When sealing demands high performance.

Seals and sealing elements made from PTFE and PTFE compounds.

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SEALING TECHNOLOGY
Teamwork guarantees performance!

Contents

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Radial shaft sealing rings

Radial shaft sealing rings have been successfully used for sealing rotating shafts for more than fifty years. Starting from seals with leather sleeves, ongoing development led to today's shaft sealing ring designs with optimised profiles and sealing materials. The standard versions with NBR, HNBR and FPM elastomers, however, are not always suited to coping with the sometimes extreme operating conditions encountered today.

For extreme operating conditions such as
- → high and low temperatures
- → insufficient lubrication or dry running
- → aggressive chemical media
- → high pressures
- → applications in the food & beverage and pharmaceutical industries
- → high circumferential speeds

the Tecoflon ring extends the range of application of the standard versions through the use of PTFE and special PTFE compounds.

Figure 1

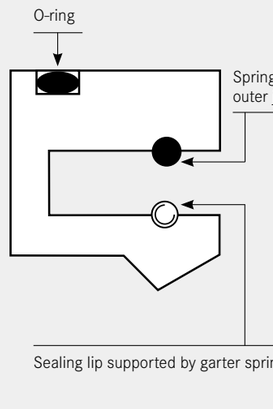
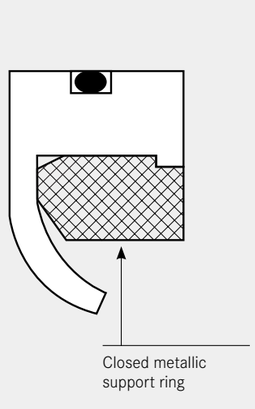


Figure 2

Figure 3



Figures 1, 2 and 3 show examples of the design of the individual components of various Tecoflon rings: Type 100/OR, Type 431 and Type 410/OR/STR.

Properties of PTFE (polytetrafluorethylene) and PTFE compounds

PTFE is a thermoplastic polymer of tetrafluorethylene. Apart from its favourable sliding and wear properties, the advantages of this high-quality product are not so much mechanical but lie rather in its thermal, electrical and chemical properties. Its characteristic features include:

- → almost universal resistance to chemicals
- → insolubility in almost all well-known solvents below 300 °C
- → high thermal stability, usable continuously within a range from −270 °C to +260 °C
- → low adhesivity, low coefficient of friction
- → excellent electrical properties
- → resistance to stress cracking and atmospheric influences
- → only limited usability for load-bearing parts because of the low modulus of elasticity

This set of properties can be modified in a variety of ways by forming compounds with additives that add strength or reduce wear.

Structure and general characteristics

PTFE is an almost unbranched polymer with a linear structure. It is this compact make-up that leads to the unusually high chemical and thermal stability. On the other hand, the low intermolecular forces in PTFE result in lower mechanical strength and rigidity. A high crystallinity and the small low-molecular forces make PTFE resistant to almost all solvents.

Fillers

The properties of pure PTFE are optimised to suit the particular application through the use of fillers, which mostly account for a proportion of between 5 and 40%. Of the wide variety of fillers available, the following have proved to be particularly useful:

Graphite
Improvement of sliding properties. Low abrasion against soft, metallic countersurfaces. Improvement of thermal conductivity.

Glass
Greater compressive strength and wear resistance. Reduction of cold flow.

Coal/coke
Increase in thermal conductivity, compressive strength and wear resistance. Electrically conductive with a high proportion of filler. Good dry running characteristics.

Bronze
Very good compressive strength and wear resistance. Increase in thermal conductivity. Often a favoured choice in hydraulic applications.

Stainless steel
Improvement of thermal conductivity. Reduction of cold flow.

Eigenschaften von PTFE (Polytetrafluorethylen) und PTFE-Compounds

Mechanical properties

Above 19 °C, PTFE undergoes a transformation of the crystalline structure. The triclinic packing changes to a more or less ordered hexagonal packing. This results in an increase in volume of about 1%.

Above a certain loading, the material is deformed by creep or cold flow if parts are made of pure PTFE.

