Simmerrings and Rotary Seals

Technical Principles

Products

Simmerrings

According to DIN or ISO the designation of these seals for sealing rotating shafts is "Rotary Shaft Seals" Simmerring® is a registered trademark of Freudenberg.

Requirements

- Reliable tightness
- High reliability
- Compatibility with the media to be sealed
- Low friction
- Easy fitting.

Features

- Cylindrical outer casing for ensuring the static sealing in the housing
  - Made from elastomer with integrated metal insert (→ Fig. 1)
  - made of metal predominantly drawn-finished at the outside diameter but also machined at the outside diameter
- Spring-loaded sealing lip for ensuring dynamic and static tightness at the shaft. Continuous further development has led to optimised sealing lip profiles for further increasing the reliability over a broad load range.
- One dust lip, or in special instances several lips, against dirt and dust ingress from the outside.

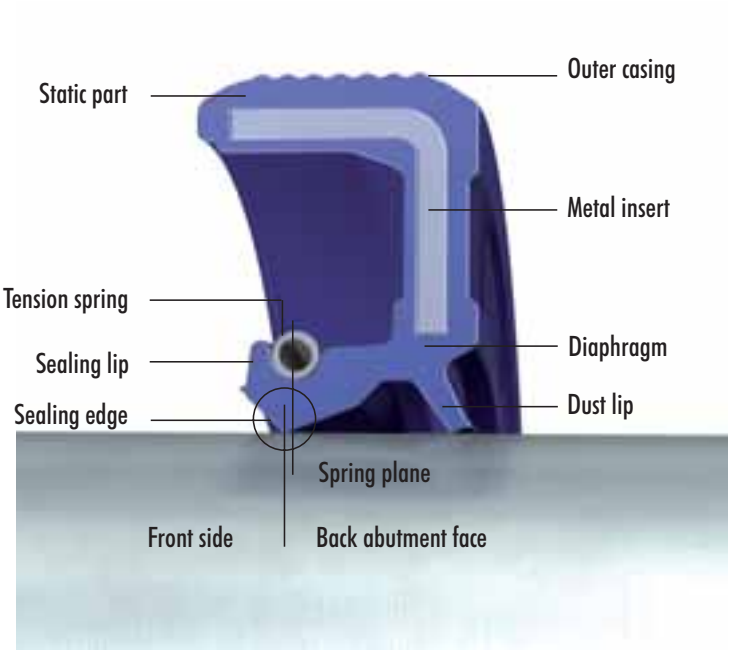


Fig. 1 Important parameters on a Simmerring®

Operating conditions

The weighting of requirements for each application and the operating conditions are crucial for the choice of seal:

- Circumferential speed, i.e. the shaft diameter and rotational speed
- Temperature
- Pressure
- Dirt ingress from the outside
- Dirt ingress in the unit to be sealed
- Vibrations
- Media to be Sealed
  - Lubricating oils of a mineral and synthetic basis
  - Lubricating greases of a mineral and synthetic basis
  - Other liquid, high viscosity and gaseous media; it must be ensured that these media are compatible with the sealing material.

Operating conditions

Simmerrings are used for sealing rotating shafts, predominantly in the following applications:

- Engines (sealing of crankshafts and camshafts)
- Drive trains in agricultural and construction machinery (sealing of transmissions, differentials, axles, wheel hubs)
- Drive trains in cars and commercial vehicles (sealing of transmissions, differentials, axles, wheel hubs)
- Industrial gearboxes (e.g. sealing of spur wheel gearboxes, worm gearboxes)
- Hydro-units (sealing of hydro-pumps, hydro-motors)
- Heavy industry (sealing of shafts in mills, cement mills, wind power plants)
- Ship building (sealing of stern tubes, thruster drives, rudder drives)
- Machines in the foodstuffs industry
- Machines in the chemicals industry
- Compressor construction
- Household and industrial washing machines.

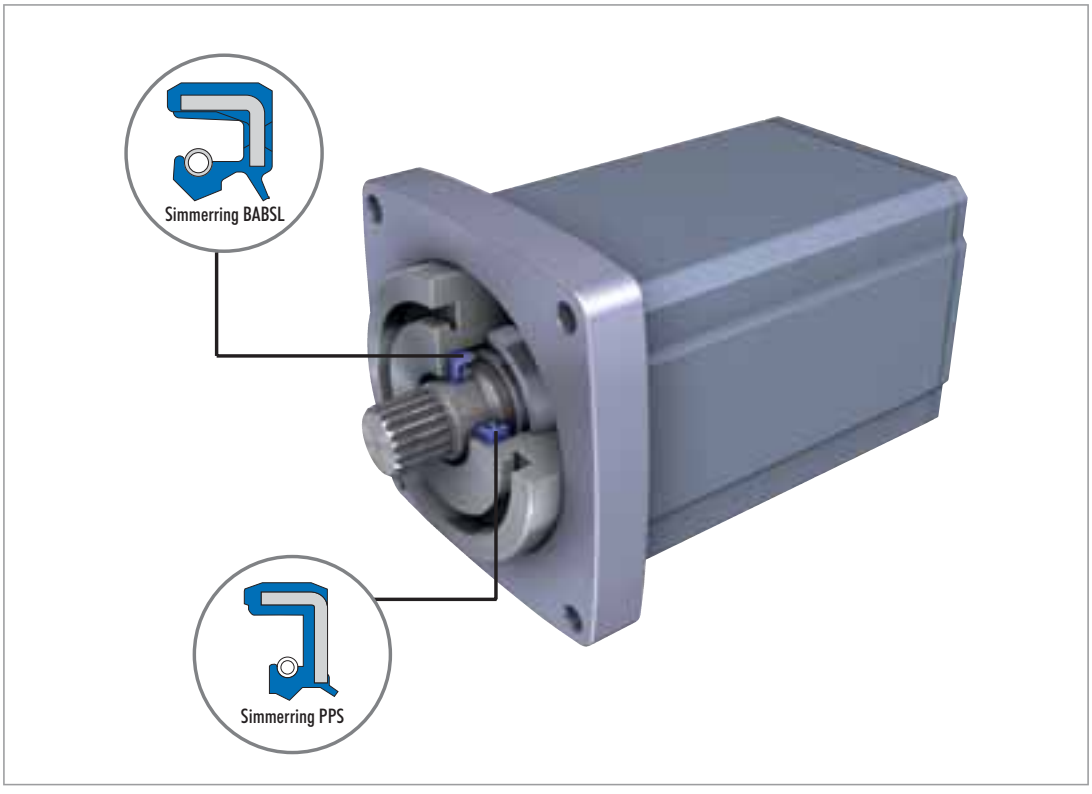


Fig. 2 Simmerrings for rotating operating pressures in hydraulic pumps and engines

