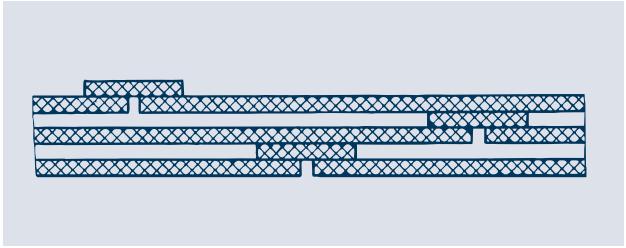
Stretch the reinforced edge to its exact length, lay the parts flush against one another and glue approx. 20 mm offset from the fabric seam (18).

Attach the inner edge reinforcement in the same way. Finished seam connection (19).

Control device, welding tongs, required equipment (20).

7.3 Repairing a compensator by separation and reconnection, if assembly in continuous form is not possible

This is a difficult task, because unlike the prepared joint, the separation point does not allow for easy overlapping. This method should only be used if the pass tube cannot be dismantled or other operating conditions prohibit assembly in an continuous condition. For this reason, one must thoroughly consider whether detaching and switching the pass tube and rewelding after partial assembly of an continuous compensator, for instance, is preferable to separating the fabric compensator. If the decision has been made to separate the compensator, the separation must take place layer by layer. Additional strips of material of the same or higher quality must be placed under respective separation points. Then the separation points must be connected to overlapped joints. Section 7.1 applies to the individual steps of the process.



7.4 Repairing mechanical damage or burn holes

In order for a repair to be successful, the ripped or cutted material aside must have sufficient stability.

» The damaged parts of the fabric are unfolded until the innermost layer is reached. In some circumstances it may be necessary to expand a small tear for this purpose.

» The innermost layer - wire mesh or textile fabric - is sewn with wire or special thread.

  Any insulation is returned to its proper position and covered with a proportionate piece of fabric.

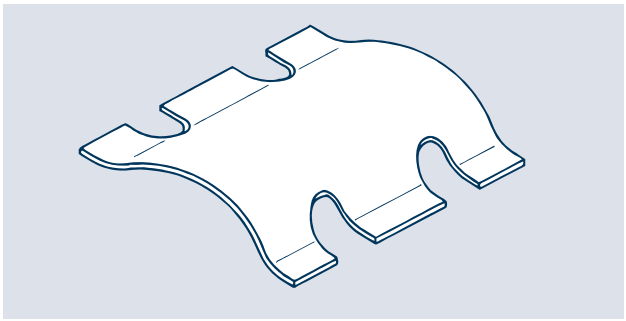
» Next a piece of the fabric layer in equivalent size is placed in front of the sealing layer. The sealing layer is painted with viton adhesive and glued to the piece of fabric, and a proportionate piece of fabric is sewn onto the sealing layer as well. The seams are in turns sealed with Viton.

» Any additional layers of damage are repaired as described above.

7.5 Emergency assistance

When damage occurs during operation and high temperatures prohibit the steps described in 7.3, it may be helpful to place a sheet metal strip over the site of the damage, particularly in band- or U-shaped compensators.

Loosen the counterflange and clamp a strip of sheet metal cut according to the illustration below in the screw hole area underneath. Attempt the recreate the shape taken on by the compensator. Seal the area between the metal strip and the compensator's outer skin with viton adhesive or silicon past



This type of repair presupposes that the position of both sections of piping or ducting have changed only slightly. However, this repair will generally allow for continued operation until the next shut-down.

8.0 Storage, installation and assembly instructions

8.1 Storage

Soft material compensators are sensitive to damage during transport and must therefore be transported properly. Be careful with sharp edges and pointed objects during transport!

Compensators must be properly stored until the time of installation. It is recommended that they be stored in climate-controlled metal trailers, from which they can be transported to the assembly site. The storage area must be heated at outside temperatures below 5 degrees Celsius.

FABRIC COMPENSATORS

When immediate assembly is not possible and the compensators must be temporarily stored at the assembly site, it is important that the compensators be protected from wet conditions, e.g. covered with a plastic tarp. When on-site, the compensators must be carefully stored on wooden palettes and protected from damage from assembly work (mechanical protection) or general construction site traffic.

Compensators that have become stiff from storage at low temperatures may not be used in this condition. They must be brought to room temperature in order to regain flexibility.

8.2 Installation

After installation, the following factors must be taken into consideration, particularly in the areas above the compensator:

» general protective measures during assembly work

» temperature protection (welding work)

» mechanical protection (welding and grinding work)

It is recommended that compensators remain protected if possible until initial operation.

Protective plates placed next to or above the compensator can obstruct heat radiation during operation. Normally, compensators may not be insulated. The same applies to the flanges, as a large portion of heat is transferred over the flanges. (Exceptions: Compensators with heat insulation or weather protective shields specially constructed for this purpose).

Fabric compensators may not be coated with paint or varnished. In certain types of compensators, the solvent can attack and destroy the compensator. Also, a varnish layer represents an unallowable insulation. There should be no sharp edges on the pass tube; any sharp edges must be repaired. The counterflanges must also be properly rounded.

8.3 Assembly

» The steel flanges are to be inspected for smooth welding seams and rounded edges and any repairs carried out.

» Bolt holes in the steel parts must be free of burrs

» The flange misalignment/the distance between the flanges must lie within the allowable tolerance

» Lay out the compensator and check which side is the inner site. The outerside is marked as such!

O With elastomer compensators and fabric compensators, with elastomer edge reinforcement, use the separating

agent provided. For directions for use, see the package.

The freedom of movement required for absorption of axial and/or radial movements is built in to the compensator. When installing, make sure that the compensator is pre-compressed so the installation length (LE dimension) is retained.

The joint/seam must be placed on the point of the compensator exposed to the least mechanical or thermal stress! In horizontal pipelines at risk for condensation formation, the inner seam must be placed at the top (12 o'clock) or on the side near the top - 2 or 10 o'clock. Stop assembly if the ambient temperature at the assembly site reaches values below 5 degrees Celsius.

It may be possible to partition off the ducting in the compensator area and heat the inside to temperatures > 5 degrees Celsius. Always check the outside temperature during assembly in the winter!

8.4 Notes on screw assembly of closed compensators

With screwed flanges, begin assembly of the compensator by placing one screw on each quarter of the circumference (C:4). The remaining sections are then halved again. The distance of 1 to 4 mm between the clamp frames is to be bridged by a shim of 0.5 mm in width. Then the screws may be tightened at half bolt force.

The full starting torque is to be applied to each screw in the second round of screwing. Important: make sure the intended surface pressures are attained! A precondition for this is that the ducting flange and clamping flange meet the aforementioned requirements.

When closing the ends of the band compensator, it is imperative to follow the instructions provided with the compensator.

The bolt screws are to be mounted with their head to the compensator so the remaining screw protrusion do not damage the compensator. After the initial heat phase, or if no initial heat phase is possible, re-tighten the screws to the required torque after 24 hours.

FABRIC COMPENSATORS

9.0 Elastomer, rubber and metal compensators

Elastomer compensators for FGD and FGP plants (see also 3.3.6)

These compensators are used wherever an increased incidence of chemical attack is anticipated. Depending on the elastomer quality, they can be used at up to 200 °C.

They are available for round and square-shaped conduit with or without pre-formed bulge at the edges and upon request with a vulcanised outlet nozzle with or without flange connection.

We produce elastomer compensators using a patented manufacturing technique with and without a pre-formed bulge at the edge area.

Edge without pre-formed bulge

Rubber compensators

With pressure-proof cord inserts for all sectors of industry to compensate expansions and to reduce noise and vibration transmission - also in a braced version.

kempchen - rubber compensator

Metal compensators

For high pressure and temperature loads, also in special steels and all weldable metals; with or without flanges, movement restrainers are supplied on request.

Chimney seals

Lining-joint seals made of fluor rubber terpolymer with wire mesh reinforcement made of high-alloy stainless steel are used to seal the expansion joint in chimney lining.

The sealing strip is attached to the lining by means of wall anchors and clamping strips made of high-alloy stainless steel. The clamping strips and wall anchors can also be coated with fluor rubber. Due to its special construction and the materials selected this seal can be subjected to a sustained temperature load of up to 200 °C.

Realon cords made of PTFE with a silicate-fibre core for permanent temperatures up to 260 °C and short-term peak loads up to 305 °C are used in chimneys to additionally safeguard the lining-joint seal.

FABRIC COMPENSATORS

Technical questionnaire for fabric compensators

An
KLINGER Kempchen GmbH
Im Waldteich 21
D-46147 Oberhausen

Please complete this questionnaire, answering as thoroughly as possible so that we may provide you with a professional quotation.

Company Name _____

Street Address _____

Location _____

Authorized Officer _____

Telephone _____ Fax _____

Dated _____ Order No. _____

Medium

☐ Flue gas ☐ Exhaust

☐ Air ☐ Other, please specify:

_____

Dust content: _____ mg/m³

Grain size : _____ mm

Dew point : _____ °C

Medium and ambient temperature

Operating : _____ °C

Interruption : _____ °C

Design : _____ °C

Ambient : _____ °C (Standard value 50 °C)

Is radiation being obstructed? ☐ no

☐ yes, specify source and nature: _____

Interruption for a

duration of _____ days or

_____ hours or

_____ minutes

accumulated over ☐ Life-span ☐ 1 year

Radiation from other plant components:

☐ no ☐ yes, specify source and nature: _____

Medium pressure

Operating pressure_____ mbar

Low vacuum _____ mbar

Design _____ mbar

Interruption _____ mbar

Alternating pressure load ☐ no ☐ yes, frequency ___ Hz

Pressure impact load ☐ no ☐ yes

Interruption for a

duration of _____ days or

_____ hours or

_____ minutes

accumulated over ☐ Life-span ☐ 1 year

Required seal impermeability: _____

Movement absorption

Axial extension :_____ mm

Axial compression :_____ mm

Lateral movement :_____ mm

Change of load: ☐ no ☐ yes, specify: _____ mm

Angular rotation: _____°

Vibration: ☐ no

☐ yes, frequency ____ Hz, Amplitude: _____ mm

Change of load: ____ times per

☐ year oder ☐ month or ☐ day or ☐ hour

Other conditions for use

Pipe lay on: ☐ horizontal

☐ vertical

Flow direction: ☐ upwards

☐ downwards

11

FABRIC COMPENSATORS

Usage area

☐ outdoors ☐ indoors

☐ Compensator must be insulated from the outside

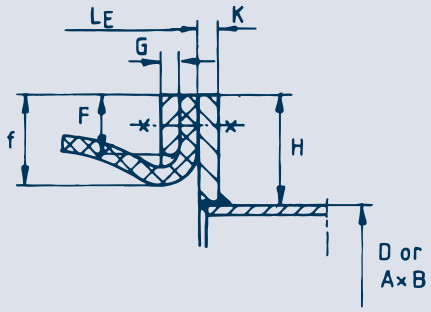
☐ Pipeline rinsing

Other (e.g. certificates, pressure tests):

_____

Dimensions / type of connection

☐ Flange connection (e.g. type 110)



☐ other type of connection (please provide drawing)

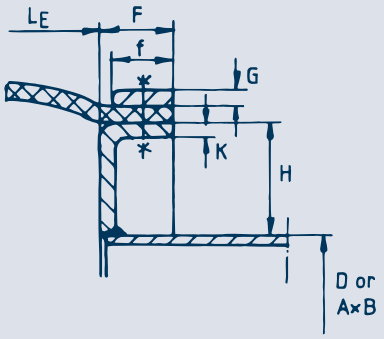
outer diameter	D	:_____ mm or
ducting dimension	A	:_____ mm
ducting dimension	B	:_____ mm
flange dimension	F	:_____ mm
thickness	G	:_____ mm
ducting flange	H	:_____ mm
thickness	K	:_____ mm

Design:

☐ closed or ☐ open

☐ with holes or ☐ without holes

☐ Band connection (e.g. type 120)



hole diameter	d	:_____ mm
number of holes	n	:_____
inside width between the flanges	LE	:_____ mm
flange height	f	:_____ mm

(optional for models such as type 110)

☐ The dimensions F, f, G, H, K und LE should be determined by KLINGER-Kempchen.

production based on

☐ measurements or ☐ drawing

☐ other (e.g. one-sided with holes), please specify:

_____

Scope of quotation desired and deadlines

Compensator pre-insulation (where necessary)	☐ be at hand	☐ quotation requested
Assembly	☐ be at hand	☐ quotation requested
Assembly supervision	☐ be at hand	☐ quotation requested
Assembly inspection test	☐ be at hand	☐ quotation requested
Backing flanges	☐ be at hand	☐ quotation requested, material: _____
Ducting flange	☐ be at hand	☐ quotation requested, material: _____
Pass tube	☐ be at hand	☐ quotation requested, material: _____
Connection screws for compensators with nuts and washer	☐ be at hand	☐ quotation requested, quality: _____

or:

Installation parts, pre-assembled ☐ quotation requested, material: _____

Surface treatment of steel parts provided:

☐ Zinc-coated

☐ Primer: _____

☐ Untreated

☐ Sandblasting: _____

☐ Final coating: _____

Quoting deadline: _____ **Anticipated delivery deadline:** _____

GENERAL INSTRUCTIONS

for installation, assembling and storage of soft-material compensators

This is a summary of the general instructions for installing, assembling and storage. Please refer to any special supplemental assembling instructions accompanying the individual compensator.

1. General remarks

Soft-material compensators are very sensitive to stress from impact and compressive stress, contact with sharp objects and overstress by heat. For this reason, the following safety measures are to be taken on site during and after assembling of the compensator:

1.1 During intermediate storage prior to assembling, make sure that the compensator does not come into contact with sharp or pointed objects, and that none are stored above or below the compensator.

1.2 Prevent damage during assembling work in the vicinity of the compensator by taking safety measures. A suitable cover must be used to protect the upper portion of the compensator from falling objects such as electrodes, screws, and toots. This is particularly important in the case of horizontal pipes. If any one side of the compensator is particularly at risk of being damaged, for instance in the presence of working being done with a crane, this side should be protected as well.

1.3 In the event of welding and grinding work being conducted near the compensator, the compensator must be protected by means of insulation from excessive temperature influence. Red-hot abrasive dust and electrode residues must be not be allowed to come into contact with the compensator.

1.4 As the aforementioned safety measures may obstruct the necessary heat transfer of the compensator, it is imperative that they be removed prior to initial operation.

1.5 Coating the fabric compensator with paint is not allowed, as doing so may obstruct heat transfer and the effects that the solvents contained in paint may have on the compensator are not known.

1.6 Unless arrangements have been made with Kempchen to the contrary, fabric compensators may not be insulated from the outside or equipped with a protective plate or grating. Obstruction of heat transfer is not allowable and will destroy the compensator. When in doubt, please contact us.

2. Steel construction

The steel parts to be used for attaching the compensator must be inspected before assembling is commenced.

2.1 All sharp edges in the region of the flanges and the pass tube must be rounded off.

2.1 Any holes drilled must be free of burs.

2.3 Inspect the flanges for possible damage. Scratches are to be touched up, tears in the direction of the duct centre are to be filled or ground (please observe the tolerance indication).

2.4 Welding beads on the flanges, traces from zinc-plating, etc., are to be removed so that a sealing connection can take place between the flange and the inside of the compensator.

2.5 The screw connections of soft-material compensators must provide for a certain surface pressure between the flange and the compensator. The torque indicated here is always based on easily movable screws.

2.6 On one side of the clamping flanges is a chamfer or rounding. Clamping flanges must also be assembled with the rounding on the side of clamping flange turned to the compensator.

3. Assembling preparation

Prior to assembling, please check to make sure that the installation dimensions corresponding to your drawing have been maintained. Allowable tolerances can be found in the tolerance indication on page 206. When in doubt, please consult with the construction manager or contact us.

At ambient temperatures below 5 C°, assembling soft-material compensators is only possible under limited circumstances at. Please consult with us before attempting to do so.

3.1 Take out the compensator, making sure that the surface underneath is free from sharp or pointed objects. Do not step, stand, or store any objects on the compensator.

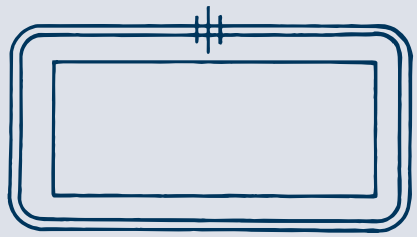
3.2 Locate the outer side of the compensator (marked with the word ”außen“ and the order number)

GENERAL INSTRUCTIONS

for installation, assembling and storage of soft-material compensators

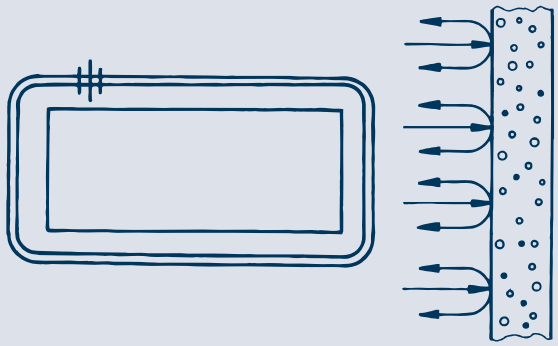
3.3 The joint is the weakest part of the compensator. It should be located on the spot exposed to the least thermal and mechanical stress. In the event of condensation collection in horizontal pipes and when heat transfer is not unobstructed, the joint is to be inserted into the upper part of the duct as shown in Fig. 1. Fig. 2. shows the placement of the joint when heat transfer is obstructed.

Figure 1



Joint placement in the event of condensation collection and unobstructed heat output

Figure 2



Joint placement in the event of obstruction of heat output by a wall

3.4 Determine whether a pass tube is to be installed. If so, please refer next to "Special instructions for installing pass tubes".

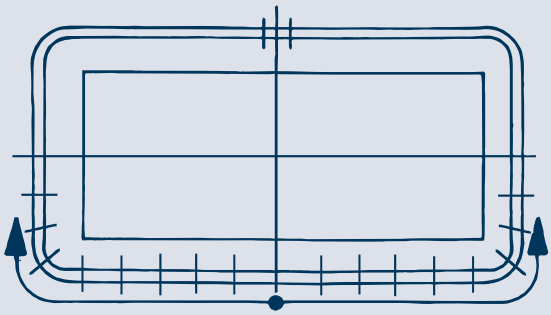
3.5 Determine whether pre-insulation is to be installed. If so, please refer next to "Special instructions for installing pre-insulation."

3.6 If the compensator is made from an elastomer or features an edge reinforcement made from an elastomer (FKM or EPDM), apply the enclosed anti-seize paste to the flanges to facilitate deassembling at a later date.

4. Assembling

4.1 Pull the compensator onto the flange. For angular compensators, have in mind the position of the corners and flanging radii. On the side turned away from the joint as shown in Fig. 3, start by fastening the compensator without a clamping iron with one screw per flange. Do not tighten these screws.

Figure 3



Assembling procedure

4.2 Starting with this screw, fix the compensator onto the flange both clockwise and counter-clockwise with additional screws. The number of the screws depends on the circumference. As a guideline, at least one screw per flange should be used per meter of circumference. Do not tighten these screws. The screws must always be equally fitted in both directions to avoid displaced assembling.

4.3 After the compensator is roughly set up on the flanges, begin assembling the clamping flanges. Next, remove the corresponding number of provisorily attached screws.

Important: Note the manner in which the screws must be arranged and whether

- a washer
- a disk spring set
- or both

will need to be installed, and arrange the screw set as required for assembling in order to simplify the process.

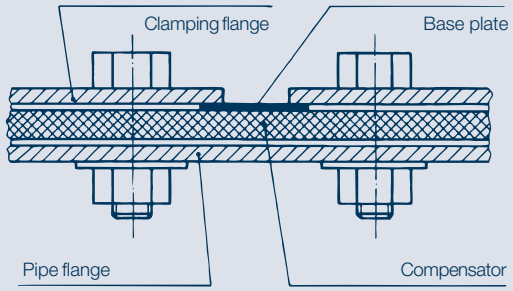
The screws should only be tightened by hand. If the compensator is delivered with open ends, please see "Special instructions for closing a compensator."