Moulding materials made of PTFE exhibit high viscosity, which applies even at temperatures as low as −200 °C.

Of all solid materials, PTFE has the lowest coefficient of friction – which is another consequence of the low intermolecular forces. As the dynamic and static coefficient of friction are the same, no stick-slip occurs. The favourable sliding properties are retained both at low temperatures (below 0 °C) and at high temperatures. The coefficients of friction of the filled compounds are usually lower than those of unfilled PTFE. Generally, the coefficient of friction can be expected to be between μ = 0.1 and 0.25.

Moulded PTFE parts are not manufactured by melting but by means of a sintering process. This, and the weak intermolecular forces, explains the low abrasion resistance of PTFE. In contrast, abrasion is significantly lower with PTFE compounds.

Thermal properties

The thermal stability of PTFE is unsurpassed by any other commercially available plastic. No noticeable degradation occurs until temperatures reach > +350 °C. The upper temperature for continuous operation is +260 °C, which means that PTFE spans an application range from −200 °C to +260 °C. PTFE still exhibits a certain elasticity at −200 °C. The material can therefore also be used for seals and components with liquefied gases.

Electrical properties

The electrical insulation characteristics are extraordinarily good. They are almost entirely independent of frequency, temperature and ambient conditions.

Chemical properties

The chemical stability exceeds that of any other elastomers or other thermoplastics. This provides good resistance to swelling in almost all media. Only liquid alkali metals and some fluorine compounds affect the PTFE material at relatively high temperatures and pressures. PTFE is characterised by high resistance to ultraviolet radiation and weathering, and can be recommended without reservation for outdoor use. Furthermore, the relatively loose microstructure (somewhat larger than PVC, for example) leads to low permeability for gases and vapours.

Health assessment

There are no concerns regarding the use of PTFE in respect of German food law. Thermal degradation begins at temperatures above 200 °C. In its non-compounded form, PTFE is physiologically inert. Long-term feeding trials have shown no effects on animals. The PTFE material does not cause any skin irritation, and is very well tolerated when implanted in living tissue.

PTFE products also meet all requirements for application in the food sector.

Pure PTFE satisfies the requirements of the U.S. Food and Drug Administration (FDA, Title 21: Code of Federal Regulations, §177.350) and the regulations of the German Federal Health Office BGA (160th Report).

Particular features of Tecoflon rings

Tecoflon rings

Radial shaft sealing rings made of PTFE compounds

Advantages and application limits:

- → high chemical and thermal stability from −70 °C to +260 °C
- → can be used in starved lubrication conditions and for dry running
- → circumferential speeds of up to 30 m/s
- → special materials can be used in the pharmaceutical and food & beverage industries
- → high wear resistance of the seal material
- → low friction and low breakaway torque following lengthy stationary periods
- → anti-adhesive seal material
- → can be used on non-hardened shafts, depending on material
- → installation spaces can be designed as required, according to DIN 3760 or customer specifications

Note: these limit values depend on the material combination, the type of seal and the operating conditions.

Areas of application

Sealing for a wide variety of media, for example:

- → aggressive and corrosive chemicals in both the liquid and gaseous state
- → granulates, powders and liquids in the food & beverage and pharmaceutical sectors
- → mineral and synthetic greases and oils
- → lubricating and cooling liquids
- → bulk goods for the building materials industry
- → water and steam
- → resinous and paste-like masses

