

## 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  $\sigma_v$ , 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  $\sigma_v$  and  $\sigma_\delta$  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  $\sigma_\delta$  value must be taken into consideration. The  $\sigma_v$  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- Super plain sheet metal	RivaTherm- Super ringed sheet metal	RivaTherm- Super-Plus	RivaTherm- HD
Recommended max. roughness of flange surface	$\mu\text{m}$	from 50 to 100	50 100	50 100	50 100	50 100	25 50	50 100	50 100	50 100	50 100
Surface pressure limits for 20 °C	$\text{N/mm}^2$	$\sigma_v$ 40	$\sigma_v$ 35	$\sigma_v$ 30	$\sigma_v$ 15	$\sigma_v$ 2	$\sigma_v$ 35	$\sigma_v$ 10	$\sigma_v$ 20	$\sigma_v$ 20	$\sigma_v$ 20
		$\sigma_\delta$ 100	$\sigma_\delta$ 80	$\sigma_\delta$ 60	$\sigma_\delta$ 90	$\sigma_\delta$ 15	$\sigma_\delta$ 60	$\sigma_\delta$ 120	$\sigma_\delta$ 140	$\sigma_\delta$ 160*	$\sigma_\delta$ 290*
Surface pressure limits for 300 °C	$\text{N/mm}^2$	$\sigma_v$ -	$\sigma_v$ -	$\sigma_v$ -	$\sigma_v$ -	$\sigma_v$ -	$\sigma_v$ -	$\sigma_v$ 10	$\sigma_v$ 20	$\sigma_v$ 20	$\sigma_v$ 20
		$\sigma_\delta$ -	$\sigma_\delta$ -	$\sigma_\delta$ -	$\sigma_\delta$ -	$\sigma_\delta$ -	$\sigma_\delta$ -	$\sigma_\delta$ 110	$\sigma_\delta$ 120	$\sigma_\delta$ 140*	$\sigma_\delta$ 260*

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

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## 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
TFG 9A	Metal-graphite
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

## 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<sup>-</sup> < 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<sup>-</sup> < 25 ppm
- Temperature range – 200°C to 550°C

**Approvals and test reports from KTW, DVGW, BAM and PAS.**

## Flat gaskets made from graphite, fibre, PTFE, elastomer

**RivaTherm Super Plus Type RSP 2S205-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 2S205-I is made easy by the retention of the 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
- KTW
- Blow out-Test Hops 2
- Fire safe

**RivaTherm-HD Type RHD 2S305-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.

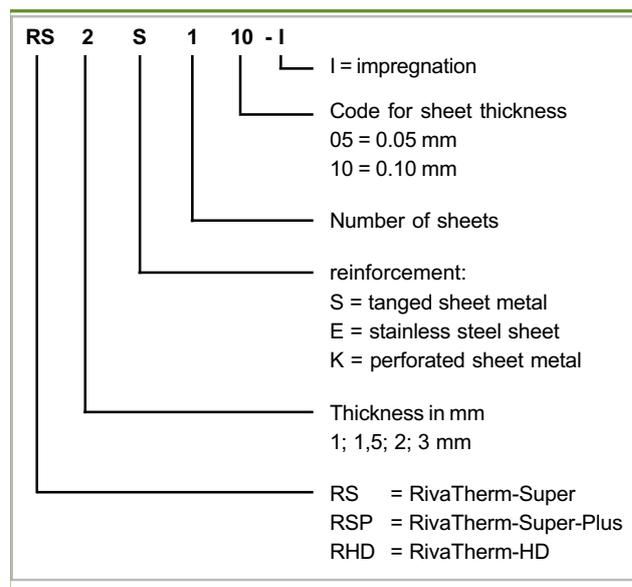
The structure of the high-strength RivaTherm HD sealing sheet is based on a glue-free sandwich construction with three modified tanged sheet metal inlayers made from stainless steel with alternating arrangements of graphite sheets.