GENERAL INSTRUCTIONS

for installation, assembling and storage of soft-material compensators

4.4 Any base plates are to be placed between the segments of the clamping flanges, as shown in Fig. 4.

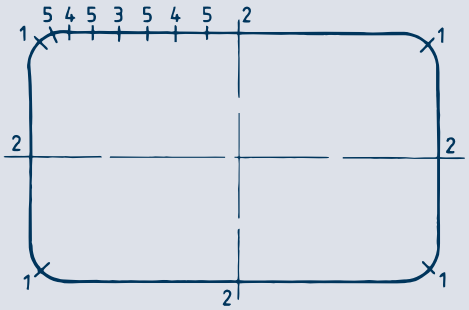
Figure 4



Base plate placement

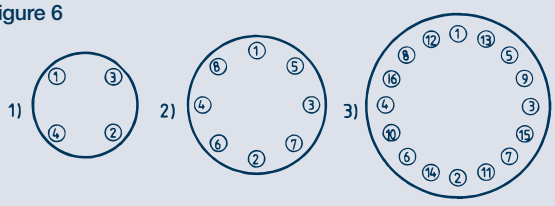
4.5 Begin by tightening the screws. The screws must first be tightened at approximately half torque. Next, perform a second round of tightening at the indicated torque. For angular compensators, see Fig. 5; for round compensators, Fig. 6.

Figure 5



Screw diagram for angular compensators

Figure 6



Screw diagram for round compensators

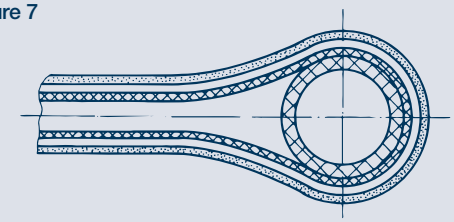
4.6 Initial assembling of the fabric compensator is complete; however, all screws are to be retightened at the indicated torque approximately 24 hours after the operating temperature has been reached for the first time.

5. Storage

Long-term storage of compensators as replacement parts must take place in the proper manner. Sharp kinks must be avoided, as these may result in breakage of the sealing foils. As shown in Fig. 7, the areas at risk for kinks should be supported by a cardboard roll.

Compensators stored at low temperatures (<5 °C) are to be warmed to room temperature before and during assembling.

Figure 7



Anti-kinking using cardboard rolls

6. Maintenance instructions

Fabric and elastomer compensators are typically maintenance-free. Compensators with horizontal piping and media with a high proportion of dust and/or condensate should be inspected regularly and cleaned from the inside when necessary.

Sedimentation restricts movement absorption and may cause damage! If the underside of the compensator feels hard to the touch and does not be squeezable, there may be internal sedimentation. The compensator should be inspected as soon as possible.

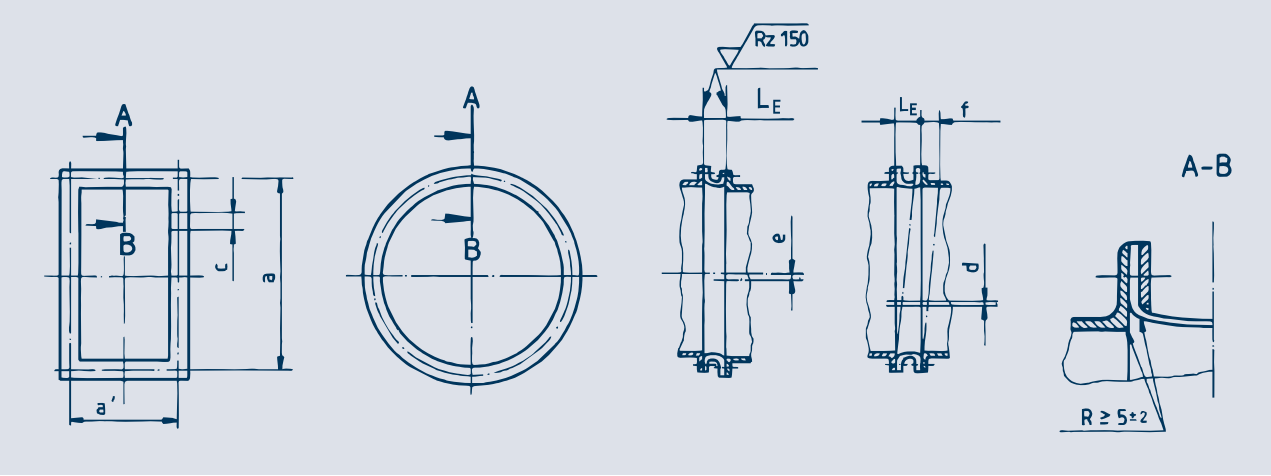
Sharp tools and pressure washers may not be used when cleaning the compensator.

The instructions for assembling apply to work on and near the compensator!

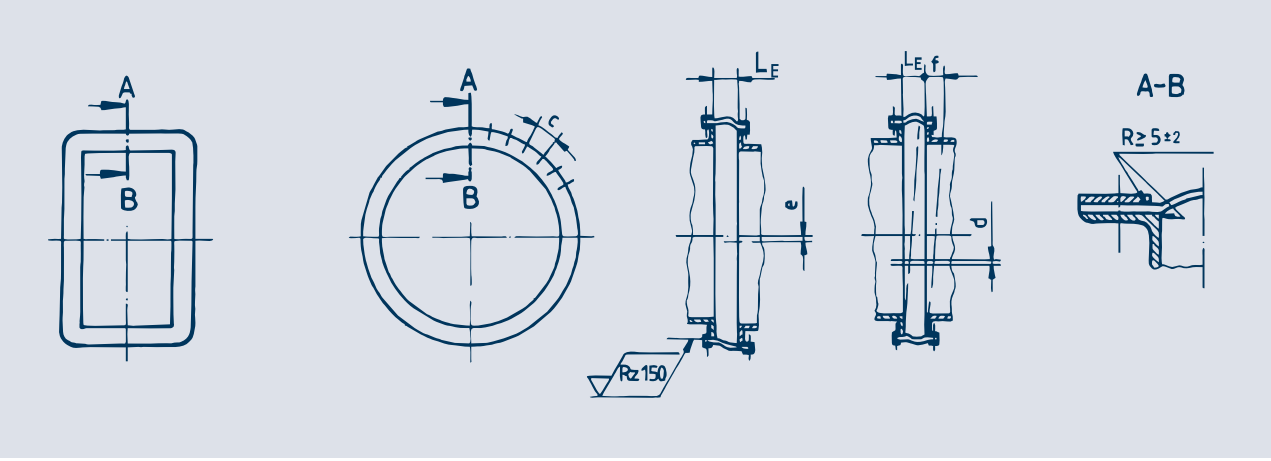
GENERAL INSTRUCTIONS

for installation, assembling and storage of soft-material compensators

7. Tolerances



U-shaped compensator (e.g. type 110)



Band-shaped compensator (e.g. type 120)

Table 1:

Diameter of bolt circle / distance between hole rows	a/a'	±3
Overall length	Le	±10
Hole distance	c	±1
Hole mismatch with counterflange	d	±3
Misalignment	e	±3
Inclination (parallel flanges)	f	±0,2 %
Surface roughness	max.	150 µm
Protrusion per 1000 mm measuring length	max.	±1 mm

- Joints may not have any misalignment
- The measuring deviations of the hole distances must not add up

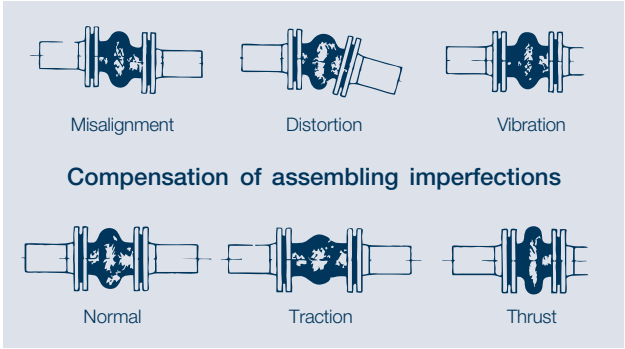
RUBBER COMPENSATORS

Design 1 + 2

Design 1 with rotating flanges

Highly elastic pipe connectors

For all sectors of industry, apparatus and pipeline construction, power plants, shipbuilding, fuel pumps, heating, climate control and ventilation plants, etc.



Use

Absorption of axial and radial expansion, noise, vibrations and oscillations. For subsidence of buildings and containers, assembling imperfections, for electrical insulation, for nearly total noise absorption in pipelines, domestic supply mains, heating systems, pump and motor connections.

Construction

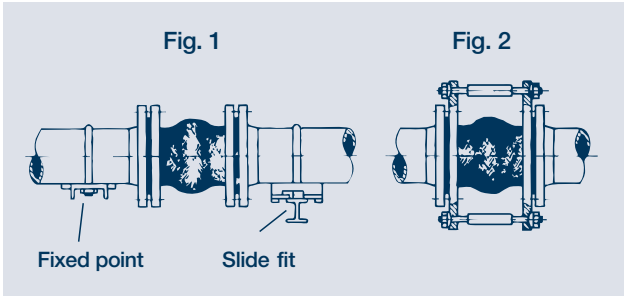
Smooth inside and out, high pressure-resistant textile fabric interlinings with moulded rubber stub end vulcanised on both sides, with embedded steel wire reinforcement that allows for accurate and complete adaption to the counterflange. Therefore no gaskets are necessary.

Flanges

Rotating, made from carbon steel, galvanised, zinc-plated and chromatised; or high-grade steel, plastic, etc., bored in accordance with DIN, also available in special designs in accordance with ASA, BS, etc.

Installation instructions

Low inherent resistance allows a very simple installation (no additional tools necessary). The pipelines are to be secured by a sufficient number of anchors (fixed points).



(Fig. 1) For axial expansion, our movement limiters (Fig. 2) serve a stroke-limiting function.

For lateral expansion absorption and for noise absorption, the movement limiters serve to relieve the load on the anchors.

Use

For noise absorption, rubber compensators with movement limiters (Fig. 2) and a shorter overall length are generally recommended for installation.

A shorter installation is also recommended for expansion absorption at a traction and thrust of +/- 20 mm. The installation for other operating behaviours is based on the expansion absorption. However, under no circumstances should the overall length exceed 130 mm. In the event of low pressure and high suction operation, use a high-grade steel inner support ring.

Available in various rubber qualities

Type	Surface (inner)	Surface (outer)
red	**EPDM***	**EPDM***
	for warm water, wastewater (including those with added acids and bases), water and drinking water (not suitable for media containing oil).	
yellow	**Perbunan***	**Neoprene***
	for petroleum products, premium fuel and cooling water with corrosion protection oils up to 90 °C	
green	**Hypalon***	**Hypalon***
	specially designed for acids and bases (chemicals) Pressure and temperature depending on the abrasiveness of the medium, up to 80 °C	
	Special design with ultra heat-resistant **textile interlinings**	
	EPDM*	**EPDM***
	for heating water, cooling water, hot air up to 110 °C (up to 6 bar); temporarily up to 130 °C Not suitable for drinking water or media containing oil	

* Materialcode designation see "Material commonly used".

Special advantages:

Low inherent resistance, short installation length, excellent axial and radial expansion absorption and noise reduction.

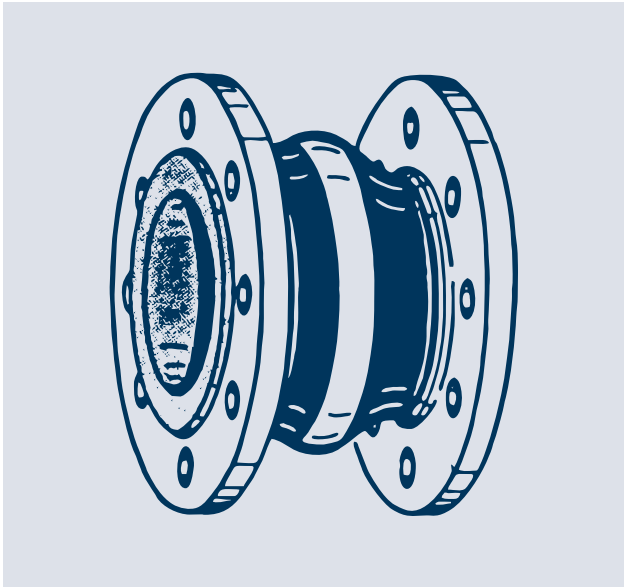
When making an enquiry or placing an order, please indicate:

Expansion absorption . . . . . +/- mm
Medium, operating pressure . . . . . bar
Operating temperature . . . . . °C

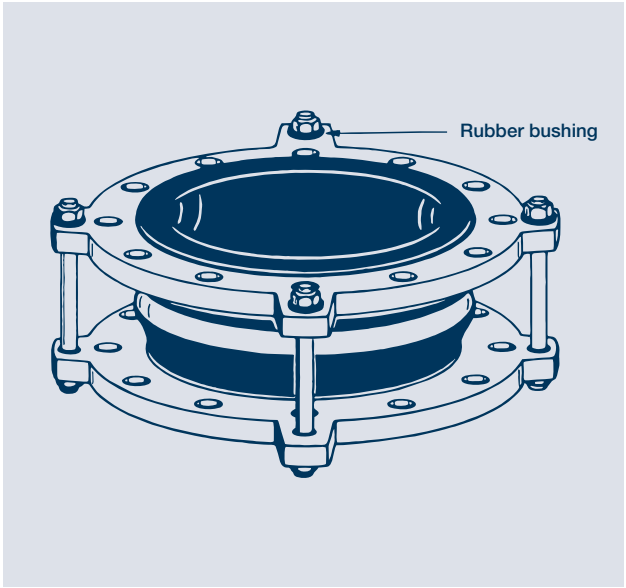
RUBBER COMPENSATORS

Design 1 + 2

Design 1 with rotating flanges



Standard design with lose rotating flanges on both sides



Standard design with noise-absorbing movement limiters

Dimensions for Type 1 with standard steel flanges

Allowable loads for types yellow, green, red

Nominal Flange mating dimensions according to DIN 2501									Pressure		Max. vacuum where L= Normal		Total length**			movement	
DN		Nominal-pressure	D	k	g	l	b	W	operating	test Cold water			L	L	L		
I.D. mm	I.D. in.	PN	mm	mm	mm	mm	mm	mm	bar	bar	without m WS	with m WS	Normal mm	Thrust mm	Traction mm	lateral ± mm	angular ± °
25	1"	10/16	115	85	66	4x14	18	81	16	25	7		130	100	160	30	35
32	1¼"	10/16	140	100	66	4x18	18	81	16	25	7		130	100	160	30	35
40	1½"	10/16	150	110	70	4x18	19	86	16	25	6		130	100	160	30	35
50	2"	10/16	165	125	90	4x18	19	96	16	25	6		130	100	160	30	35
65	2½"	10/16	185	145	105	4x18	19	111	16	25	6	10	130	100	160	30	30
80	3"	10/16	200	160	116	8x18	21	122	16	25	5	10	130	100	160	30	30
100	4"	10/16	220	180	138	8x18	21	142	16	25	5	9	130	100	160	30	25
125	5"	10/16	250	210	165	8x18	21	168	16	25	3	8	130	100	160	30	25
150	6"	10/16	285	240	190	8x23	21	192	16	25	3	8	130	100	160	30	20
200	8"	10	340	295	250	8x23	26	252	16*	25	2	8	130	100	160	30	15
250	10"	10	395	350	300	12x23	26	302	16*	25	2	8	130	100	160	30	10
300	12"	10	445	400	350	12x23	26	354	16*	25	2	8	130	100	160	30	10
400	16"	10	565	515	455	16x26	26	480	10	16	2	8	200	150	230	30	8
500	20"	10	670	620	555	20x26	28	580	10	16	2	8	200	150	230	30	6
600	24"	10	780	725	670	20x30	28	680	10	16	2	8	200	150	230	30	6

*) only for flanges PN 16
**) Special installation length on request

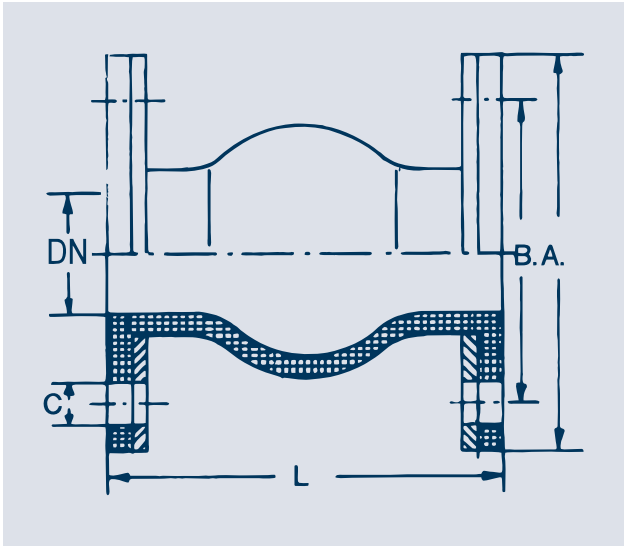
Materials, dimensions and/or application conditions subject to change at any time.

RUBBER COMPENSATORS

Design 1 + 2

Design 2

KLINGER Kempchen rubber fabric compensators with an extremely robust design for use in pipeline construction, ship-building, aggregate and power plant construction. Due to the flow-favourable bulge, they may be used both horizontally and vertically.



In EPDM quality, these parts are especially hot-water resistant and suitable for installation in hot water plants.

Rubber inside: Suitable for carrying freshwater, cooling water, ocean water and hot water up to 120 °C.

Interlining: Synthetic fibre, highly tear-proof and rot-resistant

Rubber outside: Non-aging, oil and weather-proof, and particularly flame-resistant

Flanges: Backing flange and collar rings made from carbon steel

Compensators are available upon request in NBR, chloroprene, EPDM (APTK), hypalon and drinking water design, with expansion limiters and teflon lining. Vacuum support rings can be inserted/incorporated; however, due to the construction of the compensators, these are not necessary in most cases.

KLINGER Kempchen rubber fabric compensators in design 2 are characterised by their reliability and durability.

DN	Overall length		Flange according to DIN 2632 PN 10		
l.	L	Nominal pressure	Outer-Ø (A)	Circle-Ø (B)	Number of holes x Ø (C)
175	180	6	315	270	8 x 23
200	180	6	340	295	8 x 23
225	180	4	370	325	8 x 23
250	180	4	395	350	12 x 23
300	185	4	445	400	12 x 23
350	225	4	505	460	16 x 23
400	225	4	565	515	16 x 27
450	250	4	615	565	20 x 27
500	250	4	670	620	20 x 27
600	250	3,5	780	725	20 x 30
700	250	3,5	895	840	24 x 30
800	250	3,5	1015	950	24 x 33
900	250	3	1115	1050	28 x 33
1000	250	3	1230	1160	28 x 36
1200	250	3	1455	1380	32 x 39
1300	250	3	1575	1490	32 x 42
1400	250	3	1675	1590	36 x 42
1500	250	3	1785	1700	36 x 42
1600	250	3	1915	1820	40 x 48

Materials, dimensions and/or application conditions subject to change at any time.

RUBBER COMPENSATORS

Design 1 + 2

Higher pressure ranges and flange designs in accordance with DIN for PN 6, PN 16 are available upon request. Different flange finishes, for instance zinc-plating, are also available.

Greater nominal diameter and differing installation lengths are available upon request

The availability of large quantities of moulding material enables us to provide for special requests regarding installation length and special designs during manufacture. Please make any special requests when indicating flange dimensions, pressure range, temperature, expansion absorption, vacuum and installation length.

Kempchen rubber fabric compensators counteract axial expansion and radial displacement that may arise from fluctuations in temperature and shocks. Damages caused by improper installation can be avoided by observing the following installation instructions.

Following these instructions is essential for the proper function and long duration of your compensator.