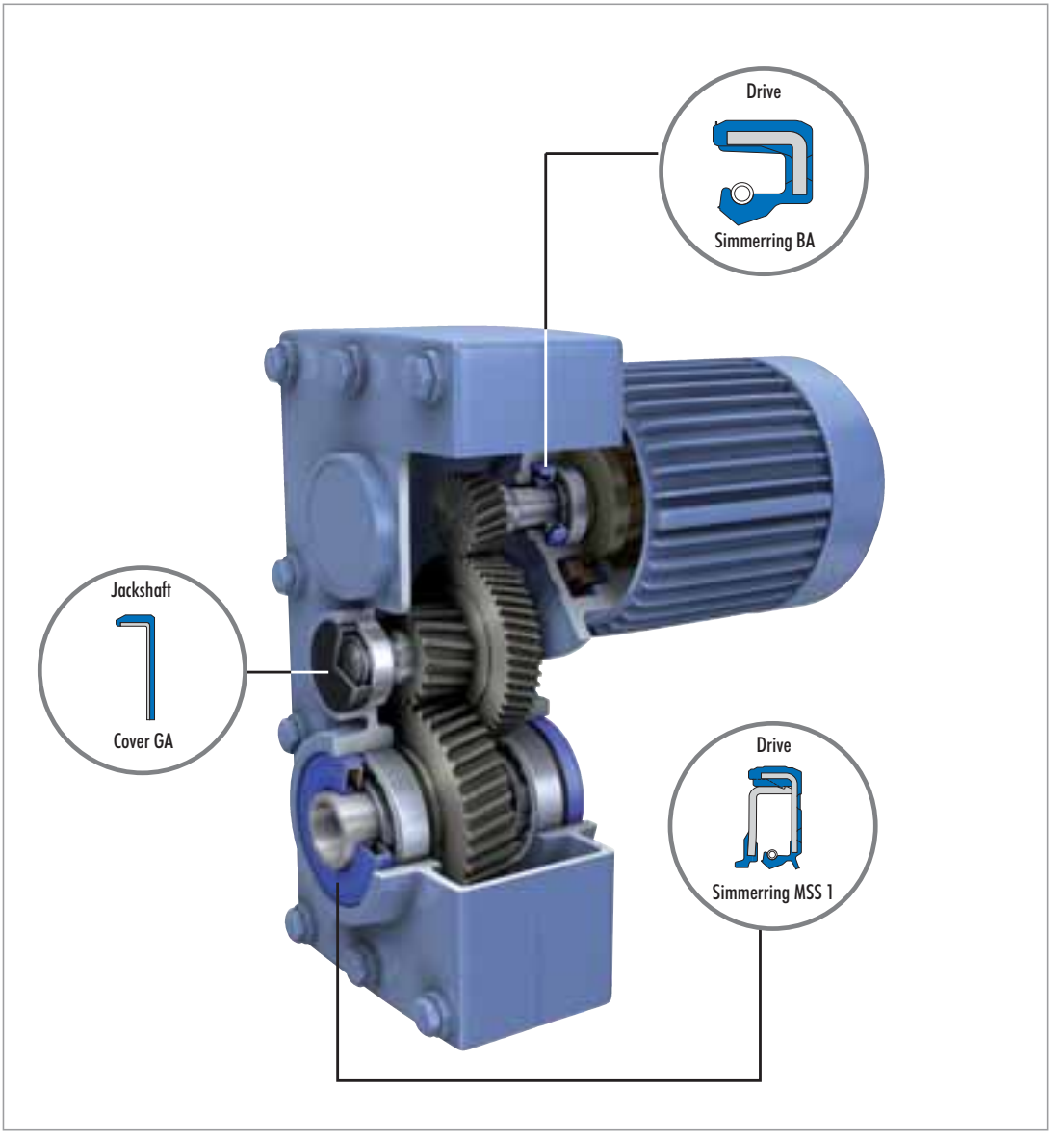


Fig. 3 Simmerrings and sealing covers in industrial gearboxes

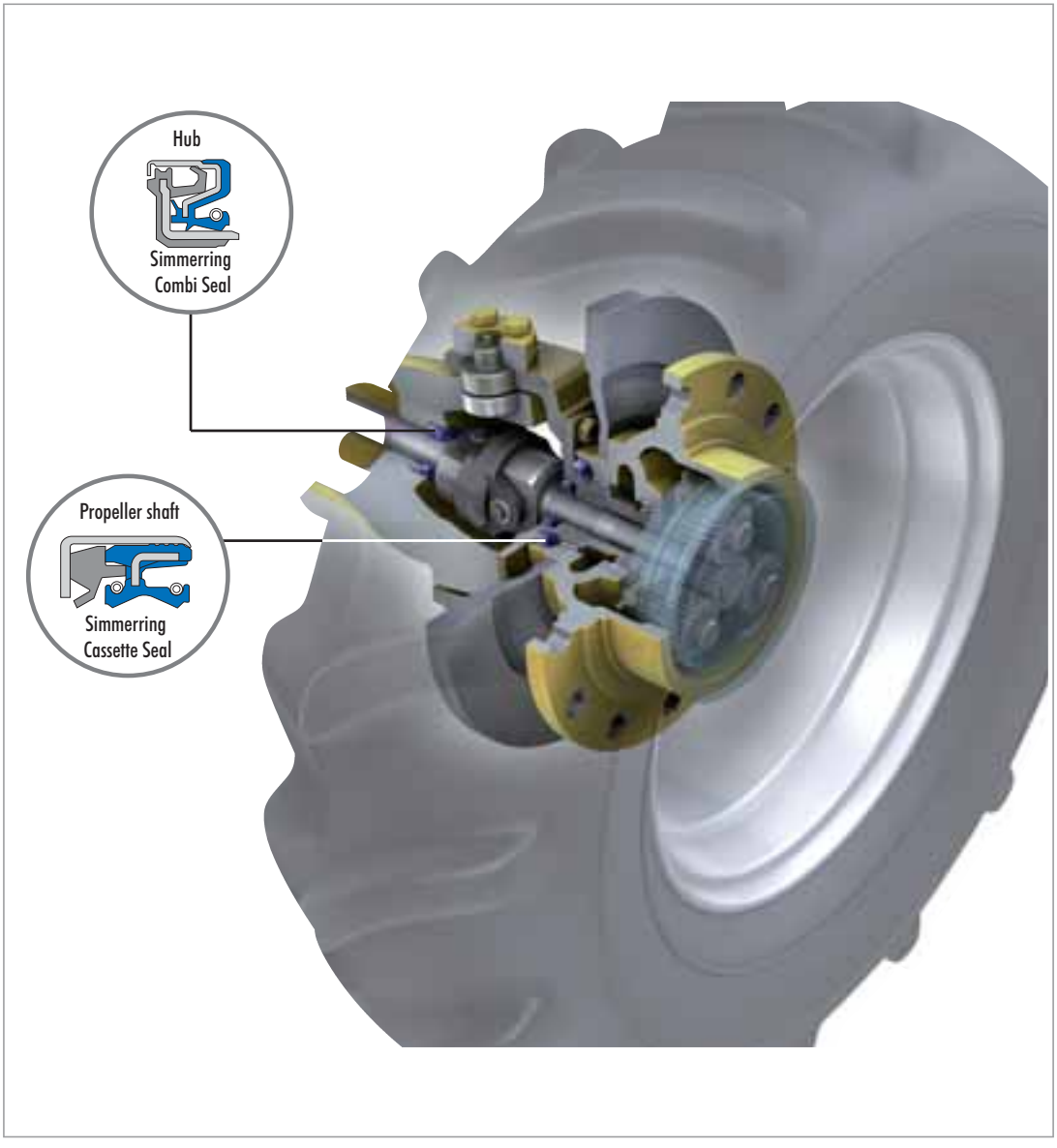


Fig. 4 Simmerring® Cassette Seals and Simmerring® Combi Seals in driven axles

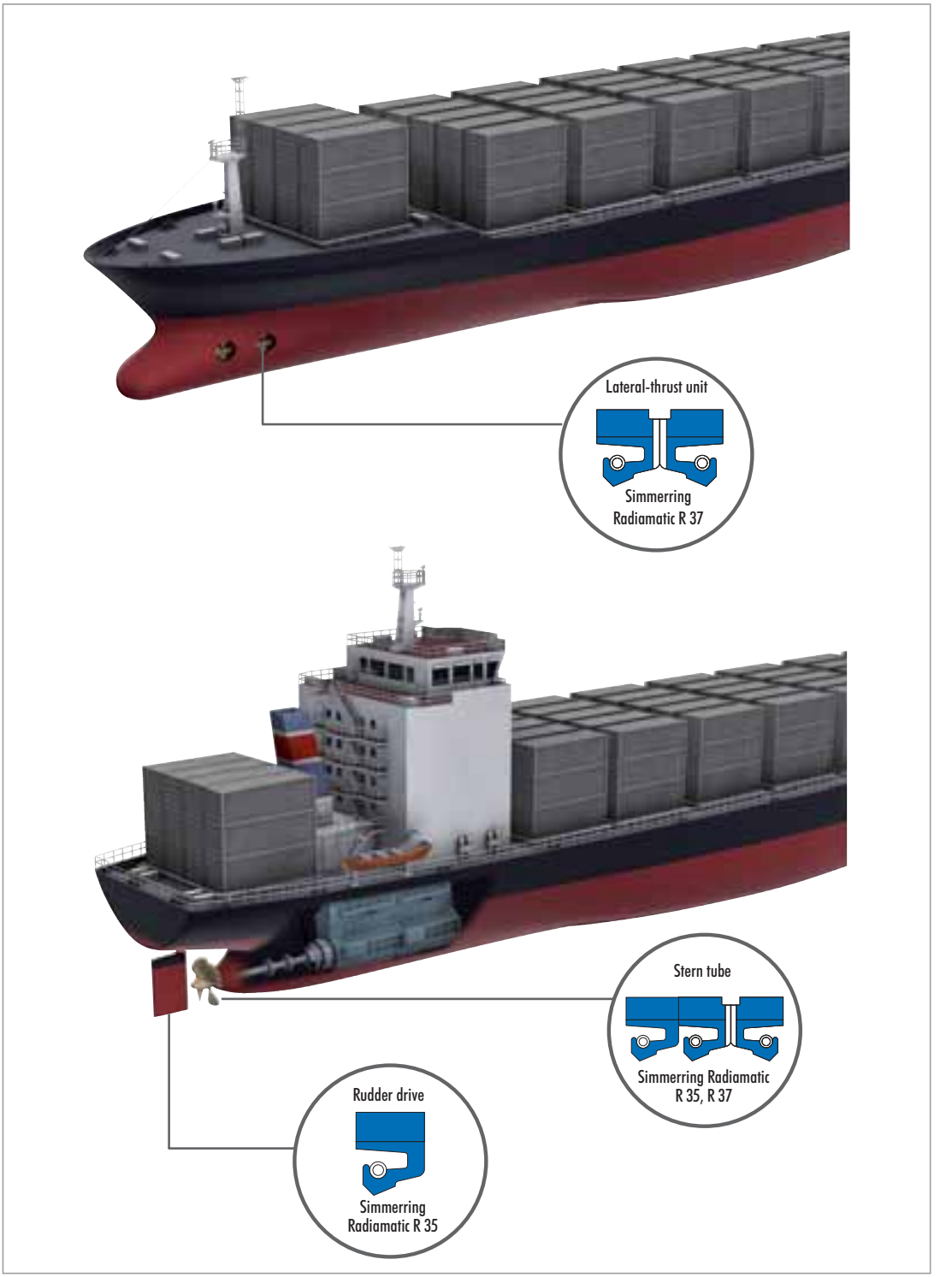


Fig. 5 Simmerrings in marine technology for underwater applications

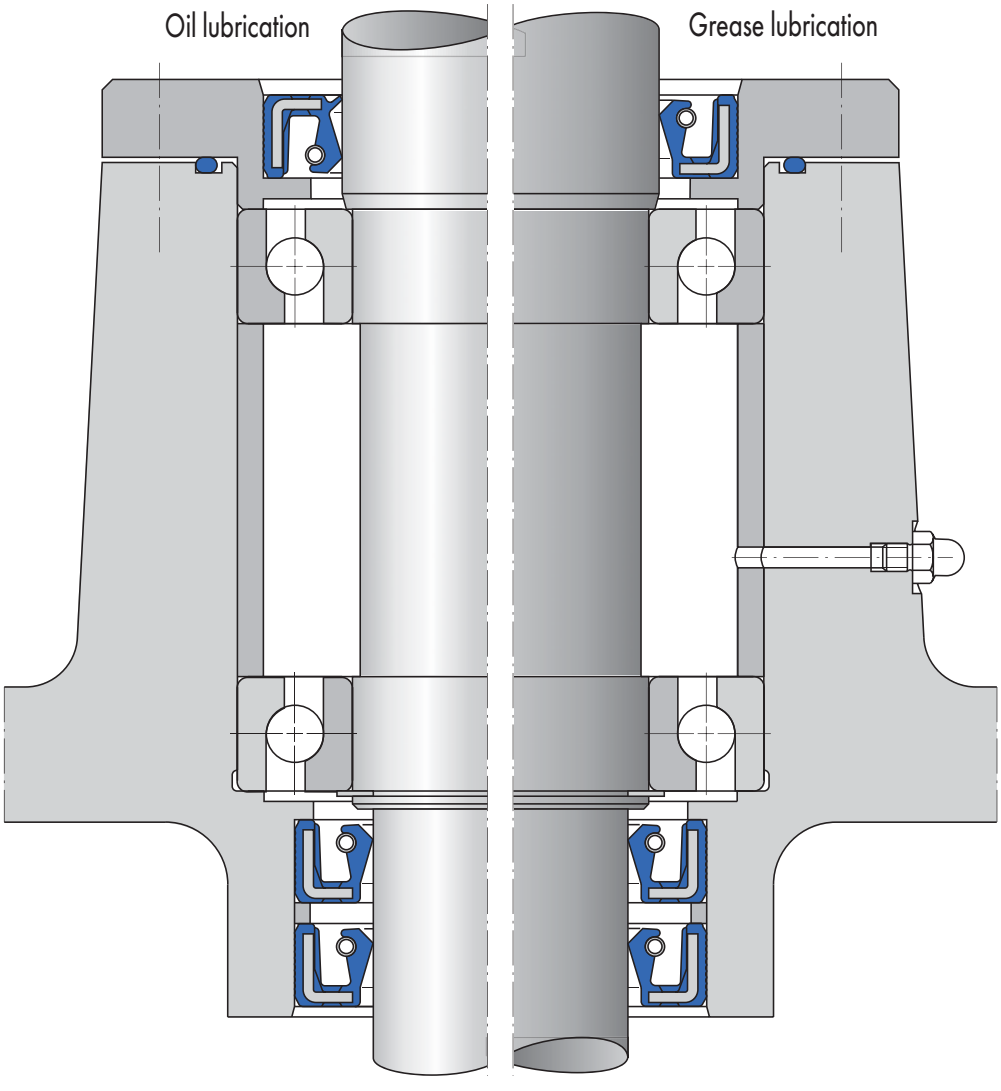


Fig. 6 Sealing of a vertical shaft

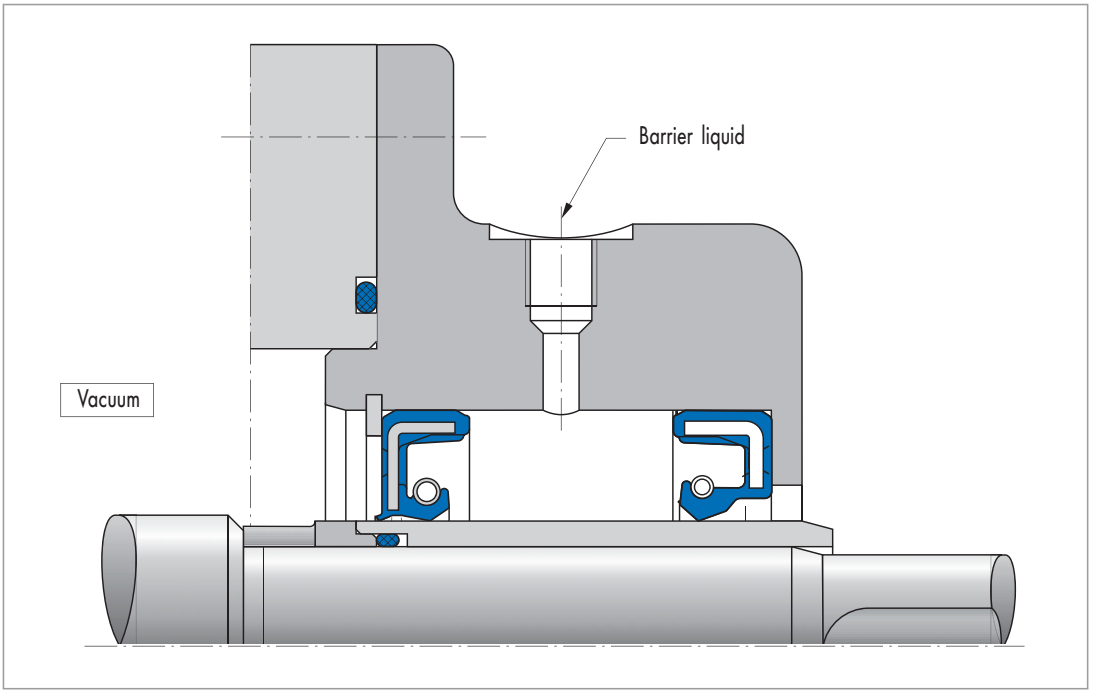