Examples of applications

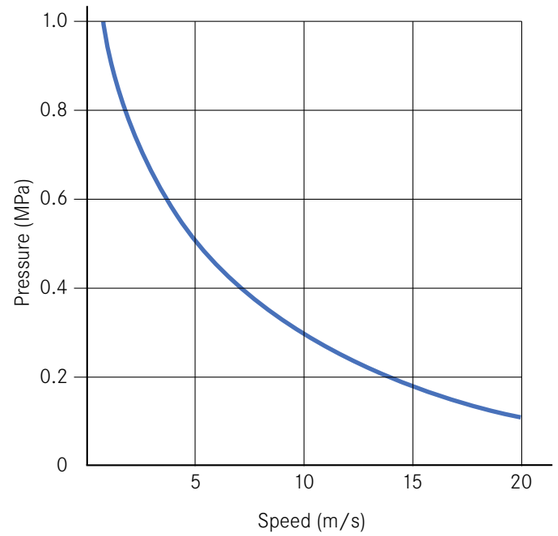
- → Machine tools
- → Beverage bottling plants
- → Bakery machinery
- → Butchery machinery
- → Mills
- → Fans
- → Compressors
- → Stirrers
- → Conveying and dosing systems
- → Gearing
- → Rotary feedthroughs
- → Centrifuges

Pressure as a function of speed

Example: Type 410 Tecoflon ring

at an operating temperature of 50 °C

at a speed of
1 m/s withstands pressure up to approx. 1.0 MPa
5 m/s withstands pressure up to approx. 0.5 MPa
10 m/s withstands pressure up to approx. 0.3 MPa
15 m/s withstands pressure up to approx. 0.2 MPa
20 m/s withstands pressure up to approx. 0.1 MPa

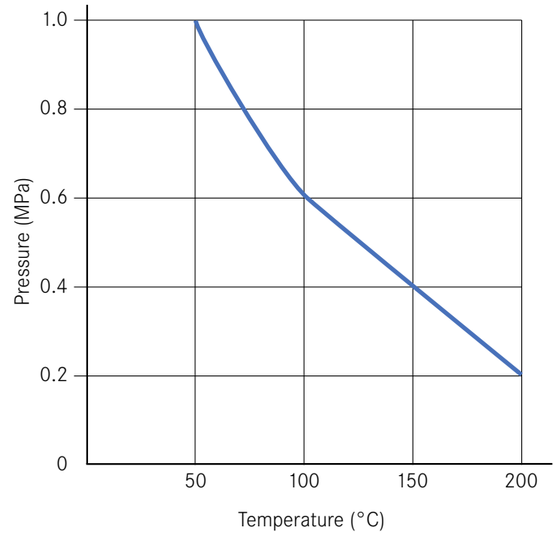


Pressure as a function of temperature

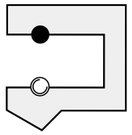
Example: Type 410 Tecoflon ring

at a speed of 1 m/s

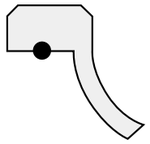
at a temperature of
up to +50 °C withstands pressure up to approx. 1.0 MPa
up to +100 °C withstands pressure up to approx. 0.6 MPa
up to +150 °C withstands pressure up to approx. 0.4 MPa
up to +200 °C withstands pressure up to approx. 0.2 MPa



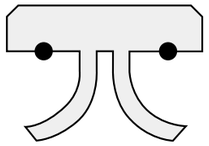
Bauformen



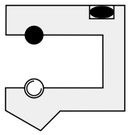
Type 100
Spring-supported outer jacket.
Sealing lip with garter spring
to accommodate radial shaft run-out.



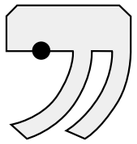
Type 411
No dead space, for medical
and food & beverage technology.



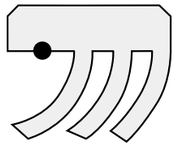
Type 421/i
Sealing lip arrangement as for Type 421,
but with internal sealing lips that do not
project beyond the width of the seal.



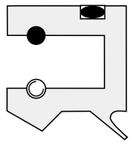
Type 100/OR
Design as for Type 100, but with an
O-ring for additional sealing at the outer
diameter.



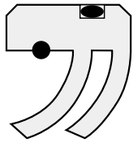
Type 420
With two sealing lips,
therefore greater operational reliability
and improved sealing function.



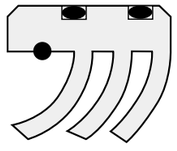
Type 430
With three sealing lips for extreme
conditions, e.g. for solids mixers and
sludge pumps.