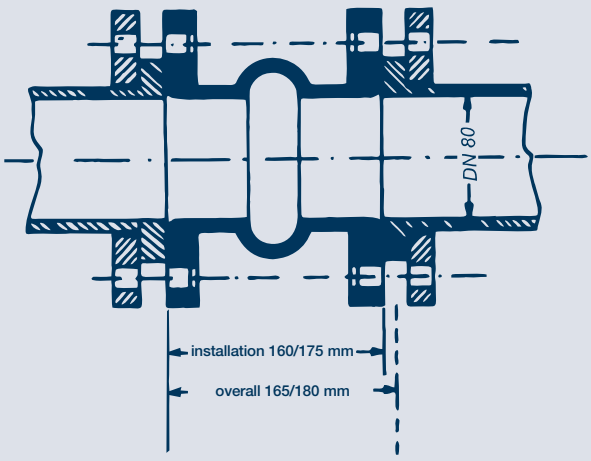
Assembling instructions

1. Screw bolts may be placed on both sides. The head of the screw should point to the bellows of the compensator.
2. Tighten screws above the comer, keep the key inside, turn outside to avoid damaging the rubber bellows with the tools.
3. Tighten the screws only moderately, as the rubber stup creates a good seal and excessively tight screws will crush the rubber stup.
4. Make sure that the pipeline flange corresponds to the nominal diameter in the inner Ø (DN of the compensator = inner Ø); otherwise, please contact us.

Installation instructions

1. Install rubber compensators in such a way as to allow inspection
2. If possible, load rubber compensators in thrust mode. Greater elongation in operation condition requires preloading. Torsion is not permissible.
3. The distance from the anchor or pipe ducts may not exceed 3 x DN. Only 1 compensator between 2 fixed points.
4. In the absence of a sufficient number of anchors, use the compensator design with a length-limiter to absorb reaction force. Length-limiters are always set at overall length.
5. Do not coat rubber compensators with paint.
6. Do not exceed the maximum allowable temperature stress (including external radiation heat).

Fig. 1



METAL COMPENSATORS

Metal compensators

Used to compensate for pipe expansions, as vibration dampers, as installation compensators for non-flooding pipes or to facilitate installation of pipe fittings.

The core piece of the compensators is the parallel corrugated, twist-free metal bellows, mainly made of stainless and acid-resistant steel alloys.

Materials

The standard versions of the steel bellows compensators consist of a stainless steel bellows made of materials 304ss – 316ss and 321ss with connecting parts made of carbon steel.

The compensators can also be manufactured from other stainless alloys and, for higher temperatures, from highly heat-resistant alloys 1.4828, Inconel, Hastelloy and the like.

Area of application of compensators

All compensators, which have neither an inner guide tube nor an outer protection tube, can absorb axial, angular and lateral movements as well as vibrations. Therefore, these types have a very versatile application and can be used for practically all cases.

Temperature

The permissible temperature of the standard versions with connecting parts made of carbon steel is up to +400 °C.

At higher temperatures, the connecting parts must also be made of alloyed steel.

Pressure and strain absorption

The values for pressure and deflection given in the tables apply at normal temperature. The values are reduced at higher temperatures.

It should also be noted that the test pressure must not exceed 1.5 times the nominal pressure at normal temperature. With angular and lateral loading, the permissible pressures are also reduced by approx. 30 %.

The total permissible axial deflection of a compensator consists of a plus deflection and a minus deflection, whereby plus deflection and minus deflection each amount to 50 % of the total deflection.

The values given in the tables for the different types of loading (axial and lateral) always apply when the expansion joint is subjected to only one type of loading. However, if the compensator is subjected to several load types, the values given must be reduced accordingly.

Fixed point forces

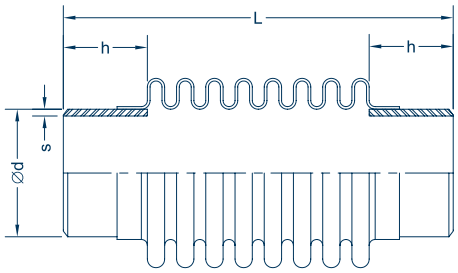
The fixed point forces are composed of the internal resistance of the expansion joint and the resulting force from the effective surface of the expansion joint and the operating pressure of the pipeline.

Installation of the compensator

If the compensator is used for axial expansion absorption, the installation length depends on the prevailing installation temperature as well as the minimum temperature occurring later in operation and the actual movement occurring.

METAL COMPENSATORS

WELD END TYPE - PN6



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
6 barg

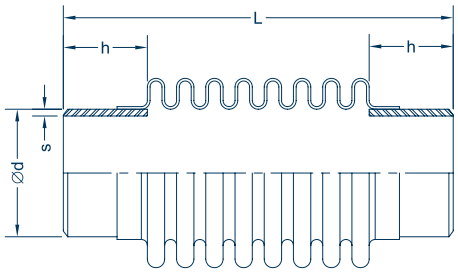
Weld end Material
Carbon Steel

Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm)		Length (L)	Spring Rates (N/mm)		d	h	s	Effective Area
		Compression	Lateral (+/-)	(mm)	Axial	Lateral	(mm)	(mm)	(mm)	(cm²)
25	1"	30	6	180	62	31	33,7	50	3	18
32	1¼"	30	6	180	62	31	42.4	50	3	18
40	1½"	30	7	185	54	31	48,3	50	3	23
50	2"	30	6	170	32	43	60,3	50	4	37
		45	10	225	50	26				
65	2½"	30	6	175	34	60	76,1	50	4	58
		60	11	230	53	32				
80	3"	30	3	160	41	145	88,9	50	4	80
		60	12	260	66	37				
100	4"	30	3	190	71	301	114,3	60	5	129
		60	9	260	72	82				
125	5"	30	3	190	84	511	139,7	60	5	185
		60	8	265	78	121				
150	6"	30	2	235	105	814	165	80	5	268
		60	7	285	63	187				
200	8"	30	2	250	146	1279	219,1	80	5	451
		60	7	310	91	310				
250	10"	30	2	290	154	2049	273	100	6	682
		60	7	365	86	369				
		75	8	385	77	267				
300	12"	30	2	320	355	4380	323,9	100	6	945
		60	6	400	197	800				
		75	9	450	162	428				
350	14"	30	2	310	386	5669	355,6	100	6	1127
		60	6	400	214	1036				
		75	8	450	175	554				
400	16"	30	2	320	250	4046	406,4	100	7	1479
		60	5	370	178	1520				
		75	8	420	139	728				
450	18"	30	2	320	307	6177	457	100	8	1839
		60	4	370	219	2321				
		75	6	420	170	1111				
500	20"	30	2	320	279	6909	508	100	8	2264
		60	4	370	199	2596				
		75	6	420	155	1243				
600	24"	30	2	320	530	18745	610	100	8	3227
		60	4	390	331	5003				
		75	6	450	265	2379				
700	28"	30	2	340	419	14565	711	100	8	4372
		60	5	425	262	3797				
		75	5	440	262	3363				
800	32"	30	1	320	755	45102	813	100	8	5705
		60	3	380	503	14411				
		75	3	410	431	9278				
900	36"	30	1	335	1194	70128	914	100	8	7201
		60	3	405	796	22008				
		75	4	450	682	13061				
1000	40"	30	1	340	1037	70455	1016	100	8	8885
		60	2	380	829	35891				
		75	4	450	592	13993				

METAL COMPENSATORS

WELD END TYPE - PN10



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
10 barg

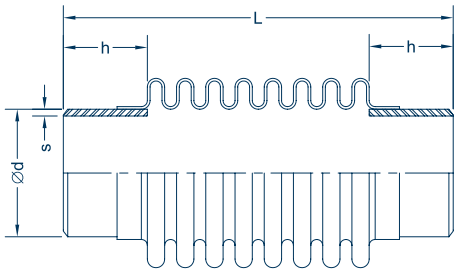
Weld end Material
Carbon Steel

Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm)		Length (L)	Spring Rates (N/mm)		d	h	s	Effective Area
		Compression	Lateral (+/-)	(mm)	Axial	Lateral	(mm)	(mm)	(mm)	(cm²)
25	1"	30	6	180	62	31	33,7	50	3	18
32	1¼"	30	6	180	62	31	42,4	50	3	18
40	1½"	30	7	225	93	30	48,3	50	3	23
50	2"	30	5	185	62	57	60,3	50	4	38
		45	8	215	106	55				
65	2½"	30	4	185	68	95	76,1	50	4	58
		45	6	215	98	77				
		60	10	240	105	56				
80	3"	30	4	185	66	124	88,9	50	4	80
		45	6	215	90	95				
		60	10	235	90	70				
100	4"	30	3	200	113	333	114,3	60	5	129
		45	5	230	88	159				
		60	7	265	109	118				
125	5"	30	2	200	134	641	139,7	60	5	187
		45	4	230	104	274				
		60	7	265	107	169				
150	6"	30	3	245	152	936	165	80	5	268
		45	4	270	118	448				
		60	6	315	127	245				
200	8"	30	3	265	211	1422	219,1	80	5	460
		45	5	305	158	584				
		60	7	330	140	385				
250	10"	30	2	310	292	2687	273	100	6	683
		45	5	360	195	888				
		60	7	395	159	499				
300	12"	30	2	310	355	4380	323,9	100	6	945
		45	3	360	254	1567				
		60	6	395	197	840				
350	14"	30	2	320	582	8653	355,6	100	6	1141
		45	4	370	364	2417				
		60	5	405	323	1509				
400	16"	30	2	320	474	7707	406	100	7	1483
		45	3	360	339	3242				
		60	5	400	296	1867				
450	18"	30	1	330	587	11842	457	100	8	1841
		45	3	375	714	7176				
		60	4	420	555	3626				
500	20"	30	2	340	758	14195	508	100	8	2268
		45	3	385	649	8039				
		60	4	430	505	3733				

METAL COMPENSATORS

WELD END TYPE - PN16



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
16 barg

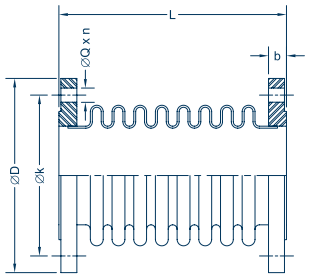
Weld end Material
Carbon Steel

Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm) Compression	Movements (mm) Lateral (+/-)	Length (L) (mm)	Spring Rates (N/mm) Axial	Spring Rates (N/mm) Lateral	d (mm)	h (mm)	s (mm)	Effective Area (cm²)
50	2"	30	4	185	117	109	60,3	50	4	38
		45	4	215	126	64				
65	2½"	30	3	185	128	179	76,1	50	4	58
		45	7	215	124	97				
		60	8	240	182	99				
80	3"	30	3	185	124	231	88,9	50	4	80
		45	7	215	123	129				
		60	9	245	166	121				
100	4"	30	3	200	145	484	114,3	60	5	129
		45	4	230	146	266				
		60	8	265	161	173				
125	5"	30	3	200	168	808	139,7	60	5	186
		45	5	230	126	333				
		60	7	265	171	267				
150	6"	30	2	245	350	2166	165	80	5	268
		45	4	270	171	648				
		60	7	315	191	379				
200	8"	30	2	265	513	3132	219,1	80	5	456
		45	4	305	338	1242				
		60	5	340	300	817				
250	10"	30	2	310	559	5149	273	100	6	684
		45	4	360	372	1517				
		60	5	395	335	1051				
300	12"	30	2	335	675	5823	323,9	100	6	964
		45	6	430	405	1282				
		60	10	510	347	616				
350	14"	30	1	335	739	7601	355,6	100	6	1155
		45	4	410	850	3840				
		60	7	480	638	1661				
400	16"	30	1	320	1545	25149	406,4	100	7	1486
		45	4	430	858	4157				
		60	6	490	702	2184				
450	18"	30	3	350	869	11727	457	100	8	1856
		45	6	430	579	3504				
		60	11	530	434	1316				
500	20"	30	2	330	1048	22570	508	100	8	2274
		45	3	390	749	7967				
		60	6	440	582	3981				

METAL COMPENSATORS

FIXED FLANGED TYPE - PN6



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
6 barg

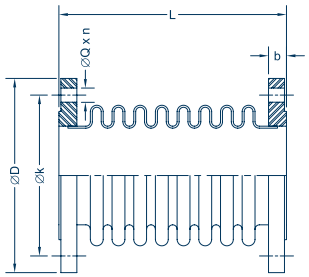
Weld end Material
Carbon Steel

Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm)		Length (L)	Spring Rates (N/mm)		d	h	s	n	Q	Effective Area
		Compression	Lateral (+/-)	(mm)	Axial	Lateral	(mm)	(mm)	(mm)		(mm)	(cm²)
25	1"	30	6	120	62	31	100	75	14	4	11	18
32	1¼"	30	6	120	62	31	120	90	14	4	14	18
40	1½"	30	7	125	54	31	130	100	14	4	14	23
50	2"	30	6	110	32	43	140	110	14	4	14	37
		45	10	155	50	26						
65	2½"	30	6	120	34	60	160	130	14	4	14	58
		60	11	170	53	32						
80	3"	30	3	105	41	145	190	150	16	4	18	80
		60	12	205	66	37						
100	4"	30	3	115	71	301	210	170	16	4	18	129
		60	9	185	72	82						
125	5"	30	3	120	84	511	240	200	18	8	18	185
		60	8	200	78	121						
150	6"	30	2	120	105	814	265	225	18	8	18	268
		60	7	175	63	187						
200	8"	30	2	145	146	1279	320	280	20	8	18	451
		60	7	200	91	310						
250	10"	30	2	145	154	2049	375	335	22	12	18	682
		60	7	220	86	369						
		75	8	240	77	267						
300	12"	30	2	170	355	4380	440	395	22	12	22	945
		60	6	260	197	800						
		75	9	310	162	428						
350	14"	30	2	165	386	5669	490	445	22	12	22	1127
		60	6	260	214	1036						
		75	8	310	175	554						
400	16"	30	2	180	250	4046	540	495	22	16	22	1479
		60	5	230	178	1520						
		75	8	280	139	728						
450	18"	30	2	180	307	6177	595	550	24	16	22	1839
		60	4	230	219	2321						
		75	6	280	170	1111						
500	20"	30	2	180	279	6909	645	600	24	20	22	2264
		60	4	230	199	2596						
		75	6	280	155	1243						
600	24"	30	2	170	530	18745	755	705	24	20	26	3227
		60	4	240	331	5003						
		75	6	310	265	2379						
700	28"	30	2	190	419	14565	860	810	24	24	26	4372
		60	5	270	262	3797						
		75	5	310	262	3363						
800	32"	30	1	170	755	45102	975	920	24	24	30	5705
		60	3	230	503	14411						
		75	3	280	431	9278						
900	36"	30	1	190	1194	70128	1075	1020	26	24	30	7201
		60	3	255	796	22008						
		75	4	330	682	13061						
1000	40"	30	1	165	1037	70455	1175	1120	26	28	30	8885
		60	2	205	829	35891						
		75	4	330	592	13993						

METAL COMPENSATORS

FIXED FLANGED TYPE - PN10



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
10 barg

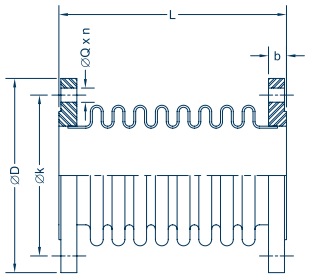
Weld end Material
Carbon Steel

Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm)		Length (L)	Spring Rates (N/mm)		d	h	s	n	Q	Effective Area
		Compression	Lateral (+/-)	(mm)	Axial	Lateral	(mm)	(mm)	(mm)		(mm)	(cm²)
25	1"	30	6	125	62	31	115	85	16	4	14	18
32	1¼"	30	6	125	62	31	140	100	16	4	18	18
40	1½"	30	7	155	93	30	150	110	16	4	18	23
50	2"	30	5	130	62	57	165	125	18	4	18	38
		45	8	155	106	55						
65	2½"	30	4	130	68	95	185	145	18	4	18	58
		45	6	160	98	77						
		60	10	185	105	56						
80	3"	30	4	130	66	124	200	160	20	8	18	80
		45	6	165	90	95						
		60	10	185	90	70						
100	4"	30	3	135	113	333	220	180	20	8	18	129
		45	5	165	88	159						
		60	7	205	109	118						
125	5"	30	2	140	134	641	250	210	22	8	18	187
		45	4	170	104	274						
		60	7	210	107	169						
150	6"	30	3	145	152	936	285	240	22	8	22	268
		45	4	170	118	448						
		60	6	210	127	245						
200	8"	30	3	175	211	1422	340	295	24	8	22	460
		45	5	210	158	584						
		60	7	230	140	385						
250	10"	30	2	180	292	2687	395	350	26	12	22	683
		45	5	235	195	888						
		60	7	275	159	499						
300	12"	30	2	165	355	4380	445	400	26	12	22	945
		45	3	205	254	1567						
		60	6	245	197	840						
350	14"	30	2	170	582	8653	505	460	26	16	22	1141
		45	4	215	364	2417						
		60	5	255	323	1509						
400	16"	30	2	170	474	7707	565	515	26	16	26	1483
		45	3	210	339	3242						
		60	5	255	296	1867						
450	18"	30	1	185	587	11842	615	565	28	20	26	1841
		45	3	230	714	7176						
		60	4	270	555	3626						
500	20"	30	2	195	758	14195	670	620	28	20	26	2268
		45	3	235	649	8039						
		60	4	285	505	3733						

METAL COMPENSATORS

FIXED FLANGED TYPE - PN16



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
16 barg

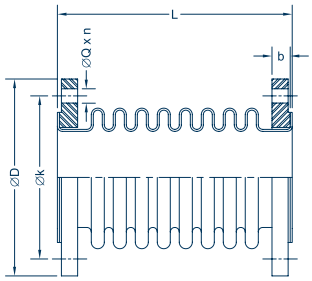
Weld end Material
Carbon Steel

Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm)		Length (L)	Spring Rates (N/mm)		d	h	s	n	Q	Effective Area
		Compression	Lateral (+/-)	(mm)	Axial	Lateral	(mm)	(mm)	(mm)		(mm)	(cm²)
50	2"	30	4	120	117	109	165	125	18	4	18	38
		45	4	150	126	64						
65	2½"	30	3	120	128	179	185	145	18	4	18	58
		45	7	150	124	97						
		60	8	180	182	99						
80	3"	30	3	120	124	231	200	160	20	8	18	80
		45	7	150	123	129						
		60	9	180	166	121						
100	4"	30	3	120	145	484	220	180	20	8	18	129
		45	4	150	146	266						
		60	8	185	161	173						
125	5"	30	3	125	168	808	250	210	22	8	18	186
		45	5	155	126	333						
		60	7	190	171	267						
150	6"	30	2	130	350	2166	285	240	22	8	22	268
		45	4	155	171	648						
		60	7	200	191	379						
200	8"	30	2	150	513	3132	340	295	24	12	22	456
		45	4	190	338	1242						
		60	5	230	300	817						
250	10"	30	2	165	559	5149	405	355	26	12	26	684
		45	4	205	372	1517						
		60	5	245	335	1051						
300	12"	30	2	200	675	5823	460	410	28	12	26	964
		45	6	300	405	1282						
		60	10	380	347	616						
350	14"	30	1	210	739	7601	520	470	30	16	26	1155
		45	4	290	850	3840						
		60	7	370	638	1661						
400	16"	30	1	210	1545	25149	580	525	32	16	30	1486
		45	4	310	858	4157						
		60	6	365	702	2184						
450	18"	30	3	240	869	11727	640	585	32	20	30	1856
		45	6	320	579	3504						
		60	11	405	434	1316						
500	20"	30	2	215	1048	22570	715	650	34	20	33	2274
		45	3	270	749	7967						
		60	6	330	582	3981						