Fig. 7 Sealing against a vacuum

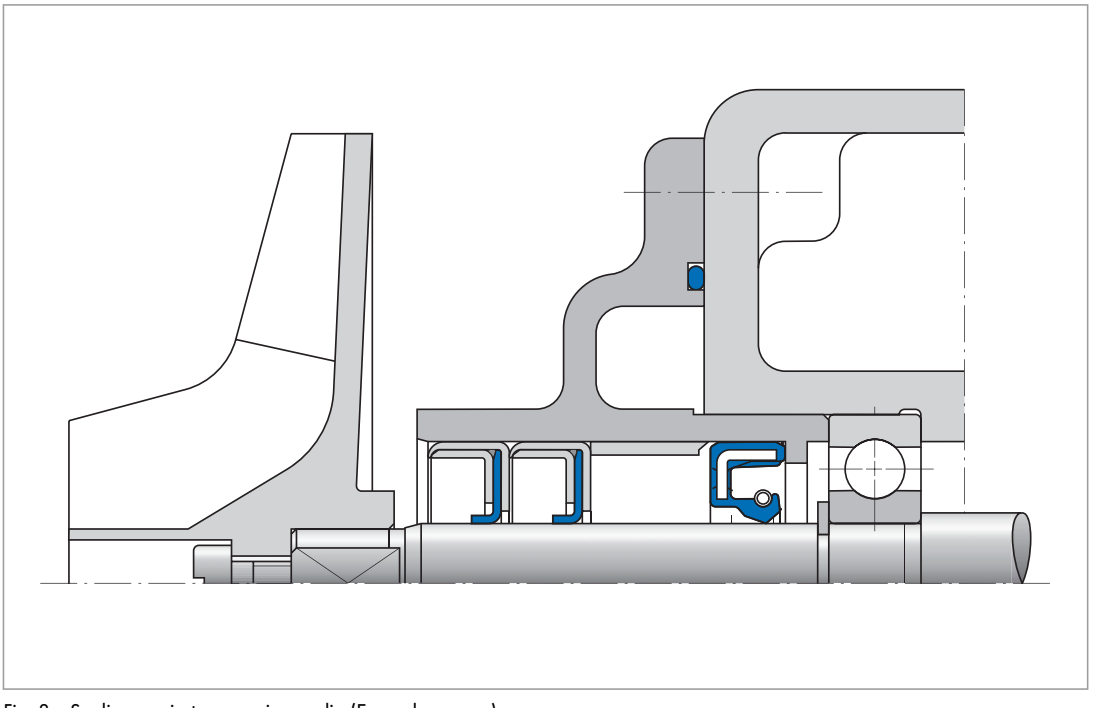


Fig. 8 Sealing against aggressive media (Example: pumps)

Sealing Mechanism of the Simmerrings

The Simmerring seals a rotating shaft against the main housing of unit e.g. (→ Fig. 2 and → Fig. 3)

- Static sealing and the assurance of the secure seating of the seal between the seal outer casing and the housing bore
- Dynamic, and when the shaft is stationary, static sealing between sealing lip and shaft.