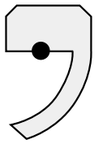
Type 110/OR
With additional dust lip,
otherwise identical to Type 100/OR.



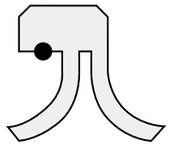
Type 420/OR
Design as for Type 420, but with an O-ring
for better sealing at the outer diameter.



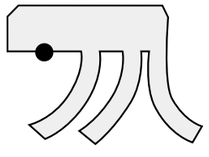
Type 430/OR
Design as for Type 430, but with
additional O-rings for better sealing
at the outer diameter.



Type 410
Standard type for small
axial installation spaces.

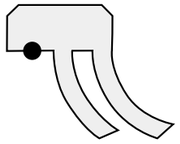


Type 421
Inversely arranged sealing lips.
For separation of two media,
e.g. for decanters and centrifuges.

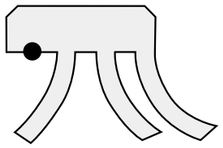


Type 431
With three sealing lips, e.g. for sealing
a screw conveyor bearing. One sealing
lip faces the bearing and two sealing lips
face the abrasive medium to be trans-
ported, thus giving greater operational
reliability and improved sealing function.

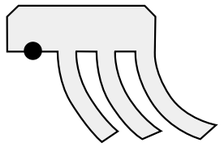
Other possible designs



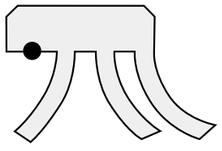
Type 422



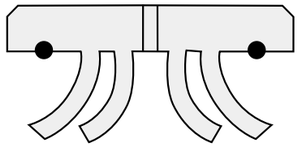
Type 432



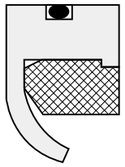
Type 433



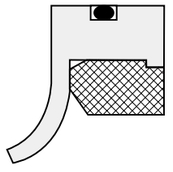
Type 432/SP
With air-barrier hole



Type 442/SP/i
With air-barrier hole and internal
sealing lips that do not project beyond
the width of the seal.



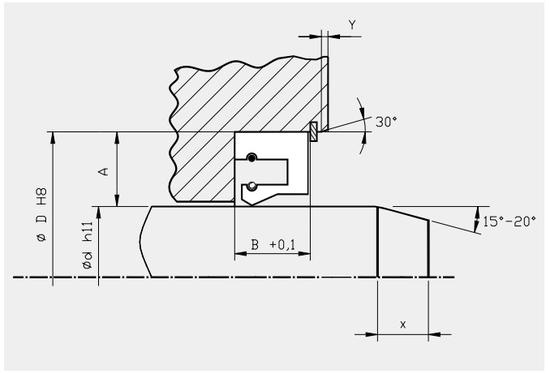
Type 410/OR/STR
With closed metallic support ring, thus
allowing installation in open bore holes
without additional axial securing.



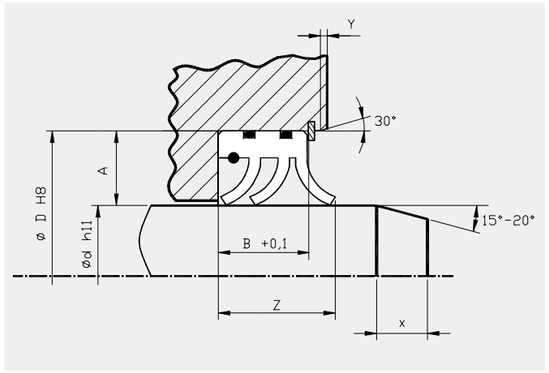
Type 411/OR/STR
No dead space, for use in medical
and food & beverage technology.