METAL COMPENSATORS

FLOATING FLANGED TYPE - PN6



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
6 barg

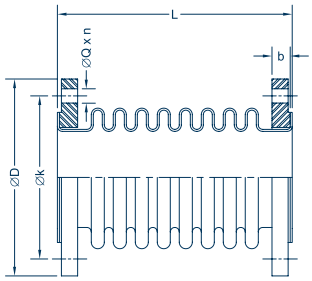
Weld end Material
Carbon Steel

Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm)		Length (L)	Spring Rates (N/mm)		d	h	s	n	Q	Effective Area
		Compression	Lateral (+/-)	(mm)	Axial	Lateral	(mm)	(mm)	(mm)		(mm)	(cm²)
25	1"	30	6	120	62	31	100	75	14	4	11	18
32	1¼"	30	6	120	62	31	120	90	14	4	14	18
40	1½"	30	7	125	54	31	130	100	14	4	14	23
50	2"	30	6	110	32	43	140	110	14	4	14	37
		45	10	155	50	26						
65	2½"	30	6	120	34	60	160	130	14	4	14	58
		60	11	170	53	32						
80	3"	30	3	105	41	145	190	150	16	4	18	80
		60	12	205	66	37						
100	4"	30	3	115	71	301	210	170	16	4	18	129
		60	9	185	72	82						
125	5"	30	3	120	84	511	240	200	18	8	18	185
		60	8	200	78	121						
150	6"	30	2	120	105	814	265	225	18	8	18	268
		60	7	175	63	187						
200	8"	30	2	145	146	1279	320	280	20	8	18	451
		60	7	200	91	310						
250	10"	30	2	145	154	2049	375	335	22	12	18	682
		60	7	220	86	369						
		75	8	240	77	267						
300	12"	30	2	170	355	4380	440	395	22	12	22	945
		60	6	260	197	800						
		75	9	310	162	428						
350	14"	30	2	165	386	5669	490	445	22	12	22	1127
		60	6	260	214	1036						
		75	8	310	175	554						
400	16"	30	2	180	250	4046	540	495	22	16	22	1479
		60	5	230	178	1520						
		75	8	280	139	728						
450	18"	30	2	180	307	6177	595	550	24	16	22	1839
		60	4	230	219	2321						
		75	6	280	170	1111						
500	20"	30	2	180	279	6909	645	600	24	20	22	2264
		60	4	230	199	2596						
		75	6	280	155	1243						
600	24"	30	2	170	530	18745	755	705	24	20	26	3227
		60	4	240	331	5003						
		75	6	310	265	2379						
700	28"	30	2	190	419	14565	860	810	24	24	26	4372
		60	5	270	262	3797						
		75	5	310	262	3363						
800	32"	30	1	170	755	45102	975	920	24	24	30	5705
		60	3	230	503	14411						
		75	3	280	431	9278						
900	36"	30	1	190	1194	70128	1075	1020	26	24	30	7201
		60	3	255	796	22008						
		75	4	330	682	13061						
1000	40"	30	1	165	1037	70455	1175	1120	26	28	30	8885
		60	2	235	829	35891						
		75	4	330	592	13993						

METAL COMPENSATORS

FLOATING FLANGED TYPE - PN10



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
10 barg

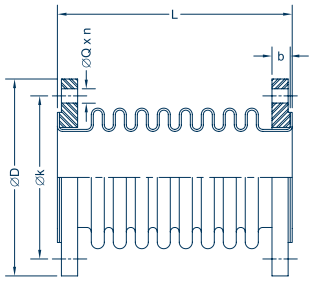
Weld end Material
Carbon Steel

Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm)		Length (L)	Spring Rates (N/mm)		d	h	s	n	Q	Effective Area
		Compression	Lateral (+/-)	(mm)	Axial	Lateral	(mm)	(mm)	(mm)		(mm)	(cm²)
25	1"	30	6	125	62	31	115	85	16	4	14	18
32	1¼"	30	6	125	62	31	140	100	18	4	18	18
40	1½"	30	7	155	93	30	150	110	18	4	18	23
50	2"	30	5	130	62	57	165	125	20	4	18	38
		45	8	155	106	55						
65	2½"	30	4	130	68	95	185	145	20	8	18	58
		45	6	160	98	77						
		60	10	185	105	56						
80	3"	30	4	130	66	124	200	160	20	8	18	80
		45	6	165	90	95						
		60	10	185	90	70						
100	4"	30	3	135	113	333	220	180	22	8	18	129
		45	5	165	88	159						
		60	7	205	109	118						
125	5"	30	2	140	134	641	250	210	22	8	18	187
		45	4	170	104	274						
		60	7	210	107	169						
150	6"	30	3	145	152	936	285	240	24	8	22	268
		45	4	170	118	448						
		60	6	210	127	245						
200	8"	30	3	175	211	1422	340	295	24	8	22	460
		45	5	210	158	584						
		60	7	230	140	385						
250	10"	30	2	180	292	2687	395	350	26	12	22	683
		45	5	235	195	888						
		60	7	275	159	499						
300	12"	30	2	165	355	4380	445	400	26	12	22	945
		45	3	205	254	1567						
		60	6	245	197	840						
350	14"	30	2	170	582	8653	505	460	26	16	22	1141
		45	4	215	364	2417						
		60	5	255	323	1509						
400	16"	30	2	170	474	7707	565	515	26	16	26	1483
		45	3	210	339	3242						
		60	5	255	296	1867						
450	18"	30	1	185	587	11842	615	565	28	20	26	1841
		45	3	230	714	7176						
		60	4	270	555	3626						
500	20"	30	2	195	758	14195	670	620	28	20	26	2268
		45	3	235	649	8039						
		60	4	285	505	3733						

METAL COMPENSATORS

FLOATING FLANGED TYPE - PN16



Standard Bellows Material
304ss - 316ss, 321ss

Design Pressure
16 barg

Weld end Material
Carbon Steel

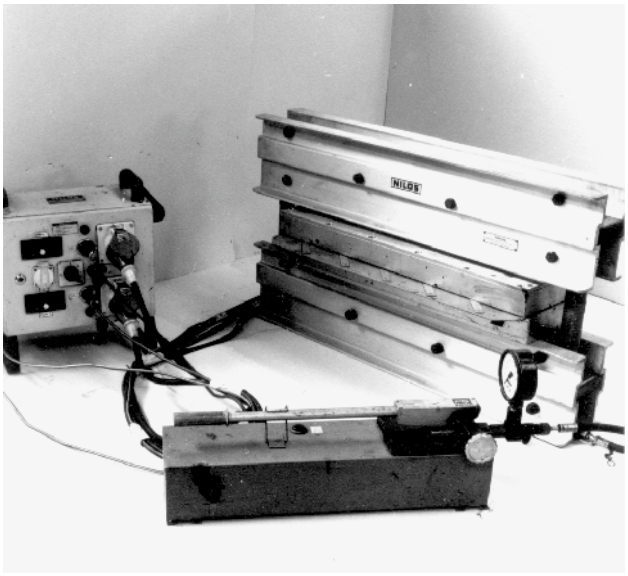
Design Temperature
400 °C

Nominal Diameter (DN)		Movements (mm)		Length (L)	Spring Rates (N/mm)		d	h	s	n	Q	Effective Area
		Compression	Lateral (+/-)	(mm)	Axial	Lateral	(mm)	(mm)	(mm)		(mm)	(cm²)
50	2"	30	4	120	117	109	165	125	18	4	4	38
		45	4	150	126	64						
65	2½"	30	3	120	128	179	185	145	18	4	4	58
		45	7	150	124	97						
		60	8	180	182	99						
80	3"	30	3	120	124	231	200	160	20	8	8	80
		45	7	150	123	129						
		60	9	180	166	121						
100	4"	30	3	120	145	484	220	180	20	8	8	129
		45	4	150	146	266						
		60	8	185	161	173						
125	5"	30	3	125	168	808	250	210	22	8	8	186
		45	5	155	126	333						
		60	7	190	171	267						
150	6"	30	2	130	350	2166	285	240	22	8	8	268
		45	4	155	171	648						
		60	7	200	191	379						
200	8"	30	2	150	513	3132	340	295	24	12	12	456
		45	4	190	338	1242						
		60	5	230	300	817						
250	10"	30	2	165	559	5149	405	355	26	12	12	684
		45	4	205	372	1517						
		60	5	245	335	1051						
300	12"	30	2	200	675	5823	460	410	28	12	12	964
		45	6	300	405	1282						
		60	10	380	347	616						
350	14"	30	1	210	739	7601	520	470	30	16	16	1155
		45	4	290	850	3840						
		60	7	370	638	1661						
400	16"	30	1	210	1545	25149	580	525	32	16	16	1486
		45	4	310	858	4157						
		60	6	365	702	2184						
450	18"	30	3	240	869	11727	640	585	32	20	20	1856
		45	6	320	579	3504						
		60	11	405	434	1316						
500	20"	30	2	215	1048	22570	715	650	34	20	20	2274
		45	3	270	749	7967						
		60	6	330	582	3981						

LINING JOINT SEALING

Legal directives and regulations have placed special demands on exhaust gas systems and chimneys in the fields of industry and power plants.

This is especially pertinent for chimneys behind flue gas desulphurisation (FGD) plants. These chimneys are made of an outer hull, a ferro-concrete tube and an inner acid-proof exhaust pipe, called the lining. This lining consists of individual sections of piping. The expansion joints between the individual piping sections must be sealed to be gas-tight and fluid-tight to avoid damage to the concrete tube. Elastomer tracks made from fluor-terpolymer rubber [Trade name and registered trademark: Fluorel (3M company) Tecnoflon (Montefluos), Viton (Du Pont)] have shown superior performance in sealing such lining joints.



Construction

Our lining joint seals are produced from strips of fluor-terpolymer rubber. The sealing strip standard design is equipped with a wire-fabric interlining made from material no. 1.4539. Both clamping strips made from 1.4539 or 1.4571 with a vulcanised fluor rubber coating and ceramic clamping strips have demonstrated good performance in this application.

The special tie bolts are made of high-grade steel in A4 quality.

Special tie bolts made from material 1.4359 may be used upon the customer's request.

Connection techniques

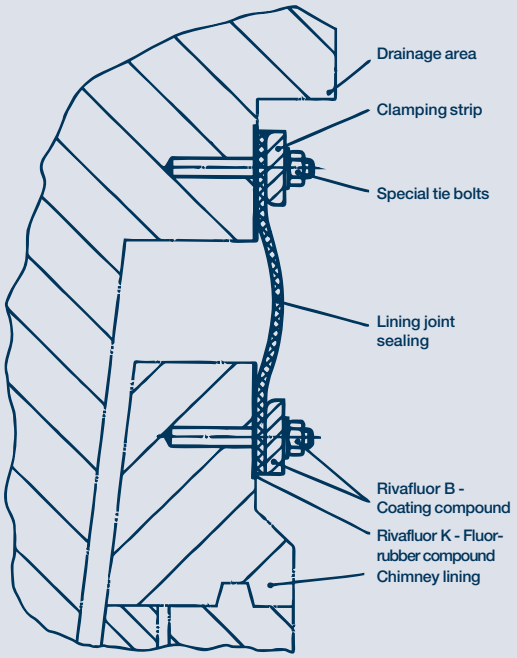
Lining joint sealings can be connected to the acid-proof lining in several different ways.

1. Connection with tie bolts

The standard method of connecting the lining joint sealing is the use of tir bolts and clamping strips. This method is suitable both for existing chimneys requiring subsequent installation as well as for new plants. Illustration 1 shows the connection principle.

This type of connection guarantees high capacity for the lining joint sealing and simple assembling. It is universally applicable, including for the reconstruction of existing plants.

Illustration 1



2. Connection without steel parts

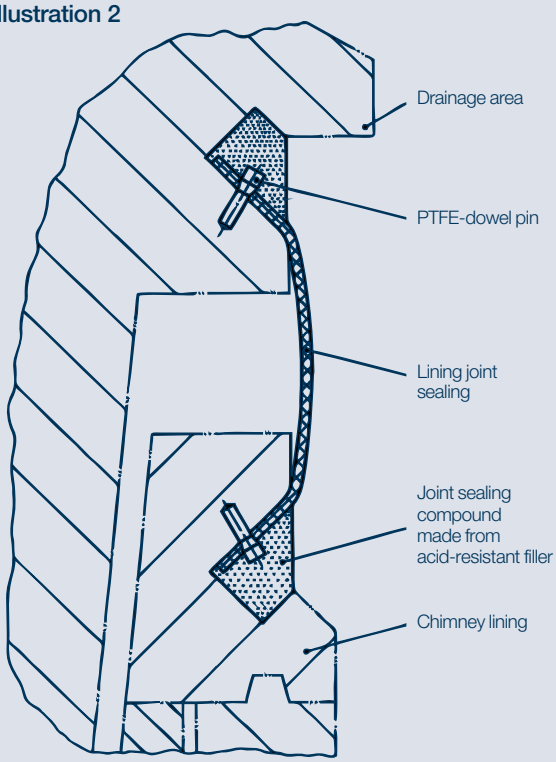
Assembling using this method requires specially shaped blocks on both sides of the lining joint sealing. As shown in Illustration 2, both blocks are equipped with a dowel pin made from PTFE. The pre-perforated sealing strip (the strip can also be perforated on-site) is attached over the dowel pin.

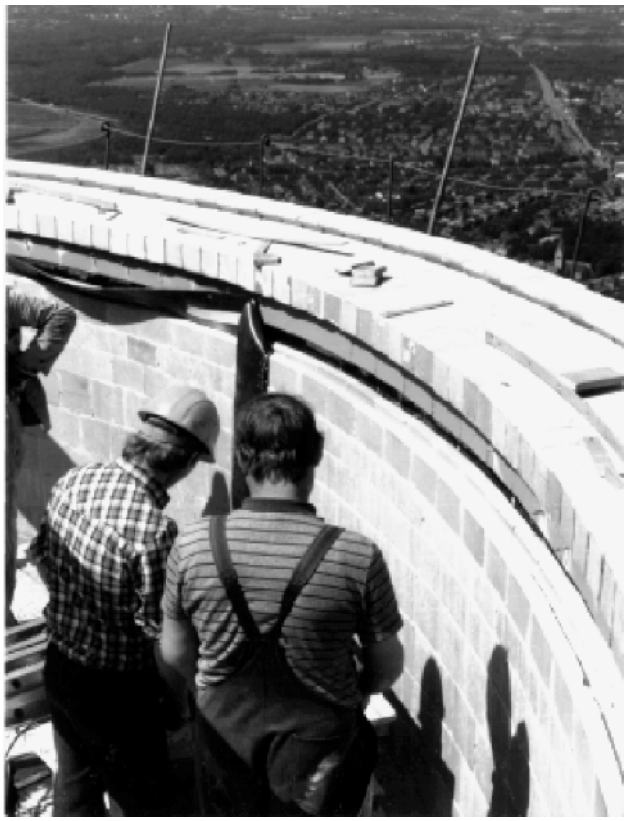
LINING JOINT SEALING

The remaining gap is then filled with acid-resistant filler. Simple disassembling is made possible by first applying a layer of foam plastic. The blocks are best arranged when the acid-resistant filler is protected by a drainage area. This method of connection without metal parts is particularly advantageous in areas with strong acid exposure. With the proper planning, this method can provide a cost-effective and technologically beneficial solution.

Installation takes places in two directions towards the joint. The connection procedure stops a few metres away from the joint so that the sealing strip can be trimmed to its finished dimension. The joint is produced using a portable hydraulic vulcanising press. Any remaining gaps are then filled with a self-vulcanising highly viscous fluor rubber surface.

Illustration 2





Technicians installing a lining joint sealing.

Assembling

Installation of lining joint sealing is professionally performed by our experienced technicians. The lining should be as even as possible in the support area to be sealed. Small unevennesses or blemishes in the block which may inevitably appear should be smoothed out.

During standard assembling, holes for the ties are drilled together with the sealing strip and the clamping strips. First, the support surface is prepared and then coated with the fluor rubber compound Rivafluor K at a thickness of 0.5 mm. The coating compound evaporates during coating, so the sealing strip can be directly attached using the coated clamping strips and ties.

REAFLEX AND REATEX

Elastomer and Fabric Compensators for Flue Gas and Desulphurisation Plants

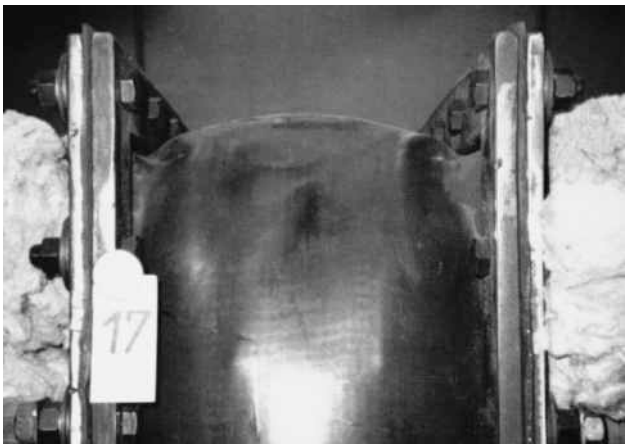
KLINGER Kempchen has developed chemically and thermally durable fabric compensators for flue gas desulphurisation (FGD) waste incineration and chemical plants:

» ReaFlex Elastomer Compensators
For temperatures up to 205 °C

» ReaTex Fabric Compensators
For temperatures above 260 °C

ReaFlex Elastomer Expansion Joints

ReaFlex compensators are manufactured from elastomer bands reinforced with wire mesh, wire weave or fabric fibre glass. They are available in U-shape or band type for circular or angular ducts. For angular ducts, expansion joints can be manufactured with or without a bulge in the edge area. The design with a preformed bulge shows increased axial movement compensation.



ReaFlex compensators are also available in an open-ended design. The open-ended design can be vulcanised on site.

The following materials have proven successful for FGD plants: **FKM** (Fluor-terpolymer rubber), **EPDM** (Ethylene Propylene Rubber) and **CIIR** (Butyl Rubber). We supply **ReaFlex** compensators in these elastomer qualities with wall thicknesses of 3.5 mm up to 6 mm with reinforcements of high-grade steel (e.g. 1.4539) or fabric fibre glass.

Table 1 shows maximum allowable material temperatures. An outlet nozzle can be installed for applications where condensation occurs. Because these compensators are self-sealing in the flange area, additional sealing is not typically necessary.

Due to technical factors during manufacture, ReaFlex compensators are available for angular ducts with a minimum interior width of 400 x 400 m. Round compensators are produced with a minimum interior diameter of 400 mm.

ReaTax Fabric Compensators

ReaTex compensators are manufactured from PTFE coated glass fabric fibres. This combination of materials has shown superior performance at media temperatures of up to 260 °C. No pre-insulation is necessary at temperatures below this point. For higher temperatures, inner pre-insulation must be installed. Outer insulation is not permitted. See Table 2.

Due to the demanding requirements, we manufacture bands of fabric fibre glass sheet coated with a 0.4 mm layer of sintered PTFE foil. A special manufacturing process allows a sustained temperature resistance of 260 °C without the PTFE foil peeling off. All seams are gas-tight sealed with sintered PTFE foil. Our manufacturing process avoids seams in edge areas. **ReaTex** compensators are also available in an open-ended design. The open-ended model can be vulcanised to be gas-tight on-site.

Due to the increased acidic condensation present at FGD plants, **ReaTex** compensators are equipped with edge reinforcements made from FKM elastomer for temperatures up to 205 °C or PTFE strips for temperatures up to 260 °C (see table 2). For special areas of application, **ReaTex** compensators can be manufactured with condensation outlet nozzle made from a material such as PTFE.

Table 1: Application limits of ReaFlex compensators.

Media temperature	Elastomer quality	intermediate layer		
		Wire Mesh	Wire Weave	Fibre Glass
T<=100 °C	CIIR	one layer	two layers	one or two layers
T<=120 °C	EPDM			
T<=205 °C	FKM			

Table 2: Application limits for ReaTex compensators

Media temperature	Inside Edge Reinforcement	Inside Pre-insulation	Outside Insulation	Leak Tightness
T<=205 °C	FKM-Elastomer	no	yes	very good
T<=260 °C	PTFE-tape			
T<=300 °C	PTFE-tape*	yes	no	very good*

* depending on assembly type, please consult Kempchen.

PTFE SEMI-FINISHED PRODUCTS AND FINISHED PARTS

Material characteristics

PTFE = Polytetrafluorethylene

PTFE is excellently suited as a construction material for the chemicals industry. It temperature resistance ranges from -190 °C to +250 °C, and it can temporarily sustain temperatures of +300 °C. Because of its low friction coefficient, it is used as an anti-friction coating and lubrication material. Because of its particularly high insulation resistance and puncture resistance, it can also be used for insulation purposes.