A complex system of variables and their interaction affect the sealing behaviour and the service life of the seal:

The unit to be sealed

- The housing
  - Surfaces
  - Middle offset to the shaft
  - Tolerances
  - Material.
- The shaft
  - Diameter
  - Rotational speed
  - Eccentricity
  - Surface
  - Axial movement
  - Material.

The medium

- Temperature
- Chemical effects
- Viscosity
- Lubricating efficiency
- Pressure
- Decomposition products.

The surroundings and the place of work

- Temperature
- Dust and dirt
- Running periods and stationary periods.

The Simmerring

- The design and the tolerances
  - Of the static part
  - Of the sealing lip
- The radial force
- The material
  - Hardness
  - Resistance to wear
  - Resistance to swelling and shrinkage
  - Frictional properties
  - Degree of sealing etc.

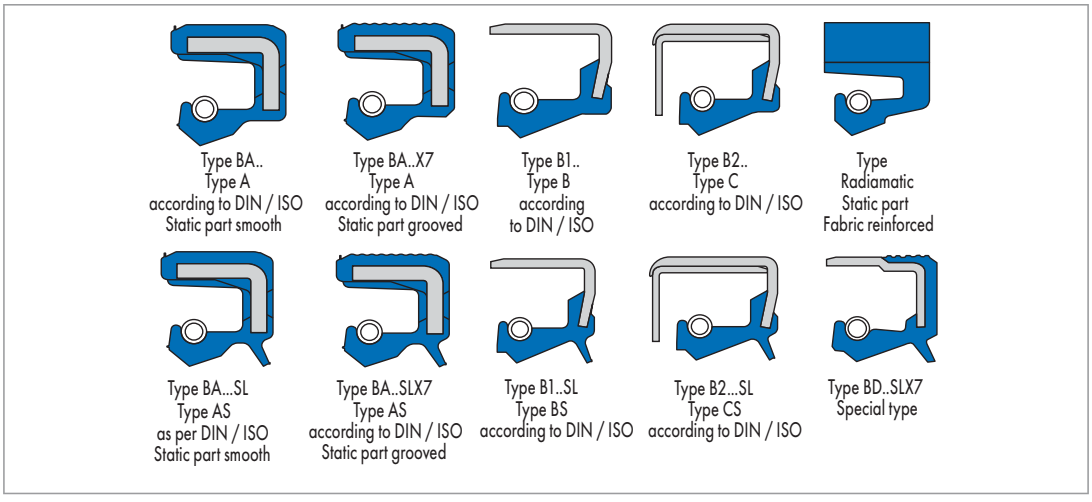


Fig. 9 Designs of the static part of the Simmerrings

Static tightness and seating in the bore

The outer casing (also referred to as the static part) of the Simmerring has the tasks of:

- Static sealing in the housing bore
- Assurance of secure seating in the bore
- Facilitating a faultless, easy fitting of the seal.

Various versions of the static part are used depending on the key aspects and operating conditions for these tasks (→ Fig. 9).
The following must be taken into account for trouble-free fitting:

- Chamfers on the static part (see DIN 3760)
- Press-fit oversize in relation to the nominal diameter depending on the design of the static part according to DIN 3760.

Design requirements of the housing bore → Design of locating bore from page 51.

Simmerring with elastomer outer casing Type BA (A in accordance with DIN 3760)

Provides the best prerequisites for static sealing:

- With split housings
- With housings made of light alloy with increased thermal expansion
- With pressurised applications
- With low viscosity and gaseous media.

Simmerring with elastomeric outer casing Type BA... X7 casing with grooves

- Facilitates easy fitting
- Avoids risk of springing back or inclined positioning of the seal
- Facilitates higher press-fit oversize for increasing the reliability of the static sealing, above all on housings with increased thermal expansion.

Simmerring with partly rubberised outer casing Type BD

- Combines the advantages of reliable static sealing by the elastomeric component with secure seating of the metal part of the outer casing
- Not part of the standard range, but available as customer-specific series production or special parts. Please enquire!

Simmerring with sheet metal case Type B1 and B2 (B/C in accordance with DIN 3761)

Manufacturing of smooth, metal outside surface by deep drawing, turning or grinding. Protection against corrosion according to manufacturing process by means of anti-corrosion oil or a thin layer of resin.

- For requirements for particularly secure and exact seating in the bore
- Attention: unfavourable conditions, such as
  - Rough bore surfaces
  - Low viscosity and creeping media
  - Pressurised applications
    can make the use of a sealing compound necessary in the seat area
- Only of limited use in housings with increased thermal expansion or split housings
- There is a risk of scoring the bore when pressing into a light alloy housing
- Type B2 (with fixed metal cap) has higher radial stiffness for:
  - Larger dimensions
  - Difficult and rough fitting.

Material for the metal insert and for the metal housing

- For all standard applications, unalloyed steel DIN 10027-1
- For special cases stainless steel according to DIN EN 10088.

Dynamic sealing function

The most important functional part of the Simmerring is the sealing edge in contact with the surface of the rotating shaft(→ Fig. 10). The sealing mechanism in the sealing lip contact area is of crucial importance for the sealing function. It is dependent on:

- The design of the sealing lip
- The structure of the elastomeric material
- The finish of the shaft surface
- the media to be sealed.

Sealing lip parameters

Results of extensive experience in all applications are necessary for the definition of the parameters.

The manufacturer designs the profile depending on the material, size, geometry and application of the Simmerrings.

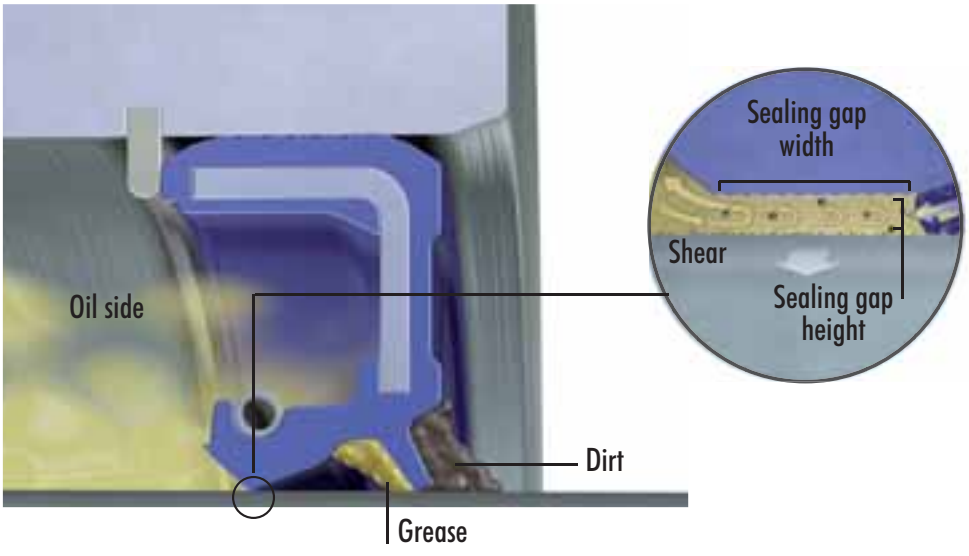


Fig. 10 Simmerring® seal-shaft contact area

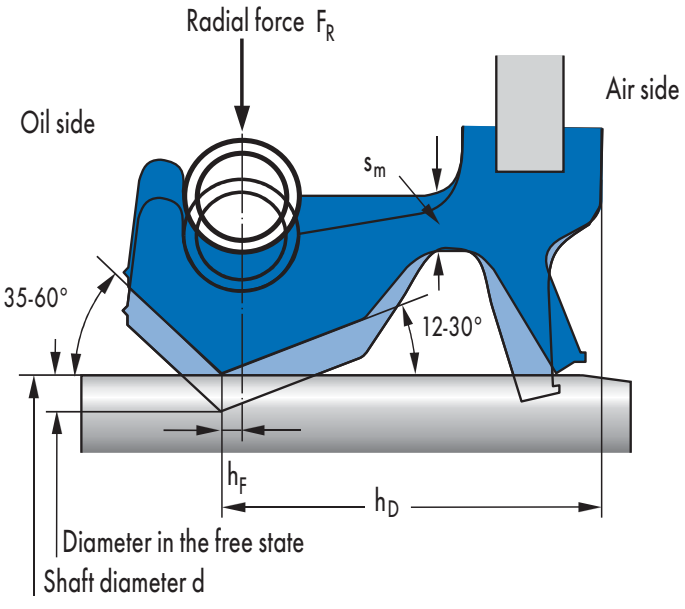


Fig. 11 Dimensions of the sealing lip profile

The overlap (→ Fig. 11)

The inside diameter of the sealing lip in a free, unloaded state is always less than the shaft diameter. The overlap (also pre-load) is the difference of these two dimensions and lies between approx. 0,8 mm and 2,5 mm depending on the shaft diameter.

