When movement meets extreme environments.

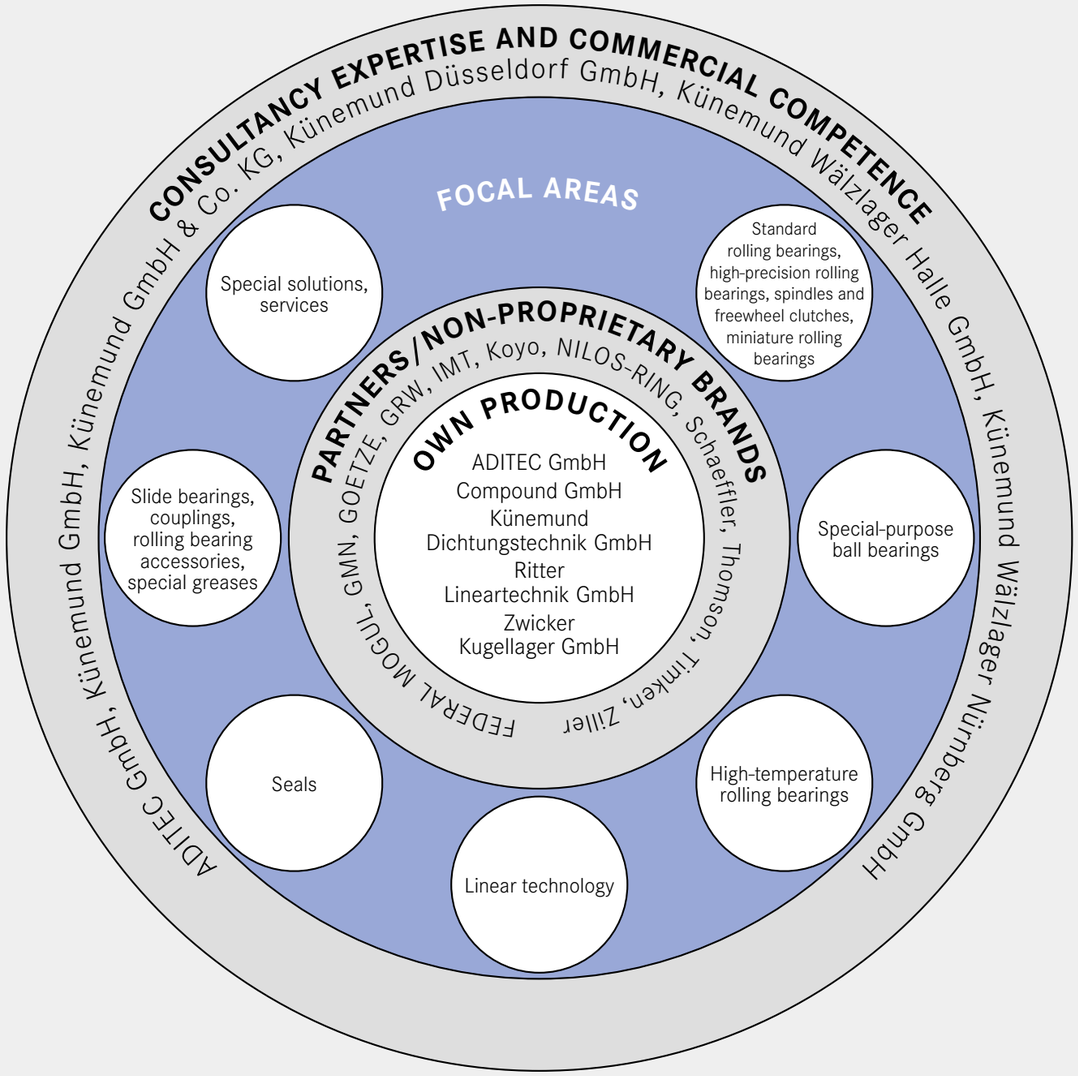
Solid-lubricated rolling bearings for extreme operating conditions.

COMPOUND

HIGH TEMPERATURE ROLLING BEARINGS

Teamwork guarantees performance!