- Graphite purity 99%
- Low chloride < 25 ppm
- Temperature range – 200°C to 550°C

Approvals and test reports:

- TA-Luft
- BAM
- DVGW
- KTW
- Blow out test Hops 2
- 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

## 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.

### We stock the following gaskets:

Meter and fitting gaskets NBR 50219.0 0 (80 + 5 Shore A) certified for use with both gas and water.

- DVGW-DIN 3535-1
- HTB in accordance with DIN 3374, DIN 3376 Part 1 and 2 in gas meter fittings
- KTW recommended Part 1.2.13 Areas D1+D2

### Gaskets for water meters

- ¾" Ø 23.0 x 30.0 x 3.0 mm ID No. 20 2867
- 1" Ø 29.0 x 38.0 x 3.0 mm ID No. 20 2940
- 1 ½" Ø 43.0 x 54.5 x 3.0 mm ID No. 20 2942

### Gaskets for gas meters, two pipe fittings

- ¾" Ø 23.0 x 30.0 x 3.0 mm ID No. 20 2867
- 1" Ø 30.5 x 37.5 x 3.0 mm ID No. 20 2945
- 1 ¼" Ø 39.5 x 49.5 x 3.0 mm ID No. 20 2947
- 1 ½" Ø 45.5 x 55.5 x 3.0 mm ID No. 20 2948
- 2" Ø 58.5 x 70.5 x 3.0 mm ID No. 20 2949

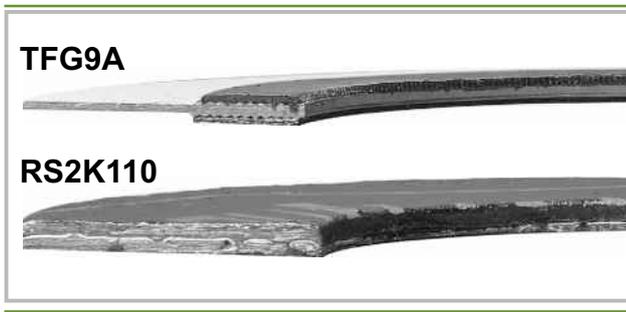
Supplied as: pack of 100 pieces

# 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  $< 1 \cdot 10^{-2}$  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.

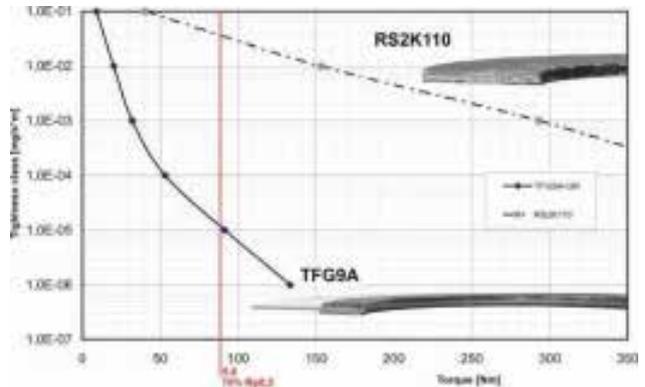
See for yourself with a calculation by the use of our online calculation program Kemproof at <http://kemproof.kempchen.de>. The gasket TFG9A has been listed there for a calculation.

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.

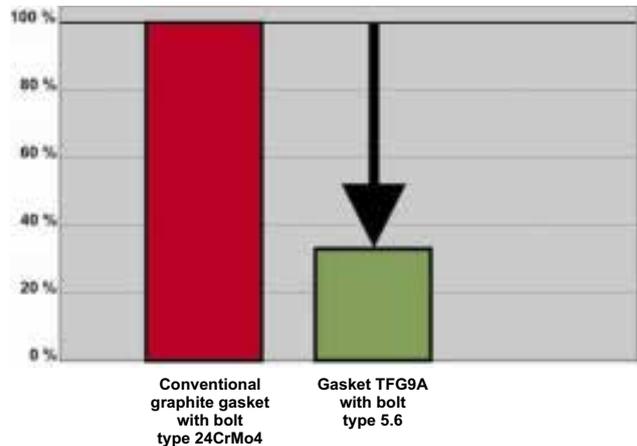
The flat gasket type **TFG9A** shows clear advantages not only in the technical overall assessment of the system but also in the economic evaluation.