The geometric parameters

Parameter for the length of the lip is the dimension h_D. Parameter for the cross section of the lip is s_m. s_m forms the centre of rotation for the expansion or deflection of the lip . h_D and s_m are designed in dependence of the shaft diameter and the operating conditions. The matching of the two parameters affects the flexibility of the lip:

- Long and flexible sealing lips for high tolerances on concentricity and runout (permissible values → Fig. 30 and → Fig. 31)
- For pressurised applications a short profile that has a stable position in relation to the shaft.

The parameter for the distance from the centre of the spring to the sealing edge is the spring lever h_f:

- An h_f that is too small can result in folding back over of the lip, particularly when there is radial shaft deflection and skewed installation
- An h_f that is too large can result in the deformation of the lip and, as a consequence, a wide lip contact area on the shaft and a wide contact surface.

The sealing lip angles

The sealing lip angles affect the sealing mechanism due to their effect on the contact pressure conditions:

- Oil side: steep angle 35° ... 60°
- Air side: shallow angle 12° ... 30°.

The radial force

The radial force, due to the expansion of the sealing lip in the installed state, exerts an annular force on the shaft. The total tangential tensile and bending forces on the sealing lip and spring are determined by the:

- Effect of the elastomer: The modulus of elasticity is dependent on material, temperature and ageing. This means that the gradual reduction in the radial force during operation is dependent on temperature and time
- Effect of the sealing lip profile: flange thickness, profile head (flange strength, dimension h_D,amongst others) and elongation, i.e. overlap
- Effect of the tension spring: Material (in all standard cases spring steel wire DIN 17223; in special cases stainless steel in accordance with DIN EN 10088), temperature, length, winding diameter and wire strength.

A radial force as low as possible is aimed for in order to keep friction and seal wear low.
Attention: the radial force must be large enough to provide the sealing function!

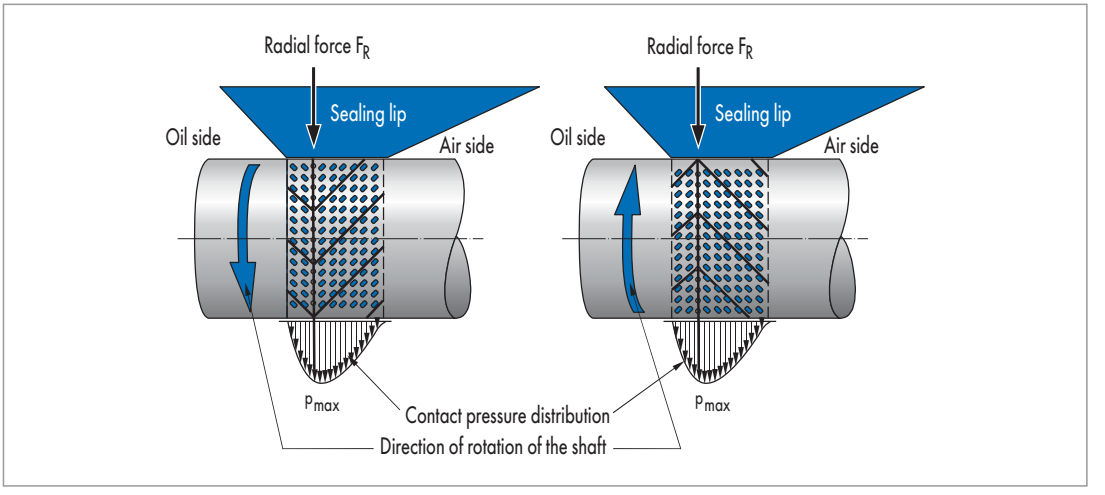


Fig. 12 Deformation structure (micro-lead) of the elastomer in the sealing lip contact surface

Sealing function in sealing lip contact zone

The sealing lip radial force generates, in combination with the design of the sealing lip angle and spring lever, an asymmetric contact pressure distribution(→ Fig. 11):

- Pressure maximum and steep rise on the oil side
- Shallow decay on the air side.

This asymmetric distribution of contact pressure is of major significance for the function of the seal.
The contact pressure distribution and the circumferential force produced by the rotating shaft lead to a characteristic deformation structure of the sealing lip contact surface (→ Fig. 12). For sealing, a suitable elastomeric material features the formation of a clear structure for the "deformation". The seal elastomer forms the deformation structure when the seal is run-in.

Therefore: a running-in phase is necessary for the seal. Only then is the full sealing function present. This deformation structure produces a lead-effect and, together with the rotating shaft, a pumping action on the media to be sealed towards the oil side. This micropump effect is crucial the sealing function (→ Fig. 13).

Sealing lips with return pumping lead

To increase the sealing capacity under high loads from high temperatures and speeds, the air side of the sealing lip is provided with a return pumping lead for specific types (→ Fig. 14). Angled lead ribs pointed in the direction of rotation reach into the contact zone of the sealing lip. They strengthen the pumping action of the micro lead of the elastic material. The direction of the ribs of the uni-directional lead are bound to a direction of rotation. An arrow on the back abutment face of the lead ring indicates the permissible direction of rotation. The bi-directional lead is used when both directions of rotation are necessary. Their effectiveness is less than the uni-directional lead.
All lead rings have a finished sealing edge i.e. created in the mould tool.

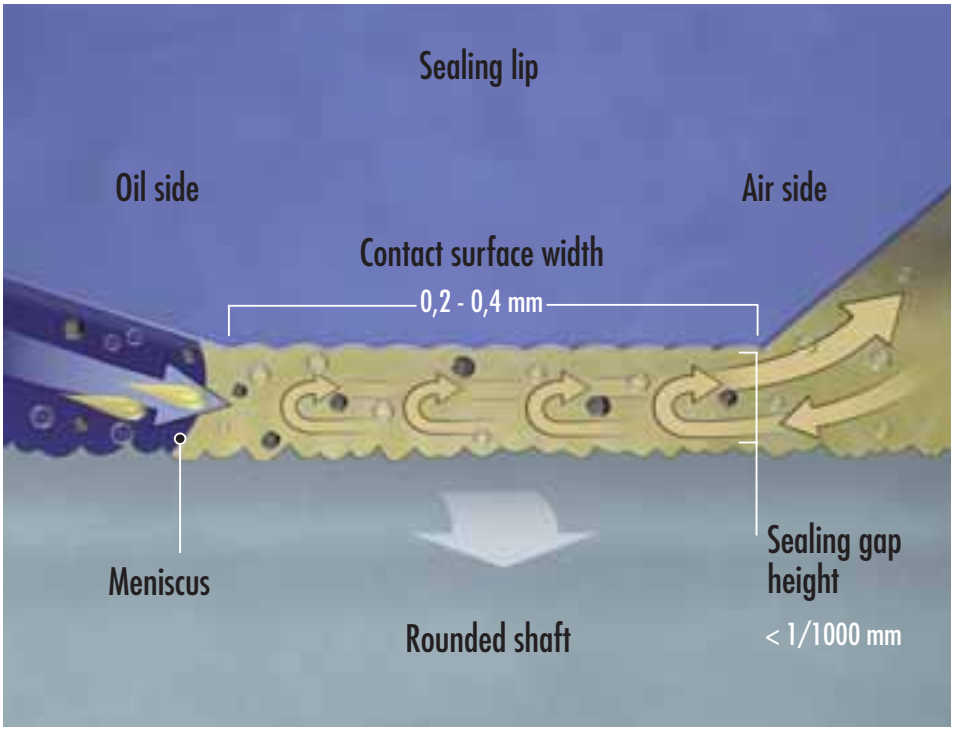


Fig. 13 Micro-pumping action of sealing lip in the shaft-sealing lip contact zone