The Künemund Group comprises manufacturing companies, trading enterprises and a computer centre. All of the companies are networked with each other and are ready to meet your tasks with bundled expertise.



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Teamwork guarantees performance!

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Particularly demanding conditions apply to rolling bearings in the steel, ceramics and glass industries, for example, because of high temperatures and, in vacuum applications, low pressures. Compound GmbH develops and produces solid-lubricated systems and rolling bearings with special greases, which safeguard the operational capability of rolling bearings under extreme operating conditions.

Extreme temperatures and pressures are a problem for rolling bearings. Apart from ours.

Olga und Karl Fink, Produktion, Compound GmbH Hochtemperatur Wälzlager

Products

- → Solid-lubricated rolling bearings
- → High-temperature rolling bearings up to 350 °C
- → Specially greased deep-groove ball bearings
- → Rolling bearing coatings

Compound GmbH Hochtemperatur Wälzlager in Kehl am Rhein is a Künemund Group company. It manufactures rolling bearings with solid lubrication which guarantee long, maintenance-free running times even under extreme conditions.

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General remarks on solid-lubricated rolling bearings

Under normal operating conditions, rolling bearings are usually lubricated with greases or oils. However, lubrication by means of greases and oils is insufficient for some fields of application in which the lubricant loses its lubricating properties or does not remain effective for long enough as the result of chemical and/or physical effects occurring at the lubrication point.

Such fields of application are characterized by the following:

- → extremely high or low temperatures
- → penetration by aggressive mediums
- → very low pressure (vacuums)
- → air flowing through the bearing
- → operation of the bearings after a long period out of operation
- → penetration of hard and soft particles
- → stress exerted on the bearing (e.g. centrifugal, gravitational, etc.)

Some examples of this can be found in the following industries:

High temperatures, T > 180°C:
- → the steel industry (e.g. circular arc plants, roller gears, rocker bar furnaces, cooling racks)
- → the ceramics industry (e.g. carriage bearings for tunnel furnaces, conveying chains)
- → the glass industry
- → the foodstuffs industry (e.g. ovens)
- → the aluminium industry

Low pressures:
- → vacuum based applications (e.g. coating plants)

Penetration of aggressive mediums:
- → presence of solvents and cleaning agents
- → media lubrication (e.g. diesel, benzine, water, etc.)

Dry lubrication on the basis of various compounds or coatings can ensure full functionality of rolling bearings under the extreme operating conditions set forth above.

Types and properties of the most important solid lubricants

Property	Graphite C	Molybdenum disulphide MoS_2	Polytetrafluor ethylene PTFE
Colour	black	grey	white
Density (g/cm³)	1,4–2,4	4,8–4,9	2,1–2,3
Metal adhesion	moderate	good	poor
Friction co-efficient	0,1–0,4	0,04–0,1	0,04–0,09
Melting point (°C)	3500	1180	327
Operational temp. (°C)	-20 bis +430	-180 bis +350	-250 bis +270
Lubricating behaviour at			
low/high load	good/good	good/very good	very good/poor
Applicability with			
Inert gases	poor	good	very good
High degree of dampness	good	moderate	good
Vacuums	poor	very goo	good
Corrosion	good	poor	good
Chemicals	very good	moderate	very good
Vibrational friction	good	poor	very good
Stick-slide effect	yes	no	no
Decomposition products	CO, CO_2	MoO_3, SO_2	C_2F_4

Fields of application of the various types of COMPOUNDS

COMPOUND 1 (COMP1):
from -30°C to +280°C (or higher for short periods), in damp environments or if media is utilised (diesel, water, benzine, etc.). COMP1 should never be utilised in a vacuum, in a dry atmosphere or under inert gases such as nitrogen.

COMPOUND 2 (COMP2):
from -180°C to +300°C (or 350°C for short periods), in dry to slightly damp or inert (e.g. nitrogen) atmospheres. Through its special mixture of solid lubricants, COMP2 covers a wide range of applications. We therefore recommend COMP2 for individual cases where the environmental influences are not precisely known.
However, COMP2 is only suitable to oscillating movements up to a certain extent.