Mounting dimensions (special dimensions on request)

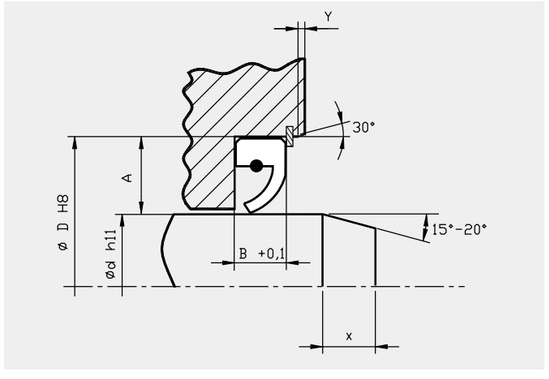
Type 100



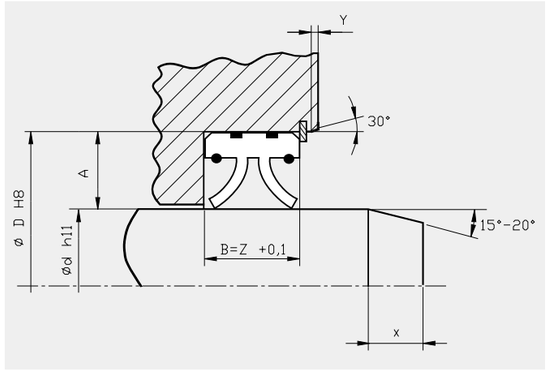
Type 431/OR



Type 410



Type 421/OR/i



Mounting dimensions (special dimensions on request)

Type series 100, 100/OR, 110

Shaft ø d		ø D	Housing/seal								Mounting chamfer	
			100		100/OR		110		110/OR			
over	up to		A	B	A	B	A	B	A	B	X	Y
10	25	ø D = ø d + 2 x A	6	6	8	6	6	6	8	6	3	1
26	40		8	8	10	8	8	8	10	8	3	1
41	120		10	10	10	10	10	10	10	10	4	1
121	260		15	15	15	15	15	15	15	15	5	1,5
261	500		20	20	20	20	20	20	20	20	6	2
501	900		25	20	25	20	25	20	25	20	7	2

Type series 410/OR/STR and 411/OR/STR

Shaft ø d		ø D	Housing/seal					Mounting chamfer	
			410/OR/STR		411/OR/STR				
Über	Bis		A	B	A	B	Z	X	Y
10	25	ø D = ø d + 2 x A	6	5	5	5	9	5	1
26	40		8	6	8	6	11	6	1
41	120		10	8	10	8	14	8	1

Type series 400 and 400/i

Shaft ø d		ø D	Housing/seal																				Mounting chamfer	
			410		411			420		421			422			430		431			432			433				
over	up to		A	B	A	B	Z	A	B	A	B	Z	A	B	Z	A	B	A	B	Z	A	B	Z	A	B	Z	X	Y
10	25	ø D = ø d + 2 x A	6	5	5	5	9	5	8	5	8	12	5	8	12	5	11	5	11	15	5	11	15	5	11	15	5	1
26	40		8	6	8	6	11	8	10	8	10	15	8	10	15	8	14	8	14	19	8	14	19	8	14	19	6	1
41	120		10	8	10	8	14	10	12	10	12	18	10	12	18	10	16	10	16	22	10	16	22	10	16	22	8	1
121	260		15	10	15	10	17	15	15	15	15	22	15	15	22	15	20	15	20	27	15	20	27	15	20	27	10	1,5
261	500		20	13	20	13	22	20	20	20	20	29	20	20	29	20	27	20	27	36	20	27	36	20	27	36	12	2
501	900		25	13	25	13	23	25	21	25	21	31	25	21	31	25	29	25	29	39	25	29	39	25	29	39	15	2

Type series 400/OR and 400/OR/i

Shaft ø d		ø D	Housing/seal																				Mounting chamfer	
			410/OR		411/OR			420/OR		421/OR			422/OR			430/OR		431/OR			432/OR			433/OR				
over	up to		A	B	A	B	Z	A	B	A	B	Z	A	B	Z	A	B	A	B	Z	A	B	Z	A	B	Z	X	Y
10	25	ø D = ø d + 2 x A	6	5	6	5	9	6	8	6	8	12	6	8	12	6	11	6	11	15	6	11	15	6	11	15	5	1
26	40		10	6	10	6	11	10	10	10	10	15	10	10	15	10	14	10	14	19	10	14	19	10	14	19	6	1
41	120		For all other dimensions see table for type series 400																								8	1
121	260																										10	1,5