Another specific characteristic of PTFE is its extremely anti-adhesive property. As a result of its non-stick effect, no substances adhere to PTFE surfaces. PTFE is non-flammable, does not absorb water and is physically harmless to humans. PTFE is considered to be a member of the thermoplastics group, although it is not suitable for injecting or pouring.

PTFE is resistant to nearly all chemicals. It is only susceptible to chlorine trifluoride, elementary fluoride and melted alkali metals. Additionally, PTFE will not swell or dissolve in any common organic and inorganic solvent, even at high temperatures. It belongs to the group of weather-resistant plastics.

Material types

	Standard types				
Material No.	6.3001	6.2509	6.3105	6.3231	6.3303
Filler material	none	Coal	Glass	Bronze	Graphite
Filler material content [%]	0	25	25	60	15

Materials with other filler materials and filler content on request.

PTFE without filler material

Pure PTFE is used for applications requiring high chemical resistance, strong anti-adhesive properties or very low friction values.

PTFE without filler material may be unsatisfactory for certain areas of application. Unsatisfactory characteristics that may arise include a tendency to cold flow under pressure and relaxation at temperatures, the mechanical resistance and the low capacity for heat conduction. PTFE without filler is used for

» Bellows
» O-rings
» Enveloped gaskets*
» Steering floaters
» Spheres
» Back-up rings
» Construction parts

* see section ""PTFE-enveloped gaskets".

PTFE-Compositions

By combining pure PTFE with various filler materials, individual physical and mechanical properties can be positively influenced. It is important to consider that other properties may be negatively influenced in the process.

The following are the primary results to be attained by using PTFE-types with filler material:

» Reduction of cold flow
» Increased regidity at high temperatures
» Greater heat conduction
» Greater abrasion resistance

The main filler materials used are glass, coal, graphite and bronze.

PTFE Glass

Adding glass powder drastically reduces the tendency for cold flow in comparison to pure PTFE. This composition has shown superior performance in all types of applications, but particularly

» Valve rings
» Flat gaskets*
» Sealing cones
» Bearings
» V-ring packings

* See the section "PTFE enveloped gaskets".

PTFE Coal

PTFE coal compound is characterised by a low abrasion and high stability. This composition is commonly used as a material for bearings, particularly at very low temperatures. The PTFE coal composition requires special caution when manufacturing moulding blanks for the machining of piston rings, piston guide rings and piston rod packings. The construction of modern dry-running compressors would not be possible without these high-grade rings.

Typical applications:

» Bearing bushings
» Piston rings
» Piston guide rings for dry-running compressors
» Rod packings
» V-ring packings

PTFE SEMI-FINISHED PRODUCTS AND FINISHED PARTS

PTFE Graphite

When an exceptionally high level of absrasion resistance is required, PTFE graphite compositions are used. This material also has extremely low initial wear. The PTFE graphite composition is characterised by a very low friction coefficient in comparison with the PTFE coal composition. It must be emphasised that PTFE coal and graphite compositions are show particularly high resistance when used in chemical applications.

Examples of applications:

» Shaft sealing

» Bearings

» Sliding plates

» Construction parts

PTFE Bronze

The PTFE bronze composition has the lowest tendency for cold flow of all the PTFE compositions. This composition is also characterised by a high capacity for heat conduction and superior abrasion resistance. PTFE bronze is therefore recommended as a bearings material in high-stress applications. This composition has limited suitability in chemical applications, as the bronze particles can be attacked and washed away under certain circumstances.

PTFE bronze has been shown to be suitable for:

» Bearings

» Piston cuffs

» Guide rings for hydraulic cylinders

» Foil bearings

Extruded hoses

Hoses are manufactured on paste extruders using a special process. The finished lengths depend on the diameter and the thickness of the particular wall. Our product range includes hoses from 2 mm to 200 mm in inner diameter.

Applications:

» Laboratory hoses

» Filler hoses

» Cladding for pipelines

» Steam hoses

» Hose pipes for adhesive media

» Electrical cable insulation

PTFE foils

Foils are cutted with a blade from a compact PTFE cylinders and subsequently turned over heated rollers in to release any existing tension.

We supply foils up to 1200 mm in width and 6 mm thick.

Application areas for PTFE foils:

» Foil bearings

» All types of gaskets*

» Cladding for construction parts

» Compensators and bellows

» Cladding for chutes and containers

» Insulation for the electrical industry

* See section ”PTFE-enveloped gaskets“.

Adhesive PTFE foils

Non pre-treated PTFE foils are not adhesive. Foils requiring adhesive properties are therefore prepared after cutting using a chemical finishing treatment for adhesion on one side to steel, plastic, wood, etc. The special adhesive required for pasting is available upon request.

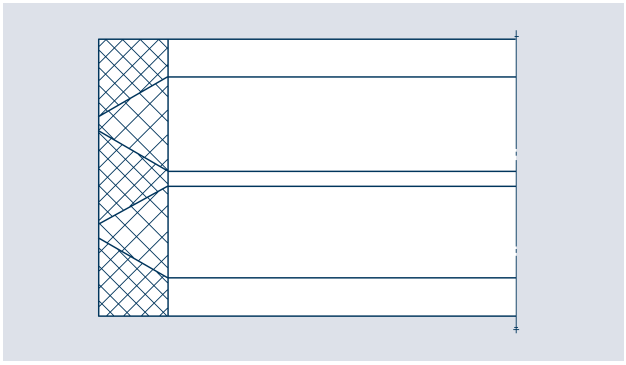
Adhesive foils are available at up to 1200 mm in width and 3 mm thick.

PTFE SEMI-FINISHED PRODUCTS AND FINISHED PARTS

PTFE finished parts

PTFE wedge ring packings

This robust and reliable packing is suitable for sealing valve shafts at high pressures and with abrasive media. The wedge rings are extruded inwards against the shafts and outward against the housing by the pressure of the stuffing box. The stuffing box follower can only be pre-stressed far enough to reliably seal the packing.



Piston rings and piston guide rings

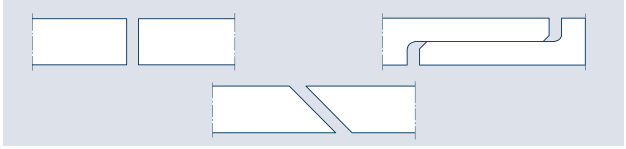
Today's industry is increasingly in need of compressors that guarantee lubricant-free gas-tight sealing. In applications requiring the compression of dry gases a compressor at high temperatures and piston speeds, equipping the plant with PTFE piston rings is the design engineer's only option.

It is important to note that PTFE without filler material is not suitable for the manufacture of piston rings. We strongly emphasise the importance of working with the proper PTFE composition in order to guarantee the optimal function of the piston rings.

The following are application areas for piston and piston guide rings made from PTFE compositions:

- Dry-running compressors
- Cold compressors
- Pumps for abrasive fluids and fluids with poor lubrication
- Hydraulic and pneumatic cylinders

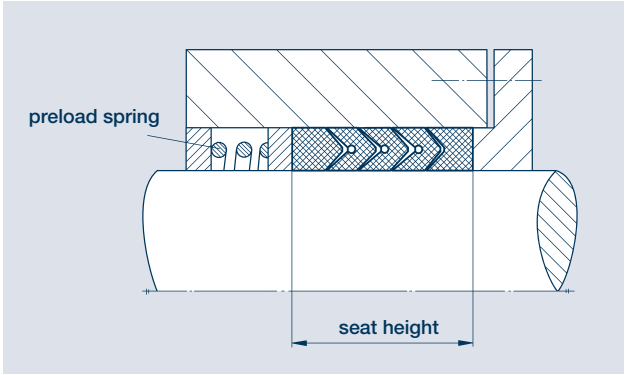
Piston rings are designed with overlapping, diagonal or straight joints, depending on the application.



V-ring packings

V-ring packings are primarily used for sealing with axial movements. A complete set consists of several V-rings with one pressure and support ring each.

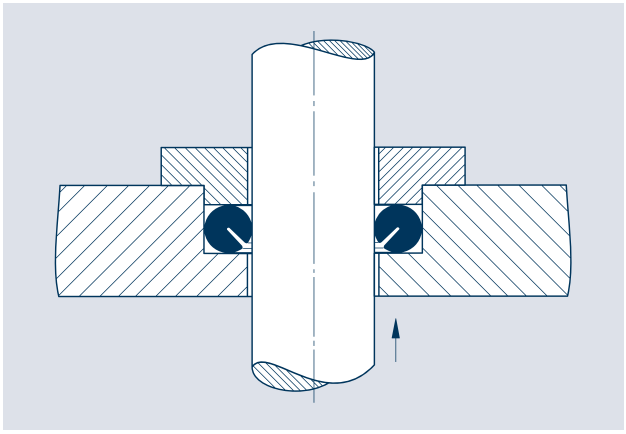
Compounds with glass or coal are used at higher pressures due to the tendency for cold flow characteristic of PTFE without filler materials. At particularly high pressures, the packing is reinforced by installing V-rings, and pressure and support rings made from bronze or acid-resistant steel. In this configuration, one metal V-ring is installed in the packing after every or every other PTFE V-ring



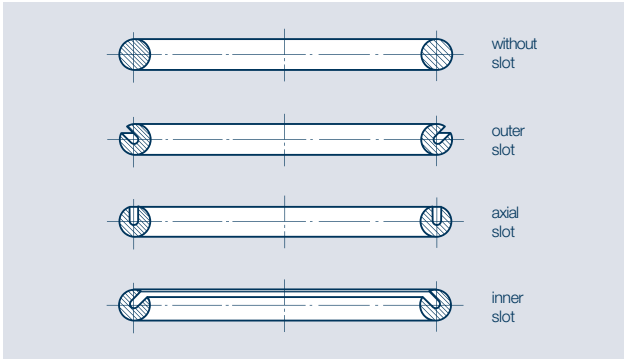
O-rings

For applications where the use of O-rings made from elastomers is not suitable - whether as a result of chemical attack or excessive temperatures - O-rings made of PTFE are used instead. Because of their low level of elasticity, these O rings are primarily used as static sealings. In order to achieve higher levels of elasticity, a slot is made around the circumference of the O-ring. The placement of the slot is aligned with the direction of the pressure. During assembling of the O-ring, the expanding slot is installed against the direction of pressure.

We supply seamless O-rings up to approx. 500 mm in diameter These are also available in a welded design.



PTFE SEMI-FINISHED PRODUCTS AND FINISHED PARTS



PTFE-enveloped O-rings

PTFE enveloped O-rings unify the superior chemical resistance and low friction of PTFE and the elasticity of O-rings made from elastomers.

We cover O-rings made from elastomer with a 0.4 mm thick PTFE envelope. The envelopes can be butted or overlapped The butts/overlaps are to be placed on the side turned away from the pressure. Because only the core, and not the envelope, of these special O-rings is elastic, a PTFE-enveloped O-ring may not be strongly expanded or squeezed.

Depending on the application area, a material such as viton, hypalon, silicone, neoprene, perbunan or another elastomer may be selected for the O-ring.

PTFE Support rings (Back-up rings)

The task of the PTFE support ring is to back-up the constant gap between the pistons and the cylinder.

The installation of support rings prevents the extrusion of the rubber O-rings into the sealing gap at axial movements to pressures over approx. 2.5 N/mm², leading to the destruction of the CD-ring.

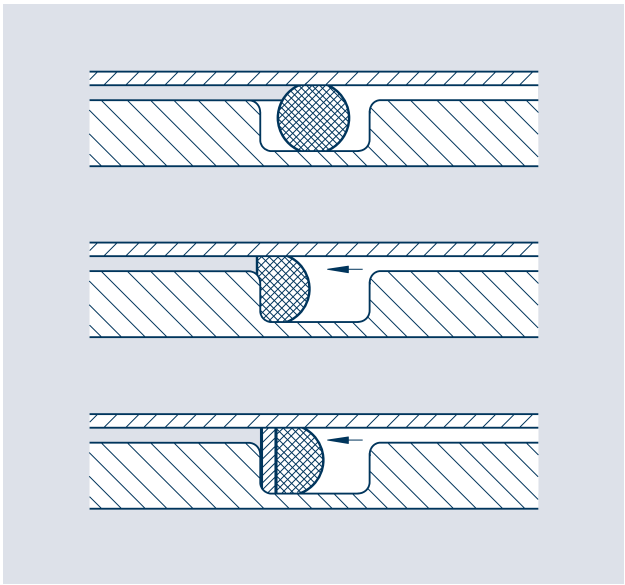
The advantages of installing support rings made from materials such as PTFE are as follows:

a) Chemical and thermal resistance

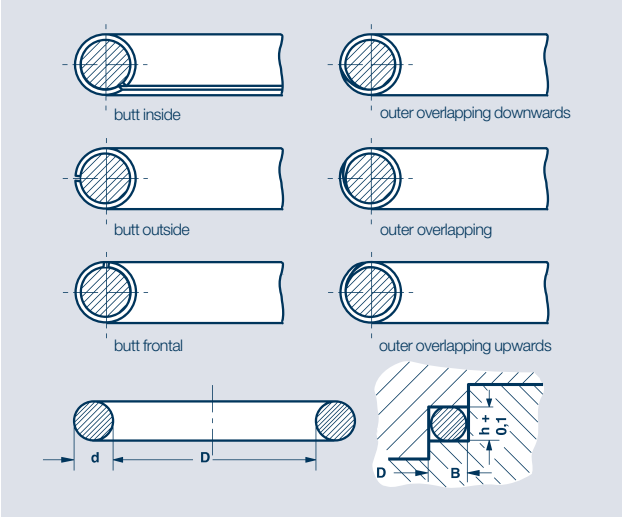
b) Creation of a PTFE film on the bearing surface of the cylinder or piston, reducing the frictional factor of the CD-ring

c) Easy assembling – easy disassembling

d) Significantly longer life cycle of the O-ring.



Diameter range D	Gauge diameter d	Installation dimension B	h
20-30	3	3	2,6
31-60	4	4	3,5
61-110	5	5	4,3
111-300	6	6	5,2
301-400	7	7	6,0
401-600	8	8	7,0



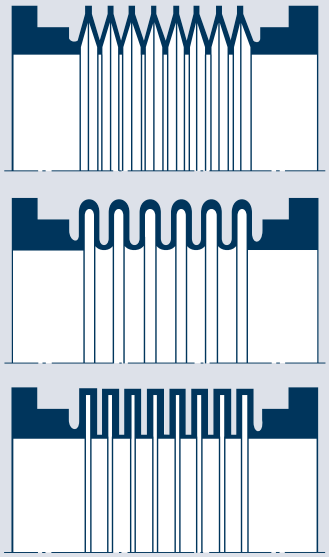
PTFE SEMI-FINISHED PRODUCTS AND FINISHED PARTS

Bellows

Because of the great mechanical demands which may be required in individual cases, and the chemical resistance necessary, PTFE bellows are manufactured from special high-grade semi-finished products with total impermeability

The following bellow types have proven suitable in practice:

- prick pointed, type S: most elongation, low pressures
- cutting round, type R: moderate elongation, medium pressures
- cutting angular, type E: least elongation, high pressures



The shape of bellows depends on the intended application and is based on the operating pressure, operating temperature, required elongation and radial misalignment.

Please provide the following technical information when enquiring:

- Installation length
- Elongation, +/-
- Misalignment, parallel and angular
- Medium
- Operating pressure
- Operating temperature

In many cases, the sealing cone from a corresponding PTFE composition is sintered onto bellows for fittings without stuffing boxes.

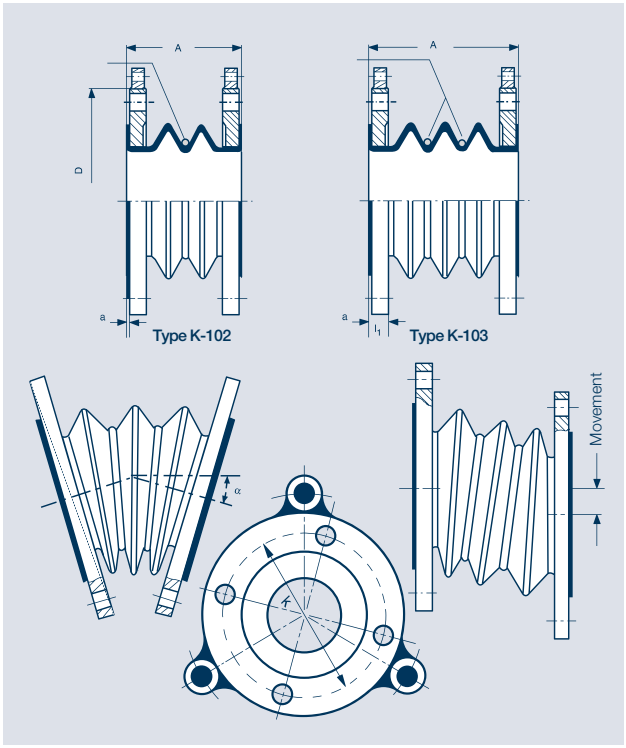
PTFE SEMI-FINISHED PRODUCTS AND FINISHED PARTS

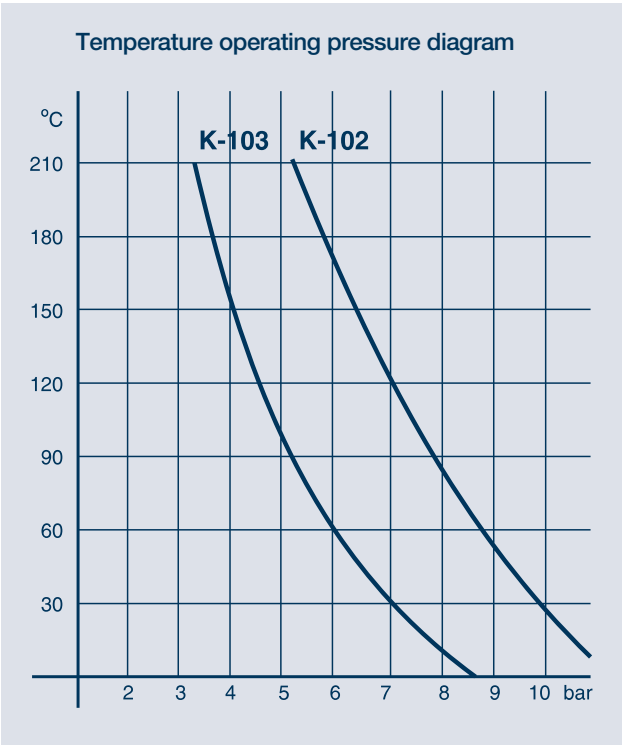
PTFE compensators

These compensators are manufactured of exceptional nighly compressed PTFE material.

The extremely flexible and besides pressure-proofed manufactured from a compact block but in a complex manufacturing procedure without destruction of the existing filamentous structure. The compensators are provided with reinforment rings of stainless steel to increase the pressure-proof.

PTFE compensators are suitable to absorption axial and radial movement. Also at applications with critical cinditions no symptoms of fatique occur. A especially long duability distinguish this product from others.