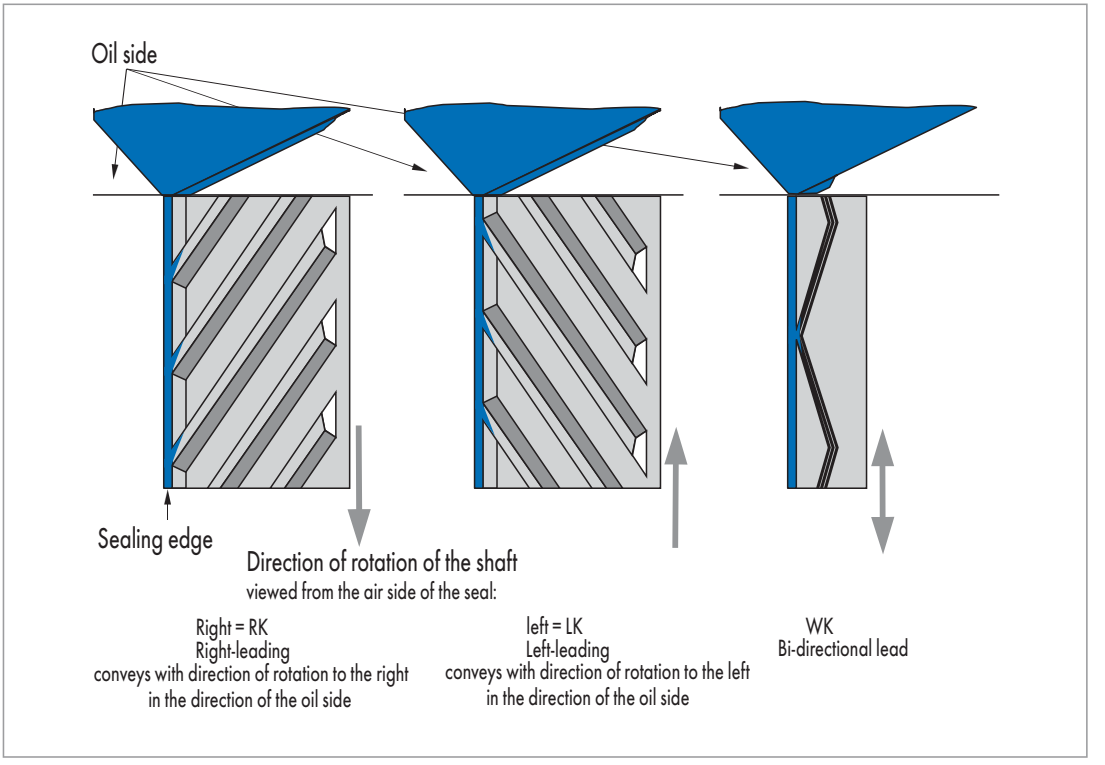


Fig.14 Return pumping lead on the air side of the sealing lip

Causes of leakage

The seal leaks when the complex relationships in the area of the contact zone are disturbed by:

- Incorrect shaft roughness
- Scratches, pores and other damage to the shaft and seal
- Contamination and decomposition products in the medium
- Hardening and cracks on the sealing edge.

Lubrication and friction

The sufficient supply of lubricant to the seal is crucial for the service life and reliability of the seal. The more intensive the lubrication, the lower the wear.
Even when stationary, the medium to be sealed, which at the same time is used for lubrication, penetrates the uneven areas of the shaft and sealing lip due to capillary forces. However, the direct contact of the sealing lip with the shaft predominates. Initial and then larger rotary movements produce a change, similar to a plain bearing, from a state of start up friction through mixed friction to predominantly hydro-dynamic friction.
The seal must not run dry under any circumstances. Therefore: When fitting the seal, lightly grease or oil the shaft and seal.
The medium to be sealed is not only a lubricant, but also a coolant that draws off heat produced by friction.
In the construction phase already, ensure that even during the initial rotations that there is sufficient lubricant present at the sealing edge (e.g. through boreholes and channels).
Individual types of roller bearings, especially the conical type, exercise a considerable pumping effect on the medium in some circumstances when running. This can result in different oil conditions being established that can endanger the lubrication of the sealing edge. Remedy: provide appropriate bores and passages during design.
All the parameters that affect the radial force and the lubrication conditions at the sealing lip also affect the power consumed by friction of the seal.

The minimum friction loss is produced by the lowest contact pressure at the sealing lip that guarantees the sealing function.
The figures were determined with complete lubrication of the sealing lip (Fig. 15.). The stated figures only give the order of magnitude of the friction. They cannot be used as absolute figures for individual cases.
The constant design requirements for less friction and reliable sealing function lead to continuous further development of the seal materials and the sealing lip design.

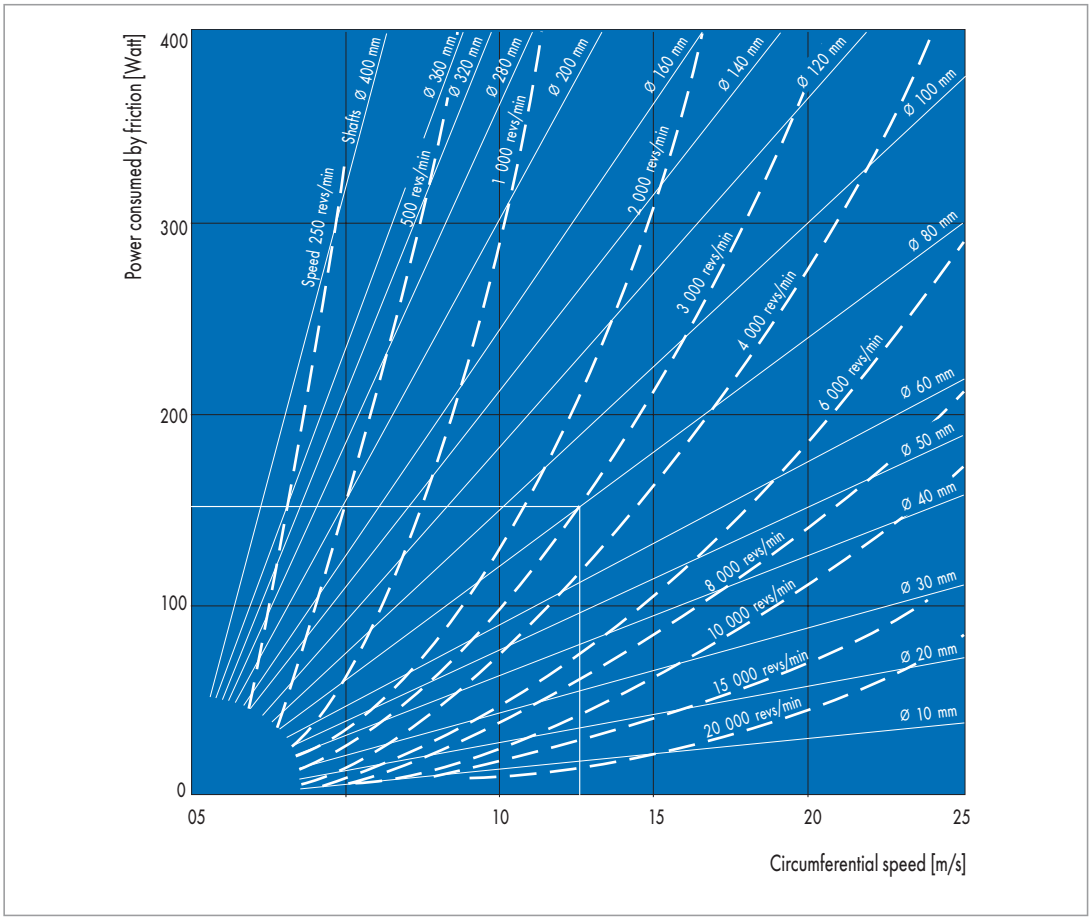


Fig. 15 Recommended values for the friction loss on a Simmerring in engine oil SAE 20, at T=100 °C, Example: shaft ∅ d1=80 mm, speed n=3000 U/min, friction loss approx. 150 W

Media to be Sealed

Medium and selection of material

The medium to be sealed defines the selection of material from Simrit and also the Simmerring seal design. Sealing is possible against liquid, high viscosity, and in exceptional cases, even gaseous media.

As a result of the continuously increasing loads of the units through higher power densities, lubricants are continuously being adapted and redeveloped. The seal-compatibility here is an important criterion. The intensive testing of the new lubricants has led to the creation of a comprehensive database which provides information on the seal-compatibility. Please enquire if necessary. Sealing against lubricants, e.g.:

- Mineral oils
- Synthetic oils
- Mineral oil based greases
- Synthetic greases,

as well as against liquids used in engineering production, e.g.:

- Hydraulic oils according to DIN 51524
- Fire-retardant, hydraulic fluids according to VDMA 24317 and VDMA 24320
- Silicone oils with low lubricating properties.