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.

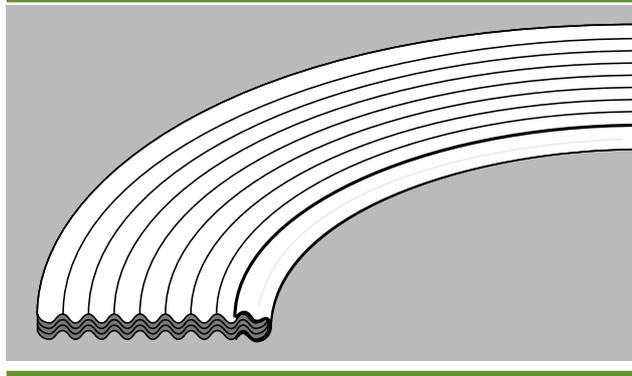
## Required torques to achieve a tightness class at DN 40/ PN 40 - Flange P245GH / 150°C with 5.6 M16 bolts



## Cost savings by not investing in high-strength bolt materials



## Waveline WLP® flat gaskets



### 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 0.05mm 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.

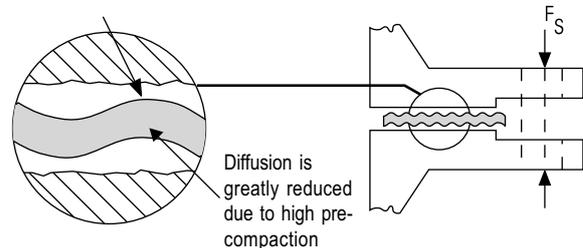
### Gasket limiting values

Min surface pressure N/mm <sup>2</sup> :	$\sigma_v$	20
Max. surface pressure N/mm <sup>2</sup> :	$\sigma_g$	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

## Flat gaskets from KLINGER® top-chem

### Soft material flat gaskets from KLINGER® top-chem

With the superb quality of the KLINGER® top-chem 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 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, KTW, FDA, BAM (liquid oxygen), TA Luft, Germanischer Lloyd.

#### 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, Germanischer Lloyd.

#### 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, TA Luft, Germanischer Lloyd.

#### Technical data

		Top-chem		
		2003	2005	2006
Reference thickness	mm	2,0	1,5	1,5
density	g/cm <sup>3</sup>	1,75	2,2	2,9
Compressibility	ASTM F36J %	18-22	3-7	3-7
recovery	ASTM F36J %	>35	>50	>40
Leak-tightness	DIN 28090-2 mg/s*m	0,01	0,02	0,01
Stress relaxation	DIN 52913 30 MPa 16h 150°C MPa	13	25	18
Stability according to Klinger				
Compression	23°C / 50 MPa %	<10	<10	<10
	260°C / 50 MPa %	<40	<35	<45
Thickness / weight increase				
H <sub>2</sub> SO <sub>4</sub>	100% 18h / 23°C %	- / 1	2 / 2	
HNO <sub>3</sub>	100% 18h / 23°C %	- / 5	2 / 7	1 / 2
NaOH	33% 72h / 110°C %	- / 2		1 / 1

## Universal PTFE flat sealing strip Profile TF1

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

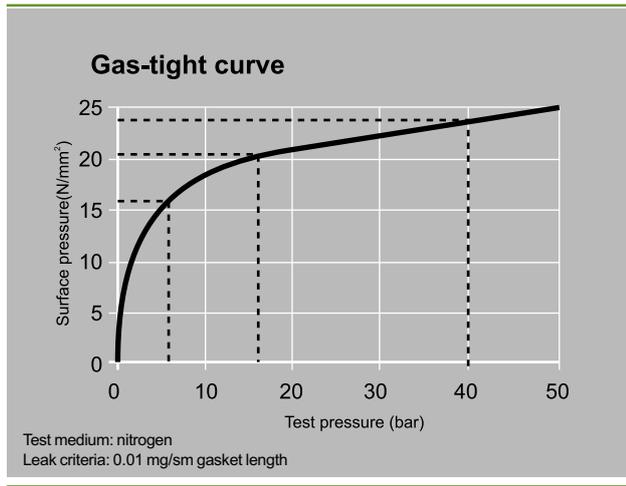
### ○ BAM-test report for use with oxygen