K-102									
DN	a	D	k	n xBolt size Hole - Ø	l_1	Angel α (Dgree)	Installation length A (mm)	Elongation ± (mm)	Movement axial (mm)
25	3	175	85	4x14	15	4	35	6,5	3
40	3	210	110	4x18	17	8	35	6,5	3
50	3,5	225	125	4x18	19,5	8	40	6,5	3
65	3,5	245	145	4x18	19,5	10	50	7,5	5
80	3,5	270	160	8x18	21,5	10	60	10	5
100	3,5	290	180	8x18	23,5	20	70	10	6
125	3,5	330	210	8x18	23,5	15	80	13	6
150	4	365	240	8x22	26	10	90	13	6
200	4	420	295	8x22	28		100	13	6
250	4	475	350	12x22	28		110	13	6
300	4	525	400	12x22	28		120	20	10
350	4	585	460	16x22	30		125	20	10
400	4	645	515	16x27	34		130	25	10

K-103									
DN	a	D	k	n xBolt size Hole - Ø	l_1	Angel α (Dgree)	Installation length A (mm)	Elongation ± (mm)	Movement axial (mm)
25	3	175	85	4x14	15	18	45	12,5	6
40	3	210	110	4x18	17	20	50	12,5	6
50	3,5	225	125	4x18	19,5	25	70	19	9
65	3,5	245	145	4x18	19,5	30	80	21	9
80	3,5	270	160	8x18	21,5	30	95	25	13
100	3,5	290	180	8x18	23,5	30	95	25	6
125	3,5	330	210	8x18	23,5	30	100	28,5	6
150	4	365	240	8x22	26	30	120	28,5	6
200	4	420	295	8x22	28	20	130	28,5	6
250	4	475	350	12x22	28	10	130	28,5	6
300	4	525	400	12x22	28	10	145	30	10
350	4	585	460	16x22	30		150	32	10
400	4	645	515	16x27	34		155	35	10
500	4	750	620	20x27	40		160	30	25

CALCULATION SERVICE

Free KemProof® online calculation program for screw tightening torques

Available online at www.klinger-kempchen.de

The program provides the tightening torque of the screws whilst taking the following into consideration:

» DIN, ANSI flange type

» Additional loads

» Screw type and screw materia

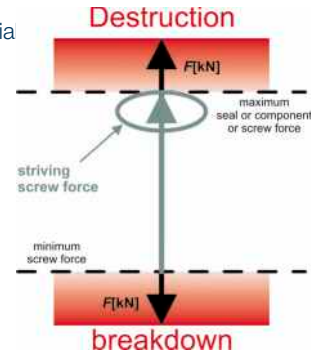
» Pressure

» Temperature

» Required leakage class

» Friction coefficients

» Gasket type



The foundation of the program is a calculation algorithm based upon AD2000-B7 whilst taking gasket values according to EN 13555 into consideration.

When dealing with EN 1092-1 flanges, it is possible to perform an online calculation according to EN 1591-1 if necessary. For this purpose, further data is taken into consideration:

» Flange material

» Nominal calculation tension

In addition to the torque, the calculation also provides the capacity utilisation of the following components:

» Flanges

» Screws

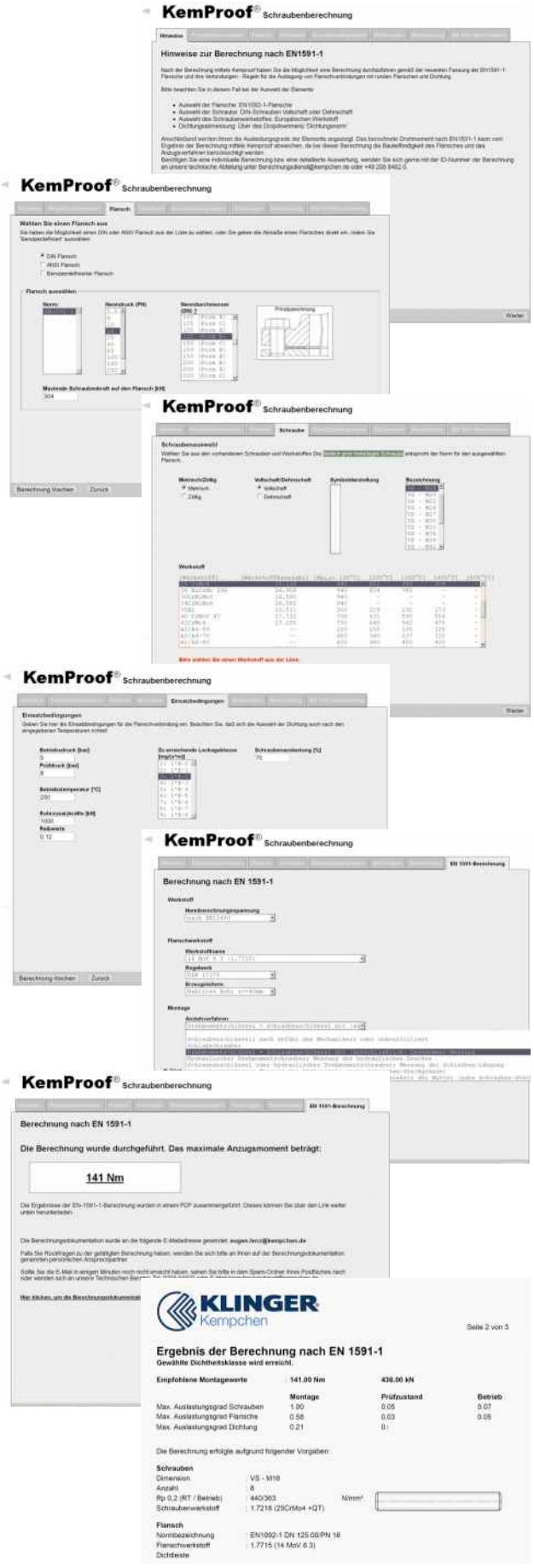
» Gasket

as well as the flange sheet inclination. A notification is issued if the maximum flange sheet inclination is exceeded. The VDI2290 minimisation requirement is taken into consideration when calculating the torque. All components are used at ideal capacity.

It is possible to select all parameters from data tables via a menu structure. Thanks to its intuitive structure, the program is extremely user-friendly and leads to a result after only a few entries.

All entered data is sent to the user as a PDF file via e-mail.

Register at **kemproof.klinger-kempchen.de**. You will quickly receive your access authorization via e-mail. It is free to use the program



CALCULATION SERVICE

Example calculation

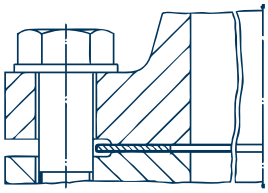
The required tightening torque is: 100 Nm

Selected tightness class reached.

The calculation was performed based upon the following specifications:

Screws
Dimension . . . . . : VS-M20
Quantity. . . . . : 8
Rp 0,2(RT). . . . . : 300 N/mm²
Rp 0,2 (operation) . . . . : 195 N/mm²
Material . . . . . : St 5.6

Flange
Standard description . . : EN1092-1 DN 100.00/PN 40
Sealing strip
Internal diameter . . . . . : 107.1mm
External diameter. . . . . : 162 mm



Operating data
Operating pressure . . . : 30 bar
Testing pressure . . . . . : 39 bar
Operating temperature : 300 °C
Additional pipe forces . : 0 kN
Friction coefficient . . . . : 0.12
Tightness class . . . . . : 1E-3 mg/(s*m)

Gasket
Order text . . . . . : B9A grooved gasket
Stainless steel beam with 0.5 mm graphite coating
Standard/plant standard: WN 145 / EN 1514-6173 77 5
Inner diameter . . . . . : 118 mm
External diameter . . . . . : 138 mm
Total acting gasket area : 4021 mm²

The gasket is of a premium standard within the context of TA Luft

Gasket values according to EN 13555
QSmin. . . . . : 13 N/mm² mini. surface pressure in operating state
Qmin . . . . . : 32 N/mm² min. surface pressure during assembly
Qmax . . . . . : 480 N/mm² max. permissible surface pressure

Calculation values
QA opt . . . . . : 62 N/mm² ideal installation surface pressure
Qp. . . . . : 48 N/mm² surface pressure in testing state
Qs. . . . . : 47 N/mm² surface pressure in operating stated
Screw utilisation . . . . . : 65 %

Advantages of a screw force that is as high as possible:

» Lowest possible leakage during operation.

» Highest residual surface pressure during operation.

» Highest blow out resistance

Calculation according to DIN EN 1591-1 also available as an online calculation for smart phones.

Professional flange calculation in accordance with the following regulations:

» AD-2000 B7/B8

» ASME VIII Div.I, Appendix 2

» DIN EN 1591-1

This professional and extremely comprehensive flange connection calculation represents our top-level service, and is documented using the software solutions:

» DIMY

» Compress

» PV Elite

The service includes the information required by the standards, as well as a separate listing, containing an overview of all the calculated values.

ASSEMBLY TRAINING

Assembly training to become a certified specialist in accordance with DIN EN 1591-4

Topic

Training in accordance with DIN EN 1591-4 to become a specialist for the assembly of sealing connections in flanges in accordance with PED 92/23/EC and DIN EN 1591-4.

The entry of DIN EN 1591, part 4 into force provides operators with a standard that standardises the training of assembly fitters. It is possible to select assembly personnel based upon the criterion of individual assembly expertise.

The required training measures were formulated by Kempchen upon the basis of the current standard and have been certified within the context of ISO 9001. In compliance with the standard, we offer a basic module that provides the necessary fundamental knowledge in order to produce a tight flange connection.

The training modules described by DIN EN 1591-4, including:

» Hydraulic, torque-controlled tightening techniques

» Assembly of heat exchangers

» Determination of the screw force

» Compression fittings

» Responsible persons for flange boltings

are constantly amended to comply with the current status of the standard.

In the general practice module, the participants are able to practice assembly procedures using the most diverse of flange shapes and types. The assembly technician should develop a feel for the significance of the correct selection and application of the required torques, in particular through the measuring technology available at the training centres in particular.

Content

Assembly-related fundamentals of the gasket system.

Following successful completion, the participants will be able to answer the following questions:

» What must be taken into account during storage, transport and handling of various types of gaskets?

» What must be taken into account when installing the gasket?

» Which work-safety requirements must be fulfilled during assembly and disassembly?

» Depending upon the case, which tools and tightening techniques must be used?

» How should the bracing elements (how, which and when) be handled?

» What must be taken into account when disassembling a gasket?

This includes:

» Demonstration of the various flange shapes and defective sealing surfaces.

» Presentation of suitable types of gaskets / suitable geometries.

» Practical application of various tightening techniques. Investigation of the various impacts upon the flange connection (from impact wrench to torque wrench).

» Investigation of the impact of the tightening method.

» Presentation of commonly used screws and auxiliary equipment.

» Illustration of the impact of lubrication and screw condition.

» The impact of assembly errors and defective elements upon the gasket function.

ASSEMBLY TRAINING

Service

In this context, KLINGER Kempchen offers the following services:

» KLINGER Kempchen assumes the entire organisational management of the certification, from technician registration to the delivery of the certificate and monitoring right through to recertification.

» KLINGER Kempchen performs the training courses in accordance with the contents listed in DIN EN 1591.

» KLINGER Kempchen organises the examinations and provides the necessary documents, such as the classification exam.

» KLINGER Kempchen uses a modular training plan that is structured according to a standard-compliant curriculum.

» KLINGER Kempchen has access to well-equipped training rooms in which various, practical assembly techniques can be performed.

The training sessions take place regularly or by appointment at the KLINGER Kempchen in-house training centres in Augsburg, Hamburg, Leuna and Oberhausen. The participation fee includes lunch and beverages.

Who, what, where

The instructors:

Experienced application consultants and engineers from KLINGER Kempchen GmbH and KLINGER Kempchen Leuna GmbH.

Further information regarding contact partners, participation fees, examination fees and training date can be found online at www.klinger-kempchen.de

ENGINEER TRAINING

Topic block 1

Fundamentals of gasket technology

» The steps towards a premium sealing connection

» Rules, regulations, latest developments

» Fundamental gasket types

» Selection of the "correct" gasket

» Selection of the gasket values

» Evaluation of the gasket values

» Impacts upon the sealing behaviour

- Quality of the sealing surfaces

- Impact of the assembly

Topic block 2

Calculation

» Fundamentals of the sealing connection calculation

» Presentation of calculation methods

- DIN EN 1591-1

- Kempchen algorithm

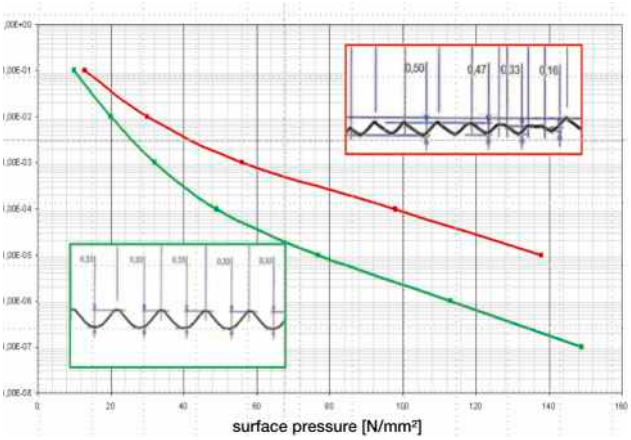
» Performance of calculations

- DIN EN1591-1 program

- KemProof

Target group:

All persons who must calculate sealing elements in a verifiable manner and in accordance with existing regulations or who are responsible for this: Technicians, engineers.



SHUT DOWN SERVICE

Productive facilities on your site

We can produce flat gaskets from all soft materials, be it graphite laminate or asbestos-free fibres or rubber, in all installation sizes while you wait. Grooved gaskets can also be inspected, cleaned and instantly regenerated on-site, and they can be newly produced at up to Ø 600 mm. Even corrugated gaskets up to 1250 mm in diameter can be produced in a container if prior arrangements are made.

Our mobile equipment also includes a screw cleaning machine, which cleans approx. 180 screws per hour (M33 x 250) and therefore reduces the work effort significantly.

The container has an online connection to the head office so the technicians can directly control and transmit production assignments. Even complicated metal construction parts for backup during shut-down can be arranged on location.

This special location also has a storage unit with a wide range of standardised gaskets, both grooved gaskets as well as flat gaskets and packings.

The competent service of our highly specialised on-site team is able to far exceed normal expectations for speed.

We would be happy to provide you with this special service.

E-COMMERCE

We offer our customers a wide range of options for e-commerce aimed at ”reducing process costs in the supply chain.“

Today, we are one of the leading companies to provide this service. We have mastery of the technologies behind the today's e-commerce platforms and are able to work with all formats and protocols.

We offer three levels of service:

» Online Catalogue

» Complete Integration

» Custom e-Store

The online catalogue is created by consulting with the customer to compile a stock list in electronic form. The online catalogue is integrated into the customer's e-Store, so that the user can carry out the ordering process directly. The online catalogue is available in six languages.

Complete Integration involves cross-linking two inventory management systems over the Internet, providing online purchase order processing. The result is complete electronic processing of sales transactions: fast, secure and accurate.

We are always happy to provide references of our customers' existing complete integration systems upon request.

Our custom e-Store option is available for customers who do not yet have their own online store. We offer customer-level access to our e-Store. This custom e-Store contains all the items selected and agreed upon by the customer. Every transaction in the e-Store results in an online order.

For all the services described above, our item numbers run in parallel to those from the customer's own ordering system. The result is comprehensive access to all items for statistics and analysis.

Additionally, the e-Store can feature detailed technical specifications for all items.

As an international company, we naturally support eClass and UNSPSC classification.

We are certified according to the standards of the Association of Materials Management and Purchasing (BME). BMEcat is the standard for electronic data transfer for product catalogues. Because of its standard interfaces, using BMEcat significantly reduces costs for all companies involved.


Zertifikat

Die BMEnet GmbH verleiht

Kempchen Dichtungs-technik GmbH

das

BMEcat Zertifikat

für elektronische Produktkataloge in der BMEcat Version 1.2.

BMEcat ist der Standard für den Austausch elektronischer Produktkataloge im zwischenbetrieblichen E-Commerce.

Die BMEnet GmbH hat den

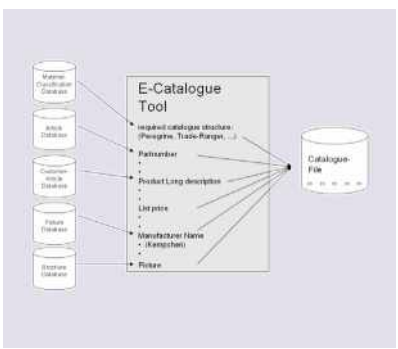
Katalog	Kempchen Produktkatalog
KatalogID	KEMKO0001
Katalogversion	001.001
generiert am	01.02.2005
in der Sprache	deutsch
BMEcat Version	1.2
am 10.03.2005	auf BMEcat Konformität geprüft.

Der Katalog entspricht den Anforderungen der BMEcat-Spezifikation Version 1.2.

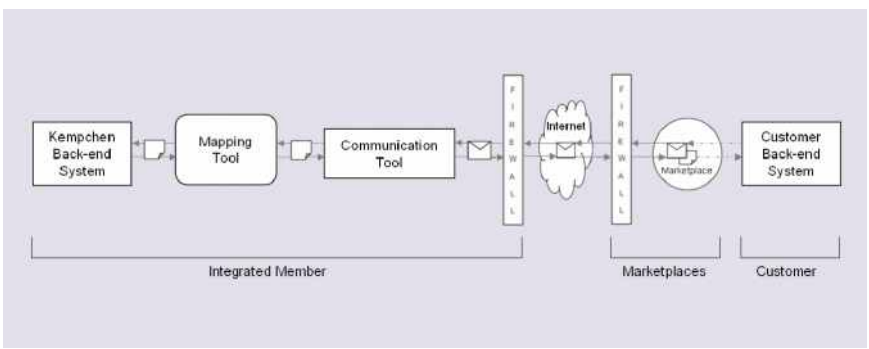
Frankfurt/Main, 10. März 2005

Thomas Trautenmüller
Geschäftsführer

Online catalogue



Result of complete integration



CERTIFICATES


TÜV NORD

CERTIFICATE

Management system as per
DIN EN ISO 9001 : 2015

Kempchen Dichtungstechnik GmbH
Im Waldteich 21
46147 Oberhausen
Germany

kempchen

Development, manufacture and sale of gaskets, packings and compensators as well as trainings and education of assembling.


TÜV NORD

CERTIFICATE

Management system as per
BS OHSAS 18001 : 2007

Kempchen Dichtungstechnik GmbH
Im Waldteich 21
46147 Oberhausen
Germany

kempchen

Development, manufacture and sale of gaskets, packings and compensators as well as trainings and education of assembling.


TÜV NORD

CERTIFICATE

Management system as per
DIN EN ISO 14001 : 2015

Kempchen Dichtungstechnik GmbH
Im Waldteich 21
46147 Oberhausen
Germany

kempchen

Development, manufacture and sale of gaskets, packings and compensators as well as trainings and education of assembling.


TÜV NORD

CERTIFICATE

for the Energy Management System as per
DIN EN ISO 50001 : 2011

kempchen

Kempchen Dichtungstechnik GmbH
Im Waldteich 21
46147 Oberhausen
Germany

Development, manufacture and sale of gaskets, packings and compensators, trainings and education of assembling


Eignungsbestätigung zur Qualitätssicherung gemäß Regel KTA 1401

PreussenElektra GmbH bestätigt für die in der VGB-Arbeitsgemeinschaft "Auftragnehmerbeurteilung" zusammengeschlossenen deutschen Kernkraftwerksbetreiber dem Unternehmen

Kempchen Dichtungstechnik GmbH
Im Waldteich 21, D - 46147 Oberhausen

für den Standort

Im Waldteich 21, D - 46147 Oberhausen

und den Liefer- und Leistungsumfang

Herstellung von Dichtungen, Packungen und Kompensatoren für kerntechnische Anlagen

die Eignung zur system- und produktbezogenen Qualitätssicherung.

Die Beurteilung am 09. August 2016 erfolgte im Auftrag durch die

AREVA NP GmbH

auf der Grundlage der Regel KTA 1401 sowie der Beurteilungsunterlagen der VGB-Arbeitsgemeinschaft "Auftragnehmerbeurteilung" unter Berücksichtigung der produktbezogenen Erfordernisse.

Einzelheiten der Beurteilung sind im Bericht 3BGS/2016/de/0022 enthalten.

Die Bestätigung gilt bis **30.09.2019** unter der Bedingung, dass sich die zugrunde liegenden Voraussetzungen der Beurteilung nicht ändern.