In special cases, against aggressive media with low lubricating properties, e.g.:

- Acids
- Alkalis
- Organic solvents.

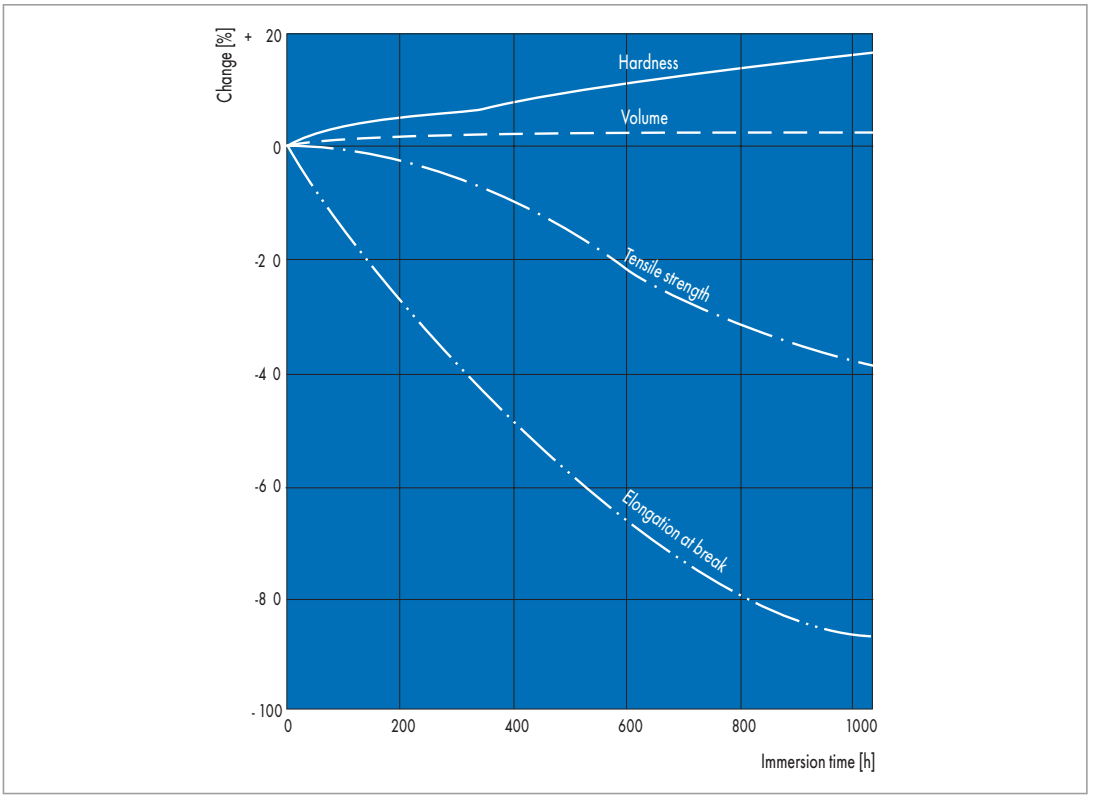


Fig. 16 Changes of the characteristic values of an NBR material as a function of storage time; immersed in gearbox oil SAE 80 at 100 °C

Reactions between media and materials from Simrit

The chemical/physical effects of the media on the seal materials are of crucial importance. The reactions or interactions are accelerated, above all with increasing temperature. Materials can harden or soften under the action of the media:

- Hardening due to ageing processes caused by the media, especially with increased temperature
- Softening due to swelling caused by the medium.

An initial, often sufficiently accurate assessment of the action of the media to be sealed on the elastomeric material is provided by the determination of mechanical figures on laboratory test specimens.
Before and after immersion of standard elastomer test specimens in the related medium, figures for hardness, elongation at break, tensile strength and volume are measured; the change over the time is determined and plotted on a graph (DIN 53521) (→ Fig. 17).

The effect of various lubricating media (particularly under the action of a high temperature) is clear from the example of the change in the elongation at break (→ Fig. 17).
For the assessment of the working life of an elastomeric material, including seals, the following can be applied as a recommended value for the max. permissible change: Reduction in elongation at break <50%

Boundary conditions

When several boundary conditions come together, such as:

- The maximum permissible circumferential speed (→ Fig. 20),
- The maximum permissible temperature (→ Tbl. 3),
- The pressure applied
- And in particular, poor lubrication or restricted heat dissipation,

the application limits for the Simmerrings are reached and exceeded, and the working life reduced.

Mineral oils

- use in cars according to API and MIL classifications:
  - Engine oils, manual transmission oils, hypoid transmission oils, ATF oils for automatic transmissions
- Use in a broad area of gearbox engineering:
  - C, CL, CLP gearbox oils according to DIN 51517

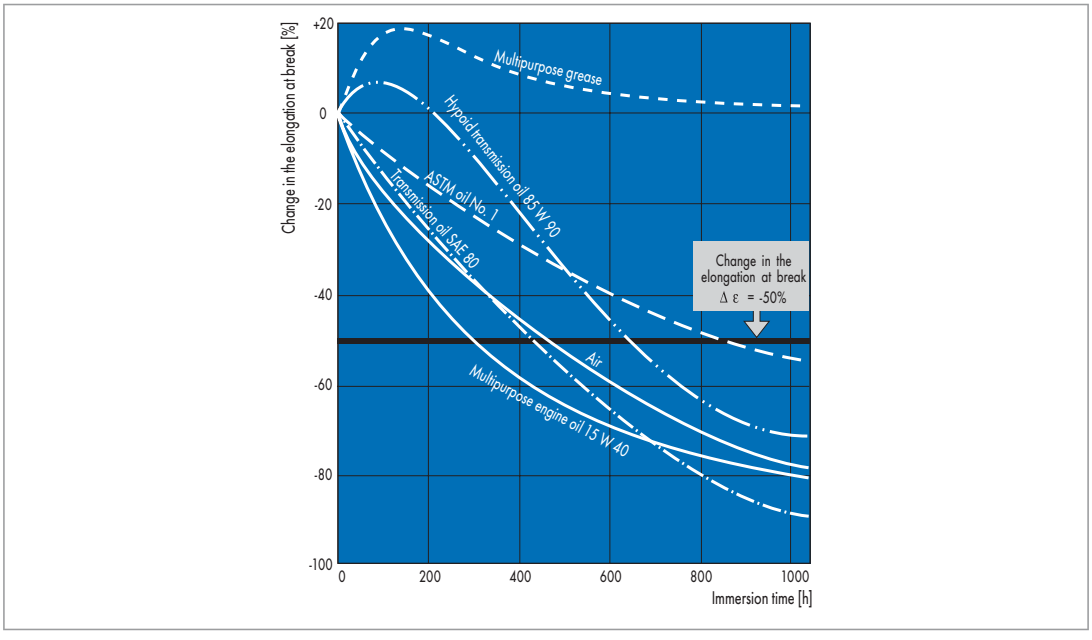


Fig. 17 Change in the elongation at break of NBR on immersion at 100 °C in various media

In general, low grade mineral oils have good compatibility with the materials employed in Simmerrings. Increasing requirements on mineral oils are leading to higher grade oils, and oils graded with new combinations. As a result, testing of compatibility with elastomeric materials is becoming increasingly important. Therefore, please note the specific information provided by the oil manufacturer and check compatibility if in doubt.

Hypoid gearbox oils

High-pressure lubricating oils with a portion of special additive, above all EP additives, are used to improve the lubricating efficiency and avoid the tendency to eat away at bearings and gearwheels.
The effects of additives can not only be seen on the teeth surfaces on the gears, but also on the sealing lip. The result is deposits in the area around the sealing edge with related production of heat.
Remedy: If necessary, use Simmerrings with the return pumping lead on the sealing lips and use special materials. Please enquire.
Additives have a hardening effect on NBR materials. The standard material 72 NBR 902 is by and large insensitive to hypoid oils, if a temperature of 80 °C of the medium is not exceeded (→ Tbl. 3).

FKM materials can withstand higher thermal loads and are more resistant to various substances in hypoid oils. Therefore: Up to the given boundary temperatures, use Simmerrings made of 75 FKM 585, Type BAUM and BAUMSL.
The sealing lips on this type are designed for low friction and thus keep down the temperature increase in the area around the sealing edge; the tendency to form oil carbon deposits is also low.

Synthetic lubricants

Partially synthetic and fully synthetic lubricants (→ Tbl. 3) are used:

- To improve the viscosity behaviour,
- To increase the high temperature behaviour
- To increase the resistance to ageing
- To improve the viscosity behaviour.

In the predominant number of cases, the base oils used have a good compatibility with the elastomers. The aggressiveness is dependent on the nature and portion of the additives contained in the lubricants. The broad range of chemical substances amplifies the variety of possible effects on the seal.