(Manufacturer certificate on the basis of a BAM test report)

### ○ General purpose

Temperature range – 200°C to 150°C

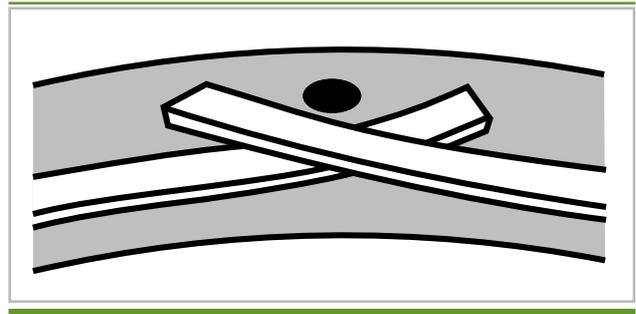
The use of the PTFE strip as a permanent replacement for flat gaskets, such as those required by DIN 2690, is not recommended.



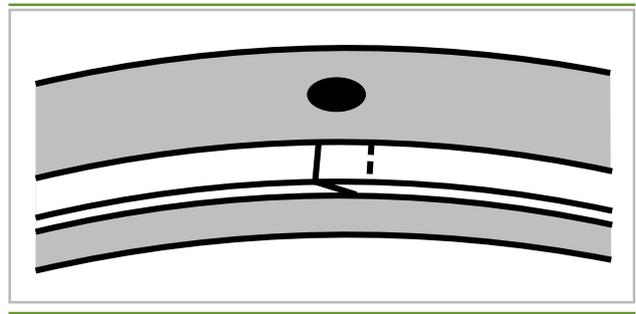
Installation is easy and inexpensive with the secure handling offered by the glue strips.

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).

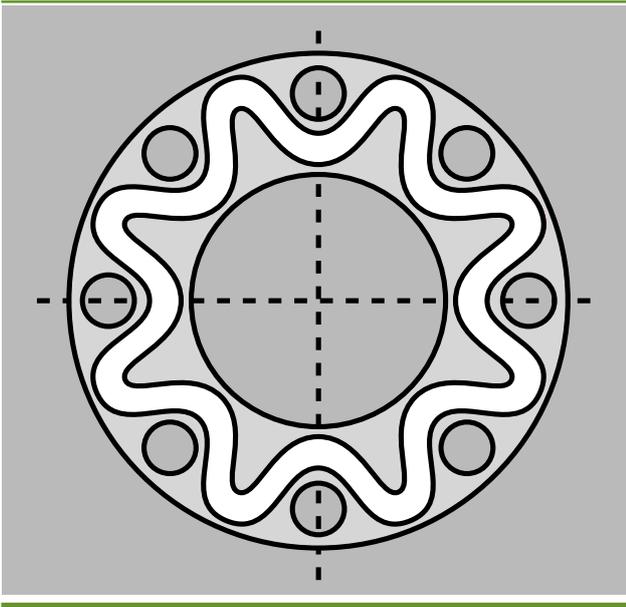


- The band should be fitted to stress-sensitive components with a bevel cut. To do this, create a scarf joint at each end to a length of approx. 1.5 times the sealing width and fit together. This method of joining can also be used in any place where only a light pressing force can be applied. The joint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

<b>Width mm</b>	1	3	5	7	10	12	14	17	20	22	28	40
<b>Thickness approx. mm</b>	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

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 metres. 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<sup>3</sup>. The strip with a thickness of 0.38 mm has a density of 1.1 g/cm<sup>3</sup>.

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. See the section entitled "Packings", RivaTherm Packing K80.