Design notes

Mounting hole

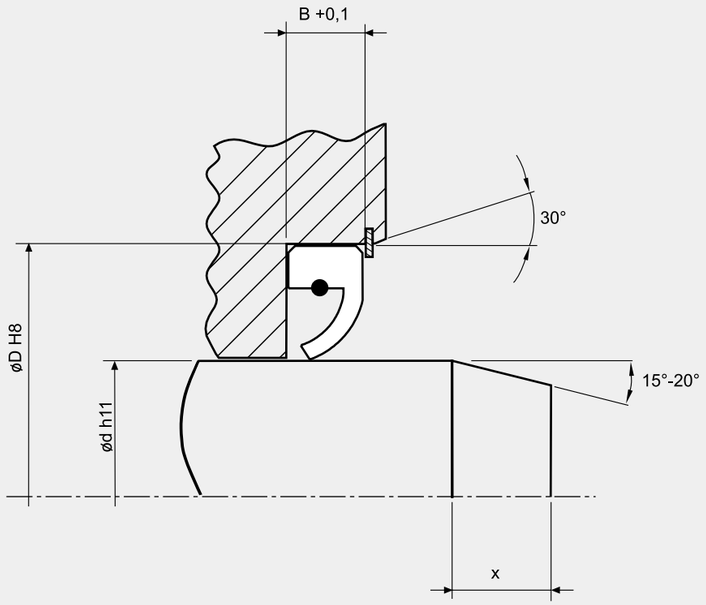
The seal chambers must be accessible from the axial direction. The hole must be closed by appropriate means to prevent the seal from becoming displaced.

Surface roughness
Ra ≤ 1,6 µm
Rz ≤ 6,3 µm

Shaft characteristics

Surface properties
Hardness 45 bis 65 HRC
Ra = 0,2 bis 0,8 µm
Rz = 1 bis 4 µm
Dry running and vacuum
Ra = 0,2 bis 0,4 µm
Rz = 1 bis 2 µm
Plunge ground

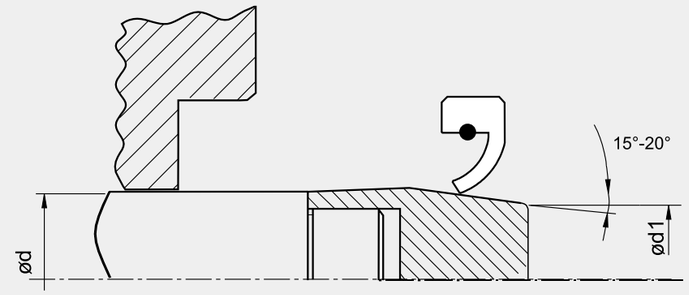
In the presence of high pressures and/or abrasive media and at circumferential speeds of over 4m/s we recommend a hardness H > 55 HRC.