COMPOUND 4 (COMP4):
This COMPOUND was developed specifically for vacuum applications. It is temperature resistant up to 300°C, or 350°C for short periods. Note that the COMPOUND begins to outgas at temperatures higher than 300°C.

Special version P.MoS_2:
At very low pressures and, at the same time, high temperatures, the gas evolution of COMP4 can disturb the surrounding vacuum to such an extent that a utilisation of this particular compound is out of the question. For this reason, we also offer a manganese-phosphate bearing in whose surfaces various different solid lubricants (MoS2 in this case) are drummed or rotated in.

Lubrication concept of the COMPOUND bearings

As solid lubrication consumes the lubricating agents, long service lives can only be achieved if the solid lubricants that have been consumed are constantly replenished (transfer lubrication). For this reason, the space between the bearing rings and the rollers is filled with a mixture of dry lubricants and a binding agent (COMP1, COMP2 or COMP4) which, once the compound has stabilized, runs with the cages. With each turn, the rollers take on dry lubricant and pass this on to the gliding surfaces, providing a continuous re-lubrication and a long, maintenance-free service life.

Suitable rolling bearing types

Which types of rolling bearings are suitable as COMPOUND bearings?

- → Deep groove ball bearings of all series and sizes
- → Thin-ring bearings and miniature ball bearings
- → Angular ball bearing
- → Self-aligning ball bearings
- → Sperical roller bearings
- → Cylindrical roller bearings
- → Tapered roller bearings
- → Rollers
- → Housing units

Sperical roller bearings

Deep groove ball bearings

Tapered and cylindrical roller bearings

Suitable rolling bearing types

Pedestal bearing housings with a COMPOUND bearing and Tecoflon seal

Housing units

Dimensions

As COMPOUND bearings are manufactured from the standard rolling bearings of leading manufacturers, the main dimensions of all COMPOUND bearings conform to German industrial standards (DIN 625, 626, 628, 635, 730 and DIN 616).

Tolerances

As COMPOUND bearings are subjected to a hardening process, there may be slight variations to the tolerances defined as standard (DIN 620).
On manganese-phosphate surfaces, an increase in the diameter of the outer ring and reduction of the diameter of the inner ring must be taken into consideration.

Bearing clearance

In principle, a dry lubricant requires increased radial clearance regardless of the operating temperature in order to compensate for kinematic imbalances arising from the coating processes and unavoidable penetration of particles causing wear. For this reason, Compound bearings are only manufactured from rolling bearings with increased bearing clearances (C4, C5 or higher). All COMPOUND bearings should have a C3 clearance as a minimum under operating conditions.

Cages

Depending on the type of bearing, COMPOUND bearings are supplied with pressed cages of either steel or brass (such as e.g. sperical roller bearings).

Heat stabilisation

As structural transformation of materials occur at temperatures of above 120°C which is accompanied by changes and dimensions of the materials as well as loss of hardness and stability, the dimensions of the rolling bearings are stabilized (depending the operating temperature) at different stages (S0 through S4).

However, COMPOUND bearings are only manufactured to order from stabilized rolling bearings for two reasons:

- → high costs and long delivery times
- → bearing tests have proven that stabilized roller bearings do not attain greater endurance at higher temperatures than non-stabilized roller bearings.

Therefore the changes in dimensions of the steel at higher temperatures is compensated for by a suitable choice of bearing clearance (C4, C5 or higher).

Speeds

As dry lubrication consumes the lubricating agent, the user only has a limited choice of speeds. The total number of speeds is, however, essentially dependent upon the following: the type of bearing used, the lubricating agent (mixture) and the operational environment. Therefore, lower speeds are the real domain of COMPOUND bearings.

Bearing load, dimensioning

For maximum endurance the load on the COMPOUND bearings should not exceed 25% (even better: 10%) of the original bearing's static loading capacity. Please remember this when determining the bearing dimensions.