Hannover, den 10.08.2016

PreussenElektra GmbH


RAL Gütezeichen

CERTIFICATE

VGB POWERTECH

CERTIFICATE

The Quality Association for Fabric Expansion Joints in cooperation with the VGB PowerTech e.V. confirms herewith

KEMPCHEN Dichtungstechnik GmbH
Im Waldteich 21
46147 Oberhausen

the authorization to use the

RAL

Quality Mark RAL-GZ 719

The Company fulfils the RAL quality requirements since 1993. The Certificate is valid until

31 December 2019

Quality Association for Fabric Expansion Joints

Management

Dr. Volker Schmid

Constanze Gille


Zertifikat

Die BMEnet GmbH verleiht

Kempchen Dichtungs-technik GmbH

das

BMEcat Zertifikat

für elektronische Produktkataloge in der BMEcat Version 1.2.

BME cat

BMEcat ist der Standard für den Austausch elektronischer Produktkataloge im zwischenbetrieblichen E-Commerce.

Die BMEnet GmbH hat den

Katalog	Kempchen Produktkatalog
KatalogID	KEM000001
Katalogversion	301.001
generiert am	01.02.2005
in der Sprache	deutsch
BMEcat Version	1.2

am 10.02.2005 auf BMEcat konformität geprüft.

Der Katalog entspricht den Anforderungen der BMEcat-Spezifikation Version 1.2.

Frankfurt/Main, 10. März 2005

Thomas Trautmann
Geschäftsführer

BME

CONVERSION TABLES

Converting tables
Millimetres — Inches (Decimal) Inches (Decimal) — Millimetres

1" (British) equals 25.399956 mm
1" (USA) equals 25.40005 mm
in British and USA industrial practice 1" is taken to be 25.4 mm.

Millimetres — Inches (Decimal)

mm	0,0	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9
0	—	.00394	.00787	.0118	.0157	.0197	.0236	.0276	.0315	.0354
1	.0394	.0433	.0472	.0512	.0551	.0591	.0630	.0669	.0709	.0748
2	.0787	.0827	.0866	.0906	.0945	.0984	.102	.106	.110	.114
3	.118	.122	.126	.130	.134	.138	.142	.146	.150	.154
4	.157	.161	.165	.169	.173	.177	.181	.185	.189	.193
5	.197	.201	.205	.209	.213	.217	.220	.224	.228	.232
6	.236	.240	.244	.248	.252	.256	.260	.264	.268	.272
7	.276	.280	.283	.287	.291	.295	.299	.303	.307	.311
8	.315	.319	.323	.327	.331	.335	.339	.343	.346	.350
9	.354	.358	.362	.366	.370	.374	.378	.382	.386	.390
10	.394	.398	.402	.406	.409	.413	.417	.421	.425	.429
11	.433	.437	.441	.445	.449	.453	.457	.461	.465	.469
12	.472	.476	.480	.484	.488	.492	.496	.500	.504	.508

Figures in Current Use

$e = 2{,}71828^2)$	$\pi = 3{,}14159$	$\sqrt{2} = 1{,}4142$
$e^2 = 7{,}389056$	$\sqrt{\pi} = 1{,}77245$	$\sqrt[3]{2} = 1{,}2599$
$\frac{1}{e} = 0{,}367879$	$\sqrt[3]{\pi} = 1{,}4646$	$\sqrt{3} = 1{,}7320$
$\lg e = 0{,}434294$	$\frac{1}{\pi} = 0{,}3183$	$\sqrt[3]{3} = 1{,}4422$
$\sqrt{e} = 1{,}6487$	$\pi^2 = 9{,}8696$	$g = 9{,}80655\ [m/s^2]$
$\sqrt[3]{e} = 1{,}3956$	$\pi^3 = 31{,}00628$	$g^2 = 96{,}2361\ [m^2/S^4]$
$\frac{1}{\lg e} = 2{,}302585$	$\frac{180}{\pi} = 57{,}2958$	$\sqrt{g} = 3{,}1321\ [\ m/S]$
$\ln 10 = 2{,}302585$	$\frac{\pi}{180} = 0{,}01745$	$\frac{1}{g} = 0{,}10194\ [s^2/m]$
$\frac{1}{\ln 10} = 0{,}434294$		$= \sqrt{-1},\ i^2 = -1$

Inches (Decimal) — Millimetres

Inch	0,0"	0,1"	0,2"	0,3"	0,4"	0,5"	0,6"	0,7"	0,8"	0,9"
0"	—	2,540	5,080	7,620	10,16	12,70	15,24	17,78	20,32	22,86
1"	25,40	27,94	30,48	33,02	35,56	38,10	40,64	43,18	45,72	48,26
2"	50,80	53,34	55,88	58,42	60,96	63,50	66,04	68,58	71,12	73,66
3"	76,20	78,74	81,28	83,82	86,36	88,90	91,44	93,98	96,52	99,06
4"	101,60	104,14	106,68	109,22	111,76	114,30	116,84	119,38	121,92	124,46
5"	127,00	129,54	132,08	134,62	137,16	139,70	142,24	144,78	147,32	149,86
6"	152,40	154,94	157,48	160,02	162,56	165,10	167,64	170,18	172,72	175,26
7"	177,80	180,34	182,88	185,42	187,96	190,50	193,04	195,58	198,12	200,66
8"	203,20	205,74	208,28	210,82	213,36	215,90	218,44	220,98	223,52	226,06
9"	228,60	231,14	233,68	236,22	238,76	241,30	243,84	246,38	248,92	251,46
10"	254,00	256,54	259,08	261,62	264,16	266,70	269,24	271,78	274,32	276,86
11"	279,40	281,94	284,48	287,02	289,56	292,10	294,64	297,18	299,72	302,26
12"	304,80	307,34	309,88	312,42	314,96	317,50	320,04	322,58	325,12	327,66

Inch	0,000"	0,001"	0,002"	0,003"	0,004"	0,005"	0,006"	0,007"	0,008"	0,009"
0,00"	—	0,0254	0,0508	0,0762	0,102	0,127	0,152	0,178	0,203	0,229
0,01"	0,254	0,279	0,305	0,330	0,356	0,381	0,406	0,432	0,457	0,483
0,02"	0,508	0,533	0,559	0,584	0,610	0,635	0,660	0,686	0,711	0,737
0,03"	0,762	0,787	0,813	0,838	0,864	0,889	0,914	0,940	0,965	0,991
0,04"	1,016	1,041	1,067	1,092	1,118	1,143	1,168	1,194	1,219	1,245
0,05"	1,270	1,295	1,321	1,346	1,372	1,397	1,422	1,448	1,473	1,499
0,06"	1,524	1,549	1,575	1,600	1,626	1,651	1,676	1,702	1,727	1,753
0,07"	1,778	1,803	1,829	1,854	1,880	1,905	1,930	1,956	1,981	2,007
0,08"	2,032	2,057	2,083	2,108	2,134	2,159	2,184	2,210	2,235	2,261
0,09"	2,286	2,311	2,337	2,362	2,388	2,413	2,438	2,464	2,489	2,515

Comparison of Stress Values (Average Values)

Brinell, Rockwell and Vickers Hardness Numbers for Steel
as laid down in DIN 50150 (Not applicable to austenitic steels)

Testing Method		Penetrating Body	Test Load	DIN
Rockwell	HRB	1/16" Ball	100 kp Initial Load 10 kp	50103
	HRC	Diamond Cone 120°	150 kp Initial Load 10 kp	
Brinell		Ball D = 10, 5, 2.5 mm	P = 30 D²	50351
Vickers		Diamond Pyramid 136°	P = 5 kg	50133

Tensile Strength kp/mm²	Brinell Hardness HB	Rockwell Hardness HRB	Rockwell Hardness HRC	Vickers Hardness HV	Tensile Strength kp/mm²	Brinell Hardness HB	Rockwell Hardness HRB	Rockwell Hardness HRC	Vickers Hardness HV
28	80	36,4		80				24	256
30	85	42,4		85	89	260		24,6	260
32	90	47,4		90				25	262
33	95	52,0		95	90	265		25,4	265
35	100	56,4		100				26	269
37	105	60,0		105	92	270		26,2	270
39	110	63,4		110	94	275		26,9	275
40	115	66,4		115				27	276
42	120	69,4		120	96	280		27,6	280
43	125	72,0		125				28	283
45	130	74,4		130	97	285		28,3	285
47	135	76,4		135	99	290		29	290
48	140	78,4		140	101	295		29,6	295
50	145	80,4		145				30	298
51	150	82,2		150	103	300		30,3	300
53	155	83,8		155				31	306
55	160	85,4		160	106	310		31,5	310
56	165	86,8		165				32	314
58	170	88,2		170	110	320		32,7	320
60	175	89,6		175				33	323
62	180	90,8		180	113	330		33,8	330
63	185	91,8		185				34	332
65	190	93,0		190	117	340		34,9	340
67	195	94,0		195				35	341
68	200	95,0		200	120	350		36	350
70	205	95,8		205	124	360		37	360
72	210	96,6		210	127	370		38	370
73	215	97,6		215	131	380		38,9	380
75	220	98,2		220				39	381
77	225	99,0		225	134	390		39,8	390
			19	229				40	392
78	230		19,2	230	138	400		40,7	400
			20	234				41	404
80	235		20,2	235	142	410		41,5	410
			21	239				42	416
82	240		21,2	240	145	420		42,4	420
			22	244				43	428
84	245		22,1	245	149	430		43,2	430
85	250		23	250	147	423		44	440
87	255		23,8	255	150	430		44,8	450

CONVERSION TABLES

Greek Alphabet

Α α Alpha (a)	Β β Beta (b)	Γ γ Gamma (g)	Δ δ Delta (d)	Ε ε Epsilon (e)	Ζ ζ Zeta (z)
Η η Eta (e)	Θ ϑ Theta (th)	Ι ι Iota (i)	Κ κ Kappa (k)	Λ λ Lambda (l)	Μ μ My (m)
Ν ν Ny (n)	Ξ ξ Xi (x)	Ο ο Omikron (o)	Π π Pi (p)	Ρ ϱ Rho (r)	Σ σ Sigma (s)
Τ τ Tau (t)	Υ υ Ypsilon (ü)	Φ φ Phi (f)	Χ χ Chi (ch)	Ψ ψ Psi (ps)	Ω ω Omega (o)

Roman Numerals

I = 1	VII = 7	XL = 40	IC = 99	DC = 600
II = 2	VIII = 8	L = 50	C = 100	DCC = 700
III = 3	IX = 9	LX = 60	CC = 200	DCCC = 800
IV = 4	X = 10	LXX = 70	CCC = 300	CM = 900
V = 5	XX = 20	LXXX = 80	CD = 400	XM = 990
VI = 6	XXX = 30	XC = 90	D = 500	IM = 999

1977 = MCMLXXVII

Conversion of Metric Measurements into Imperial Measurements and vice versa

1 mm	= 0.0394 inches
1 cm	= 0.3937 inches
1 m	= 3.281 feet = 1.093 yards = 39.371 inches
1 km	= 0.6214 statute miles
1 cm²	= 0.155 square inches
1 m²	= 10.764 square feet = 1.196 square yards = 1550 square inches
1 cm³	= 0.061 cubic inches
1 dm³	= 1 l = 0.0353 cubic feet
1 m³	= 1.3079 cubic yards = 35.32 cubic feet = 61.027 cubic inches
1 l	= 0.22 Imperial gallons
1 kg/kp	= 2.204 pounds
1 g	= 0.035 ounces
1 t	= 0.9842 long tons = 1.102 short tons = 2204 pounds
1 cm/kp	= 0.86796 inches/pound
1 kp/m	= 0.672 pounds/foot
1 kp/m²	= 0.2048 pounds/sqare foot
1 kp/mm²	= 1422.3 pounds/square inch = 0.6348 tons/square inch
1 kp/cm²	= 14.223 pounds/square inch = 0.0063497 tons per square inch
1 kp/m³	= 0.06244 pounds/cubic foot
1 (metr.) at	= 14.233 pounds/square inch = 28.958 inches of mercury (QS) oder 393.7 inches of Water (WS) = 735,5 mm QS = 1 kg/cm²
1 mkp	= 7.233 foot-pounds = 0.0093 British Thermal Unit
1 m/s	= 196.85 feet per minute
1 Fußpfund	(bei der Izodprobe) = 0.173 mkg/cm²
1 mkp/cm²	= 1.12 foot-pounds/square inch
1 PS	= 0.9863 HP = 0.736 kW
1 kW	= 1.341 HP = 1.36 PS = 102 mkg/s
1 kWh	= 1.341 horse power-hours
1 mkp/s	= 0.01315 HP = 0.013 PS = 0.0098 kW
1 kcal	= 3.968 British Thermal Unit = 427 mkp
1 kcal/cm²	= 25.59 British Thermal Unit/square inch
1 kcal/m²	= 0.00256 British Thermal Unit/square inch
1 kcal/m³	= 0.11225 British Thermal Unit/cubic foot
1 kcal/kg	= 1.8 British Thermal Unit/pound
1 kcal/t	= 0.0018 British Thermal Unit/1000 pounds = 0.00182 British Thermal Unit/1010 pounds

1 inch (1")	=25,4 mm; ¾" = 19,05 mm; ½" = 12,7 mm; ¼" =6,35 mm; 1/8" = 3,175 mm; 1/16" = 1,5875 mm
1 foot (1')	= 0,305 m = 12 inches
1 yard	= 3' = 0,915 m
1 square inch	= 6,45 cm²
1 square foot	= 0,093 m²
1 cubic inch	= 16,386 cm³
1 cubic foot	= 1728 cubic inches = 28.316 dm³ = 0,0283 m³
1 cubic yard	= 0,7645 m³
1 Imperial gallon	= 4,54 l
1 pound	= 0,454 kg/kp
1 ounce	= 28,349 g
1 long ton	= 2240 pounds = 1016 kg = 1,016 metr. Tonnen
1 short ton	= 2000 pounds = 907 kg = 0,907 metr. Tonnen
1 pound per square inch	= 703 kp/m² = 0,07 kp/cm² = 0,0007 kp/mm²
1 pound per foot	= 1,49 kp/m
1 ton per square inch	= 1,575 kp/mm² = 157,487 kg/cm²
1 pound per yard	= 0,496 kp/m
1 pound per cubic foot	= 16 kp/m³
1 inch-pound	= 1,1521 cmkp
1 foot-pound	= 0,14 mkp
1 foot/min	= 5,08 mm/s
1 foot-pound per sqare inch	= 0,0215 mkp/cm²
1 horse power = 1,014 PS	= 76,043 mkp/s = 0,7457 kW
1 horse power-hour	= 0,746 kWh
1 kW = 1,341 HP = 1,36 PS	= 102 mkp/s
1 British Thermal Unit (B. Th. U.)	= 0,252 kcal = 107,66 mkp
1 British Thermal Unit per pound	= 0,556 kcal/kg
1 British Thermal Unit per ton (2240 pounds)	= 0,252 kcal/1016 kp = 0,248 kcal/1000 kg = 0,000248 kcal/kg
1 British Thermal Unit per square inch	= 0,0391 kcal/cm² = 391 kcal/m²
1 British Thermal Unit per cubic foot	= 8,9 kcal/m³

Degrees of Temperature to Celcius and Fahrenheit

Look up value in centre column (bold type). If value is expressed in degrees Celsius, read adjoining figure in right column for °F. If in Fahrenheit, read left column for °C.

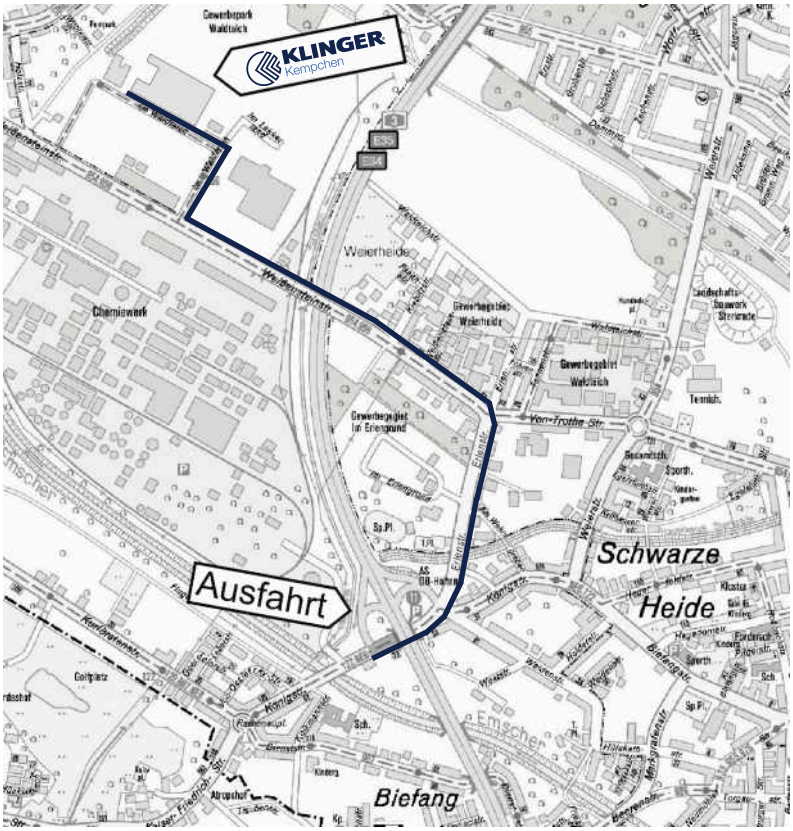
°C		°F	°C		°F	°C		°F	°C		°F	°C		°F	°C		°F	°C		°F
-73	**-100**	-148	-2.8	**27**	80.6	17.8	**64**	147.2	38	**100**	212	238	**460**	860	443	**830**	1526	649	**1200**	2192
68	**- 90**	-130	-2.2	**28**	82.4	18.3	**65**	149.0	43	**110**	230	243	**470**	878	449	**840**	1544	654	**1210**	2210
62	**- 80**	-112	-1.7	**29**	84.2	18.9	**66**	150.8	49	**120**	248	249	**480**	896	454	**850**	1562	660	**1220**	2228
-57	**- 70**	- 94	-1.1	**30**	86.0	19.4	**67**	152.6	54	**130**	266	254	**490**	914	460	**860**	1580	666	**1230**	2246
-51	**- 60**	- 76	-0.6	**31**	87.8	20.0	**68**	154.4	60	**140**	284	260	**500**	932	466	**870**	1590	671	**1240**	2264
-46	**- 50**	- 58	0	**32**	89.6	20.6	**69**	156.2	66	**150**	302	266	**510**	950	471	**880**	1616	677	**1250**	2282
-40	**- 40**	- 40	0.6	**33**	91.4	21.1	**70**	158.0	71	**160**	320	271	**520**	968	477	**890**	1634	682	**1260**	2300
-34	**- 30**	- 22	1.1	**34**	93.2	21.7	**71**	159.8	77	**170**	338	277	**530**	986	482	**900**	1652	688	**1270**	2318
-29	**- 20**	- 4	1.7	**35**	95.0	22.2	**72**	161.6	82	**180**	356	282	**540**	1004	488	**910**	1670	693	**1280**	2336
-23	**- 10**	+ 14	2.2	**36**	96.8	22.8	**73**	163.4	88	**190**	374	288	**550**	1022	493	**920**	1688	699	**1290**	2354
-17.8	**0**	+ 32	2.8	**37**	98.6	23.3	**74**	165.2	93	**200**	392	293	**560**	1040	499	**930**	1706	704	**1300**	2372
-17.2	**1**	33.8	3.3	**38**	100.4	23.9	**75**	167.0	99	**210**	410	299	**570**	1058	504	**940**	1724	710	**1310**	2390
-16.7	**2**	35.6	3.9	**39**	102.2	24.4	**76**	168.8	100	**212**	413,6	304	**580**	1076	510	**950**	1742	716	**1320**	2408
-16.1	**3**	37.4	4.4	**40**	104.0	25.0	**77**	170.6	104	**220**	428	310	**590**	1094	516	**960**	1760	721	**1330**	2426
-15.6	**4**	39.2	5.0	**41**	105.8	25.6	**78**	172.4	110	**230**	446	316	**600**	1112	521	**970**	1778	727	**1340**	2444
-15.0	**5**	41.0	5.6	**42**	107.6	26.1	**79**	174.2	116	**240**	464	321	**610**	1130	527	**980**	1796	732	**1350**	2462
-14.4	**6**	42.8	6.1	**43**	109.4	26.7	**80**	176.0	121	**250**	482	327	**620**	1148	532	**990**	1814	738	**1360**	2480
-13.9	**7**	44.6	6.7	**44**	111.2	27.2	**81**	177.8	127	**260**	500	332	**630**	1166	538	**1000**	1832	743	**1370**	2498
-13.3	**8**	46.4	7.2	**45**	113.0	27.8	**82**	179.6	132	**270**	518	338	**640**	1184	543	**1010**	1850	749	**1380**	2516
-12.8	**9**	48.2	7.8	**46**	114.8	28.3	**83**	181.4	138	**280**	536	343	**650**	1202	549	**1020**	1868	754	**1390**	2534
-12.2	**10**	50.0	8.3	**47**	116.6	28.9	**84**	183.2	143	**290**	554	349	**660**	1220	554	**1030**	1886	760	**1400**	2552
-11.7	**11**	51.8	8.9	**48**	118.4	29.4	**85**	185.0	149	**300**	572	354	**670**	1238	560	**1040**	1904	766	**1410**	2570
-11.1	**12**	53.6	9.4	**49**	120.2	30.0	**86**	186.8	154	**310**	590	360	**680**	1256	566	**1050**	1922	771	**1420**	2588
-10.6	**13**	55.4	10.0	**50**	122.0	30.6	**87**	188.6	160	**320**	608	366	**690**	1274	571	**1060**	1940	777	**1430**	2606
-10.0	**14**	57.2	10.6	**51**	123.8	31.1	**88**	190.4	166	**330**	626	371	**700**	1292	577	**1070**	1958	782	**1440**	2624
- 9.4	**15**	59.0	11.1	**52**	125.6	31.7	**89**	192.2	171	**340**	644	377	**710**	1310	582	**1080**	1976	788	**1450**	2642
- 8.9	**16**	60.8	11.7	**53**	127.4	32.2	**90**	194.0	177	**350**	662	382	**720**	1328	588	**1090**	1994	793	**1460**	2660
- 8.3	**17**	62.6	12.2	**54**	129.2	32.8	**91**	195.8	182	**360**	680	388	**730**	1346	593	**1100**	2012	799	**1470**	2678
- 7.8	**18**	64.4	12.8	**55**	131.0	33.3	**92**	197.6	188	**370**	698	393	**740**	1364	599	**1110**	2030	804	**1480**	2696
- [illegible]	**19**	66.2	13.3	**56**	132.8	33.9	**93**	199.4	193	**380**	716	399	**750**	1382	604	**1120**	2048	810	**1490**	2714
- 6.7	**20**	68.0	13.9	**57**	134.6	34.4	**94**	201.2	199	**390**	734	404	**760**	1400	610	**1130**	2066	816	**1500**	2732
- 6.1	**21**	69.8	14.4	**58**	136.4	35.0	**95**	203.0	204	**400**	752	410	**770**	1418	616	**1140**	2084	821	**1510**	2750
- 5.6	**22**	71.6	15.0	**59**	138.2	35.6	**96**	204.8	210	**410**	770	416	**780**	1436	621	**1150**	2102	827	**1520**	2768
- 5.0	**23**	73.4	15.6	**60**	140.0	36.1	**97**	206.6	216	**420**	788	421	**790**	1454	627	**1160**	2120	832	**1530**	2786
- 4.4	**24**	75.2	16.1	**61**	141.8	36.7	**98**	208.4	221	**430**	806	427	**800**	1472	632	**1170**	2138	838	**1540**	2804
- 3.9	**25**	77.0	16.7	**62**	143.6	37.2	**99**	210.2	227	**440**	824	432	**810**	1490	638	**1180**	2156	843	**1550**	2822
- 3.3	**26**	78.8	17.2	**63**	145.4	37.8	**100**	212.0	232	**450**	842	438	**820**	1508	643	**1190**	2174	849	**1560**	2840