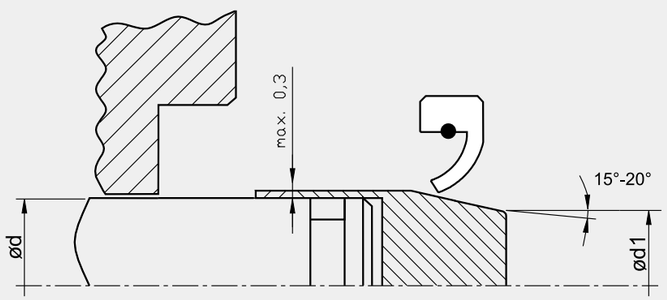


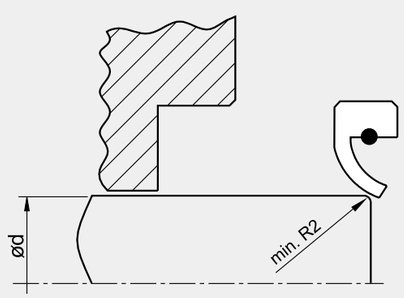
Notes on fitting

If the design of the equipment does not allow the provision of a suitable mounting chamfer on the shaft, or if the PTFE sealing lip has to be fitted via fitting key grooves or O-ring grooves, an assembly sleeve must be used to protect the sealing lip. All the edges of the assembly sleeve must be rounded off; there must be no sharp-edged transitions. The surface of the assembly sleeve should have no score marks. The installation spaces should be cleaned before the seal is fitted, and the seal itself should be checked for damage. We will be pleased to manufacture appropriate assembly sleeves on request.

Shaft dia. d (mm)	Assembly sleeve diameter d1 (mm)
≤ 25	d1 = ø d – 2,5
26–40	d1 = ø d – 3,0
41–120	d1 = ø d – 4,0
121–260	d1 = ø d – 5,0
261–500	d1 = ø d – 6,0
501–900	d1 = ø d – 8,0



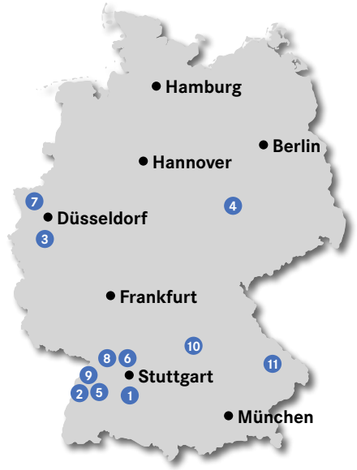




Künemund Dichtungstechnik GmbH is a Künemund Group company.
This strong alliance of consolidated companies unites professionals specialising in consultancy and sales with skilled experts in the production of roller bearings, seals and linear technology.

Further added value

- → **Group know-how:**
  there is a constant exchange of knowledge taking place within the Group. This ensures that we are familiar with all products across the board and that our know-how is completely up to date.
- → **Commercial competence:**
  at each of our six trading enterprises you have access to the entire range of products supplied by the Künemund Group – roller bearings, seals and linear technology.
- → **Flexible sales:**
  our professional field staff will be happy to visit you to offer advice.
- → **Fast order processing**
  six distribution centres and our own production facilities ensure high levels of product availability.
- → **Full-range supplier:**
  we supply products from top manufacturers such as FEDERAL MOGUL, GMN, GRW, Schaeffler, Timken etc.
- → **Merchandise management competence:**
  RZ Horlacher GmbH takes care of reliable provision of all IT solutions within the Künemund Group.



A strong network: Künemund Group's manufacturing and trading companies are situated in various locations across Germany.

1 ADITEC GmbH, 72829 Engstingen-Haid
2 Compound GmbH Hochtemperatur Wälzlager, 77694 Kehl am Rhein
3 Künemund Düsseldorf GmbH, 40589 Düsseldorf
4 Künemund Wälzlager Halle GmbH, 06179 Teutschenthal-Holleben
5 Künemund GmbH, 77694 Kehl am Rhein
6 Künemund GmbH & Co. KG, 70565 Stuttgart
7 Künemund Dichtungstechnik GmbH, 47918 Tönisvorst
8 RZ Horlacher GmbH, 70565 Stuttgart
9 Ritter Lineartechnik GmbH, 77767 Appenweier-Urloffen
10 Künemund Wälzlager Nürnberg GmbH, 90475 Nürnberg
11 Zwicker Kugellager GmbH, 94508 Schöllnach

We not only supply you with products, but also solutions. Because we are not just distributors but also manufacturers.

Dr Kai Dürr, Managing Director, Künemund GmbH & Co. KG

KÜNEMUND
GRUPPE
Gemeinsam sicher besser!

Version 12-2016

Your contact to our trading enterprises (for consultation and orders)

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Other manufacturing enterprises within the Künemund Group

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Ritter Lineartechnik GmbH
Im Ettenbach 5
D-77767 Appenweier-Urloffen

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KÜNEMUND
SEALING TECHNOLOGY
Teamwork guarantees performance!