COMPOUND bearings – general data

Fits

Due to the necessity of increased radial clearance, fits should be relatively loose (for example H7, h7). Strong press fits lead to reduction of clearances which can strongly impair the functions of COMPOUND bearings. This is to be particularly taken into consideration with the manganese-phosphate versions.

Corrosion protection

Contrary to greased rolling bearings, COMPOUND bearings offer no protection against corrosion. In cases where there is a risk of corrosion, we offer two possibilities for protection:

- → phosphating of the surfaces
- → rolling bearings made of corrosion-proof steel

Phosphating

To improve the gliding properties (better adhesion of the solid lubricants to the gliding surfaces) and protection against corrosion, we usually offer phosphating of the roller bearings.

There are two options:

- → iron-phosphating: very thin (1 - 3 µm), low protection against corrosion
- → manganese-phosphating: relatively thick (7 - 10 µm), low protection against corrosion

When determining the bearing fit, the changes to dimensions occurring during manganese-phosphating must be taken into consideration!

Enquiries

As there are a number of types and combinations of solid lubricants, please provide details of where and how the bearing is to be installed as well as the operating and ambient conditions when enquiring about a specific type of bearing, e.g.

- → operating temperature
- → speed
- → bearing load rating
- → special atmospheric ambient conditions such as incoming dust, dry or damp air, nitrogenous atmospheres, vacuums (x mbar), etc.

General information

Service life of COMPOUND bearings

Generally speaking, the service life (or duration of lubrication effect) of a solid lubricating film depends on the type of solid lubricant utilised and its ability to adhere to the contact surfaces as well the thickness of the film itself. As solid lubrication also has a wearing effect, it fails as soon as the dry lubricant is worn down. At present there is no generally accepted basis for calculating the service life of solid lubricated rolling bearings. For this reason, the user must fall back on his own experience and trial and error for all applications.

Advantages of COMPOUND bearings

- → lubrication of rolling bearings across a wide range of temperatures (-80°C to +350°C)
- → maintenance-free
- → to a certain extent, extremely higher endurance
- → the utilisation of expensive special greases whose effect on the environment is doubtful, is rendered superfluous
- → cost intensive central lubricating system no longer necessary
- → no contamination of the area around the bearing by surplus grease which is expensive to dispose of
- → low starting torque regardless of the temperature

Remarks on the utilisation of COMPOUND bearings

- → never oil or grease COMPOUND bearings.
- → COMPOUND bearings should be installed with relative care as the dry lubricating compound is a relatively brittle material.
- → the sealing effect of COMPOUND bearings do not correspond to those of a roller bearing with abradant sealing such as, for example, 2RS.
- → COMPOUND bearings in non-phosphate versions have no protection against corrosion.

Special rolling bearing greases

- → Deep groove ball bearings, self-aligning ball bearings, cylindrical roller bearings, needle bearings, spherical plain bearings, pillow type bearings, yoke type track rollers, cam followers, etc.
- → Wide range of greases and oils from all leading manufacturers
- → Defined grease quantity
- → Deep groove ball bearings shielded (2Z, 2RS, etc.) or open
- → No minimum quantity (also 2x)

Special greases

Coatings and special solutions for spindles

Wide range of rolling bearing greases and oils

Compound GmbH Hochtemperatur Wälzlager 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 GMN, GRW, Koyo, Schaeffler, Timken etc.
- → **Merchandise management competence:**
  RZ Horlacher GmbH takes care of reliable provision of all IT solutions within the Künemund Group.

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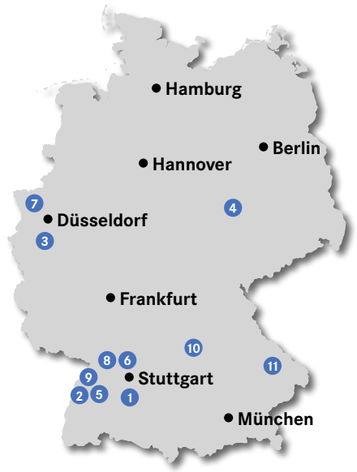

A strong network: Künemund Group's manufacturing and trading companies are situated in various locations across Germany.

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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

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