CONVERSION TABLES

Sort of dimension	Symbol	Valid units		Former unit		Conversion formula
		Name	Character	Name	Character	
Space dimensions						
Plane angle	$\alpha\ \beta\ \gamma$	Radian Round angle Right angle Degree Minute Second Centesimal degree	rad L ° ' " gon	Former degree New degree New minute New second	 g c cc	1 rad = Center square with b/r = 1 1 round angle = 2 π rad 1 L = π/2 rad 1° = π/180 rad = L/90 1′ = π/10 800 rad = 1°/60 1″ = π/648 000 rad = 1′/60 1g = 1 gon = 10^{-2} = π/200 rad 1c = 0,01 gon = 1 cgon 1cc = 0,0001 gon = 0,1 mgon
Length	l	Meter Centimeter Millimeter	m cm mm			Base unit
Area, in general Surface Cross-sectional area	A O S, Q, q	Square meter	m^2 dm^2 cm^2 mm^2	Square meter	qm qdm qcm qmm	1 qm = 1 m^2
Volume	V	Cubic meter Litre	m^3 l	Cubic meter	cbm	1 cbm = 1 m^3 1 l = dm^3 = 10^{-3} m^3
Surface moment 1st degree i. e. static moment	H		(m^3), cm^3			
Surface moment 2nd degree up to now angular impulse	I		(m^4), cm^4			
Moment of resistance	W		(m^3), cm^3			
Time dimensions						
Time, time interval, permanence	t	Second	s			Base unit
Period	T	Minute Hour	min h			1 min = 60 s 1 h = 60 min = 3600 s
Frequency	f	Hertz	Hz		per/s	1 per/s = 1 Hz 1 Hz = 1/s
Angular velocity	ω		rad/s			
Angular frequency, gyrofrequency	ω		rad/s, 1/s			
Speed, speed of rotation	n		s^{-1}, min^{-1}			
Rotative frequency	n		1/s			
Angular velocity	a		rad/s^2			
Speed	v		m/s km/h			1 m/s = 3,6 km/h 1 km/h = 0,27 m/s
Velocity	a		m/s^2			
Volume stream Volume flow	V, Q, K		m^3/s			l/s = 10^{-3} m^3/s
Mass-Dimensions						
Mass Weight = Weighting result	m	Kilogram Ton, gram	kg t, g			Base unit 1 t = 10^3 kg = 1 Mg
Density (mass relative to volume)	ϱD		kg/m^3			
Mass stream, mass flow	m		kg/s			
Moment of inertia, 2nd degree Moment of inertia	J		kg m^2 = Ws^3			
Force-Dimensions						
Force Weight force	F G	Newton	N = kg m/s^2	Kilopond Dyn	kp dyn	1 kp = 9,80665 N ≈ 10 N 1 dyn = 10^{-5} N
Moment of force, bending moment Torque (moment of a force couple)	M T		N m = J = Ws		kp m	1 kp m ≈ 10 N m ≈ 1 daN m
Impulse, momentum	p		Ns = kg m/s		kp s	1 kp s ≈ 10 N s
Moment of momentum, twist	b		N ms rad = kg m^2 rad/s = Ws^2 rad		kp ms rad	1 kp m s rad ≈ 10 N m s rad
Moment of inertia	$G \cdot D^2$		kg m^2		kp m^2 Mp m^2	$G \cdot D^2$ = 4 J ($G \cdot D^2$ in kp m^2, J in kg m^2)
Mechanical tension Face pressure	δ, τ p		N/mm^2		kp/mm^2 kp/cm^2	1 kp/mm^2 ≈ 10 N/mm^2 1 kp/cm^2 ≈ 0,1 N/mm^2
Pressure	p	Pascal Bar	Pa = N/m^2 M Pa = N/mm^2 bar = 10^5 Pa = 10^5 N/m^2 mbar = 10^2 Pa = 10^2 N/m^2	technical atmosphere physical atmosphere	m WS mm WS at Torr mm Hg atm	1 m WS ≈ 10^4 N/m^2 = 0,01 N/mm^2 1 mm WS ≈ 10 N/m^2 1 at = 1 kp/cm^2 ≈ 0,1 N/mm^2 1 Torr = 1 mm Hg = 133,3 N/m^2 = 1,333 mbar 1 atm = 0,1013 N/mm^2 = 1,013 bar
Material behavior dimensions						
Modulus of elasticity Shear modulus	E G		N/mm^2		kp/cm^2	1 kp/cm^2 ≈ 0,1 N/mm^2
Extension (Δl / l)	ε		%			proportional number
Extension rigidity (E · A)	$Sz.$		N = kg m/s^2		kp	1 kp ≈ 10 N
Flectional strength (E · I ax.)	Sb		Nm^2 = kg m^3/s^2		kp cm^2	1 kp cm^2 ≈ 10^{-3} N m^2
Restoring force per unit length Spring rate (F / l)	c		N/m = kg/s^2		kp cm	1 kp cm ≈ 10^3 N/m
Dynamic viscosity	η		Pas = Ns/m^2 = kg/s m	Zentipoise	c P	1 cP ≈ 10^{-3} N s/m^2
Kinematical viscosity $\nu = \eta/\varrho$	ν		m^2/s	Zentistokes	c St	1 cSt = 10^{-6} m^2/s = 1 mm^2/s
Energy and power dimensions						
Work, energy Quantity of heat	W $Q\ W$	Joule	J = N m = kg m^2/s^2 = Ws kWh = $3,6 \cdot 10^6$ J	Calorie	kp m cal	1 kp m ≈ 10 J 1 cal = 4,187 J
Power Heat stream	P $\Phi\ Pv$	Watt	W = J/s = Nm/s = kg m^2/s^3	Metric horsepower	PS k cal/h	1 PS = 735,5 W k cal/h = 1,163 W
Thermodynamic dimensions						
Thermodynamic temperature	T, Θ	Kelvin	K	Kelvin	°K	1 °K = 1 K Base unit
Celsius temperature	$t\vartheta$	Grad Celsius	°C			t = T — 273,15 K
Temperature interval	$\Delta t\ \Delta\vartheta$		K °C	Degree centigrade	grd	°C if reference temperature is indicated in °C 1 grd = 1 K ^ 1 °C
Thermal coefficient of elongation	α, λ		K^{-1}		grd^{-1}	m/m K
Thermal conduction value	$\Lambda\ w$		W/K		kcal/h grd	1 kcal/h grd = 1,163 W/K
Thermal conductivity	λ		W/m K		k cal/m h grd	1 kcal/m h grd = 1,163 W/m K
Temperature conductivity	a		m^2/s, m^2/h			1 m^2/s = 3600 m^2/h
Coefficient of thermal conduction Coefficient of heat conduction	a k		W/m^2 K		k cal/m^2 h grd	1 kcal/m^2 h grd = 1,163 W/m^2 K
Specific heat capacity (former specific heat)	c		J/kg K = Ws/kg K = Nm/kg K		k cal/kg grd	1 kcal/kg grd = 4187 J/kg K
Radial constant e. g. of the black ray	Cs		W/m^2 K^4 = J/s m^2 K^4		k cal/m^2h K^4	1 kcal/m^2 h K^4 = 1,163 W/m^2 K^4

HOW TO FIND US

KLINGER Kempchen Oberhausen



Motorway exit Oberhausen Holten (11)

From motorway A3, take exit 11 to Oberhausen-Holten.

Turn left on Erlenstraße and proceed to the intersection of Weiftensteinstraße and Von Trotha Straße.

Turn left on Weißensteinstraße.

After the motorway overpass, turn right on street Im Waldteich.

Follow street Im Waldteich.

KLINGER Kempchen GmbH
Im Waldteich 21
46149 Oberhausen

KLINGER Kempchen Leuna

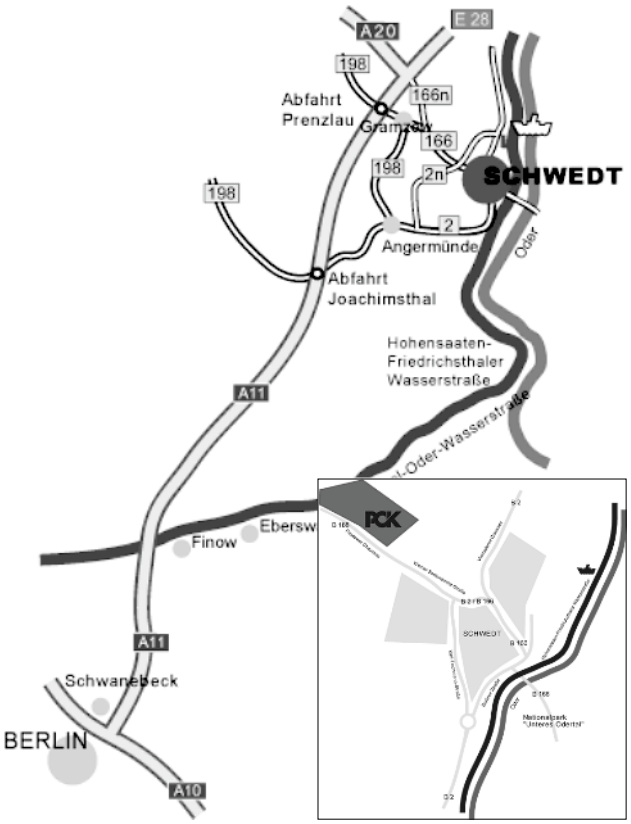
A38 direction Gottingen, Leuna exit

Take the B91 direction Merseburg; take a right on Kotzscher Straße before the bridge, then turn right on Friedrich Ebert Straße. Follow the tramway tracks all the way to Haupttor.

KLINGER Kempchen Leuna GmbH
Am Haupttor - Geb. 5512
06237 Leuna

HOW TO FIND US

Service-settlement Schwedt



On the A11 to Prenzlau exit

Continue on B 198 towards Schwedt, then take B 166. The PCK Raffinerie GmbH site will be on your left.

KLINGER Kempchen GmbH
Service-settlement Schwedt
Passower Chaussee
on site of PCK GmbH
16303 Schwedt/Oder

Service-settlement Wesseling

On the A555 until the exit Wesseling

Take the Siebengebirgstraße towards the roundabout. At the roundabout take the first exit (Ahrstraße). Turn left. Ludwigshafen in the street to the entrance of the SHELL Rheinland refinery On the premises of Shell Rheinland refinery, see our:

KLINGER Kempchen GmbH
Service-settlement Wesseling
Hauptmagazin Raum 19
Ludwigshafener Straße 1
50389 Wesseling

Service-settlement Ludwigshafen

On the A6 up to the exit Ludwigshafen North

Take the B9 in direction of BASF. Stay on the B9/L523 to the entrance of BASF. On the BASF site you will find our:

KLINGER Kempchen GmbH
Service-settlement Ludwigshafen
on site of BASF, Gebäude J544
67056 Ludwigshafen/Rhein

CORPORATE INFORMATION, PRODUCTION, TESTING FACILITIES, WARRANTY

Name:	**KLINGER Kempchen GmbH**
Address:	Im Waldteich 21, 46147 Oberhausen
Established:	1889
Employees:	200
Storage area and production area:	17000 m²
Principal customers:	Chemicals and petrochemicals industry, metal working, energy providers and shipyards and motor construction
Products:	Gaskets, packings, compensators, rubber and plastic products
Know how:	Production of gaskets, packings, compensators, rubber and plastics; technical consulting including design, computation and development
QM-System:	DIN EN ISO 9001, DIN EN ISO 14001, BS OHSAS 18001, DIN EN ISO 50001, RAL, API, KTA 1401

Primary production facilities:

- Turning lathes (up to Ø 4,800 mm)
- CNC lathes
- Shears (notching, rotary, squaring)
- Laser-beam unit
- Punching machines
- Plotters
- Presses
- Winding machines
- Branding machines for packings
- Annealing furnace (only for soft-annealing of non-ferrous metals and soft iron)
- Tool manufacture and maintenance

CORPORATE INFORMATION, PRODUCTION, TESTING FACILITIES, WARRANTY

Available testing facilities

Chemical Laboratory

» Test equipment for the verification of anions (e.g. soluble chloride, fluoride, sulfate and total chlorine and sulfur)

- IC – Ion chromatograph; company Dionex (now ThermoFisher) type ICS 1100 with AS22-column for 7 anions and autosampler

» Tube furnace with controllable purge gas (up to + 900 °C); company Heraeus

» Thermal analysis for characterization of materials, incoming inspection and failure analysis

- DSC - differential scanning calorimetry; company Netzsch type DSC 200 / Maia (- 150 °C to + 600 °C)
- STA – simultaneous thermal analysis including a DSC and a thermogravimetric analysis; company Netzsch type STA / Jupiter (+ 25 °C to + 1550 °C)

» Muffel furnaces

- Company Carbolite (up to + 1100 °C)
- Company LINN oven with controllable purge gas (up to + 1200 °C)

» Diverse drying cabinets with and without air circulation (up to + 300 °C); company Binder

» Climatic cabinet type PSL – 2 G; company Klima Systems (-100 °C to + 160 °C and 0 to 100 % r.h. with timing)

» Fully automatic hardness tester - DIGI-TEST for
- Shore A / B / 0
- Shore D / C / D0
- micro IRHD

» Stereomicroscope; company WILL Wetzlar

Application Technology (Physical Laboratory)

» Test presses for determining characteristic values according to DIN EN 13555

AMTEC I (1000kN; 400 °C)
AMTEC II (1000 kN; 500 °C)
AMTEC III (1000 kN; 900 °C)
Klinger (500 kN; 450 °C)

» Mass spectrometer for determining leakage
Leybold I (PhoniXL 300)
Leybold II (PHOENIXL 300)

» Profile recording device
Mitutoyo Contraser CV1000

» Fuji Prescale film scanner evaluation Canon FPD-8010E

» Universal measuring amplifier with force and displacement transducers

HBM measuring amplifiers Quantum X
(4 channel and 8 channel)

HBM Force Transducer (KMR/200 kN)

HBM load cells (C9B 20 kN)

HBM transducers (WI/5MM-T)

» Universal heating cabinet Memmert (UFE 400/300 °C)

» Climatic cabinet (temperature and humidity)
Company Tabai Espec (-70 to +160 °C)

Warranty

All information and technical specifications contained in this catalog are accurate to the best of our knowledge and belief at the time of compilation of this brochure. They are intended to provide information about our products and their various applications.

Therefore we accept no liability for the specific properties or suitability for concrete uses provided in this brochure, with the exception of any express warranties issued in writing on a case-by-case basis.

Any applicable industrial property rights are to be observed. By placing an order, the customer accepts our terms and conditions, which are available for review at any time.

CORPORATE INFORMATION, PRODUCTION, TESTING FACILITIES, WARRANTY

Name:	**KLINGER Kempchen Leuna GmbH**
Address:	Am Haupttor, Building 5512
	06237 Leuna
Established:	1995
Employees:	5
Storage area and production area:	650 m²
Principal customers:	Chemicals and petrochemicals industry, metal working, energy providers
Products:	Gaskets, packings, compensators, rubber and plastic products
Know-how:	Production of trade with gaskets, packings, compensators as well as service, technical consulting, computation
QM-System:	DIN EN ISO 9001

Primary production facilities:

- Turning lathe (up to Ø 500 mm)
- Shear
- Cleaning plant for grooved gaskets up to Ø 1000 mm
- Punching machine
- Plotters

CORPORATE INFORMATION, PRODUCTION, TESTING FACILITIES, WARRANTY

Name:	**KLINGER Kempchen GmbH** **Service-settlement Schwedt**
Address:	Passower Chaussee Gelände der PCK GmbH 16303 Schwedt/Oder
Established:	1991
Employees:	3
Storage area and production area:	300 m²
Principal customers:	Chemicals and petrochemicals industry, metal working, energy providers
Products:	Gaskets, packings, compensators, rubber and plastic products
Know-how:	Production of gaskets; technical consulting; service
QM-System:	DIN EN ISO 9001, DIN ISO 14001, BS OHSAS 18001, DIN EN ISO 50001

Primary production facilities

- Punching and cutting machines
- Windeing machines
- Indent machines
- Lathe
- Plotters

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NOTES

KLINGER Kempchen

KLINGER Kempchen GmbH
Im Waldteich 21 » D-46147 Oberhausen
T +49 208-8482-0 » F +49 208-8482 285
info@klinger-kempchen.de

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www.klinger-kempchen.de