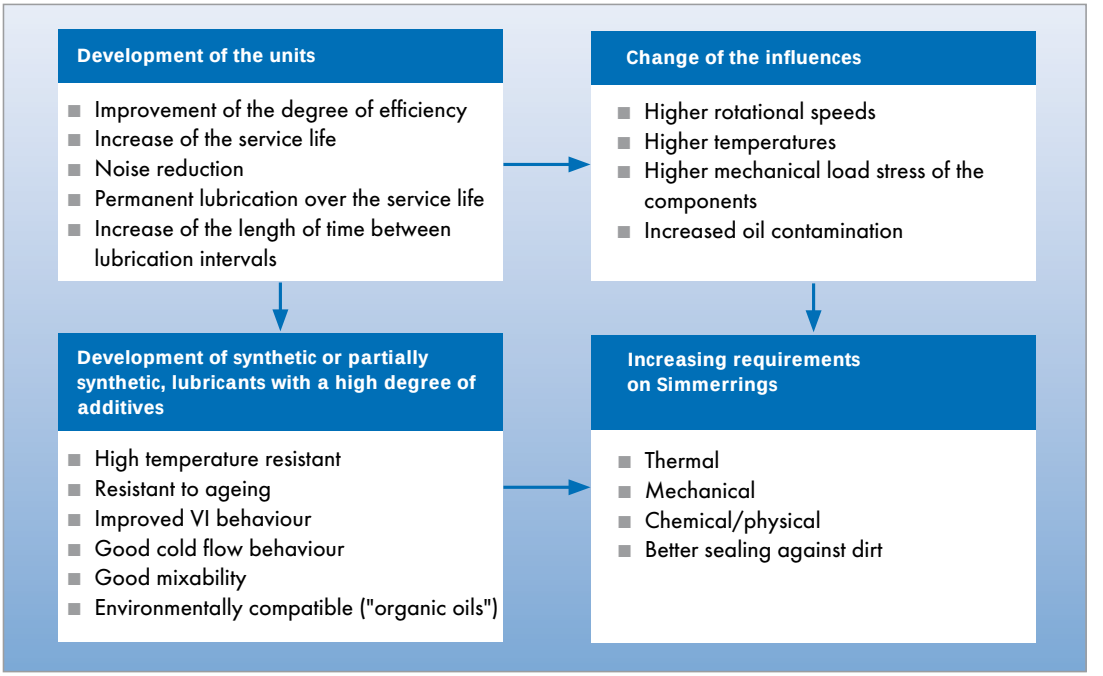


Fig. 18 Increasing requirements on Simmerrings

Note:
Before new oils are introduced, the elastomer compatibility should be analysed intensively. In the first step, a static laboratory test over at least 168 h (better 1000 h) should occur.
It has been shown in many cases that ultimately only a dynamic tightness test over 1000 h supplies a reliable picture of the seal-compatibility. The intensive cooperation between seal manufacturer and lubricant manufacturer has been well proven in this regard.

Lube & Seal

The requirements of the sealing system are continuously increasing (→ Fig. 18). It is therefore increasingly necessary to match the acting influencing parameters to each other more intensively. The goal of the "Lube & Seal" projects is the optimisation of sealing systems subject to high stress in cooperation with Klueber, Munich: Use of optimally matched seal material and lubricant:

- Optimisation of the chemical/physical elastomer – Lubricant interactions
- Minimisation of the friction and thus the dissipation loss
- Minimisation of the wear
- Increase of the reliability
- Increase of the service life.

Greases

For sealing against grease, the conditions for the dissipation of frictional heat are less favourable than for liquid media.
Remedy: if circumferential speed exceeds approx. 50% of the permissible values for oil (material 72 NBR 902, → Fig. 20), it is to be checked whether it is possible to switch to oil lubrication.
For sealing of grease-lubricated, slow-running shafts it is recommended, as far as possible, to fully fill the space with grease in accordance with the bearing manufacturer's instructions. We recommend, in relation to sealing capacity and low wear, that the seal on one side of the mounting is fitted such that the sealing lip points to the outside in order to avoid overpressure in the sealed space on heating and re-greasing. For sealing with an insufficient supply of lubricant, or against poor lubricating media such as water and washing lye, a dedicated amount of lubricant must be provided for the sealing lip; e.g., in the space between sealing lip and dust lip. We recommend filling this space approx. 40% with grease (→ Fig. 6).
The installation of two Simmerrings, arranged one behind the other, with a filling of grease between them is better. Provision for re-greasing is advisable.
For lubrication of the sealing lip, greases with high oil secretions are particularly suitable:

- Bearing greases of consistency class NLGI 1 or NLGI 2 according to DIN 51818 with a minimum worked penetration of 310 or 265 according to DIN 51804 or ASTM D217-52
- Recommendation: Grease from Klueber in Munich (Petamo GHY 133 N).

Aggressive media

For sealing aggressive media such as:

- Acids, alkalis
- Silicone oils for viscous clutches
- Chemically resistant, fluorinated oils,

the resistance to the material of the seal is to be clarified in each case → General Technical Data and Materials from page 897.

Soiling in the media to be sealed

Soiling can be, e.g.:

- Residues of foundry sand from production of cast-metal housings
- Material abraded from rotating components, e.g. from bronze worm gears in worm gearboxes
- Decomposition products from the media.

This soiling, depending on the amount, negatively affects the sealing behaviour and wear behaviour of the seals.
Remedy: Provide for the cleanest possible housing. If sealing lip soiling is unavoidable (e.g. vertical shafts), provide buffering using a collecting or thrower ring and a buffer seal.

Materials for Simmerrings

Material descriptions → General Technical Data and Materials from page 897 as well as → Tbl. 2.
The selection and the use of the elastic material for the sealing lip is the most important criterion for the function and reliability of the sealing system. The properties of the individual materials are described in the specifications for minimum or peak values of the physical values and their changes after specified tests e.g. to ASTM 2000. The essential dimension for function, the degree of sealing, can only be ensured through intensive and diversified tests.

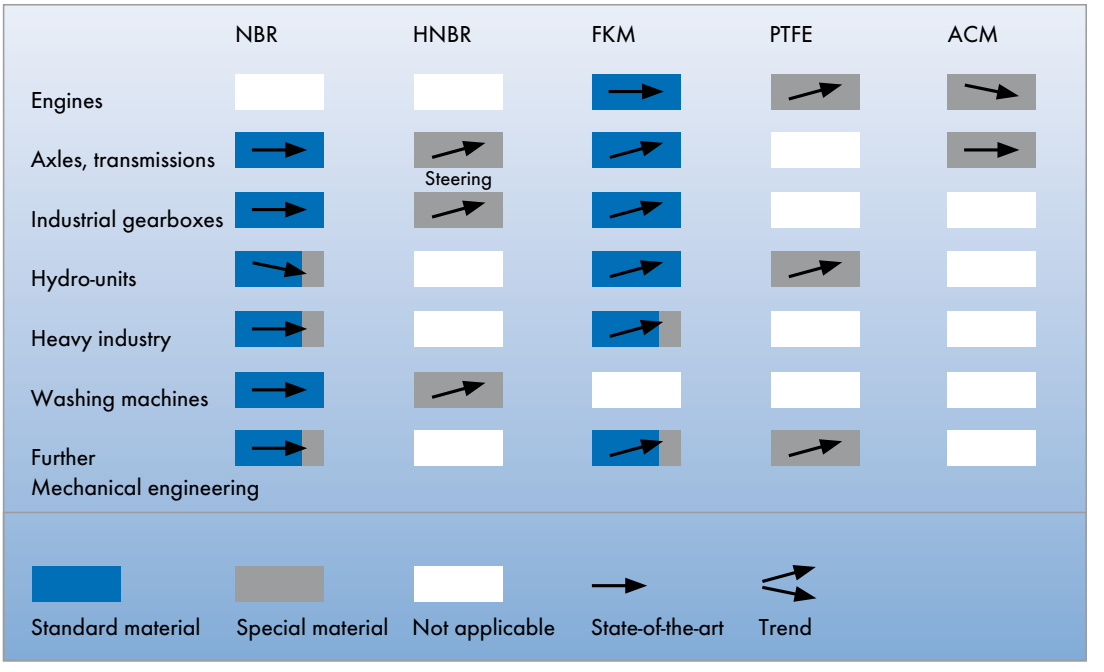


Fig. 19 Materials applications for Simmerrings

Standard materials for Simmerrings

Material		72 NBR 902	75 FKM 585[1)]	75 FKM 595[1)]	PTFE 10/F56101	75 NBR 106200
Colour		Blue	Dark brown	Red brown	Dark grey	Black
Density (g/cm³)	(DIN 53479)	1,46	2,06	2,01	–	1,44
Hardness (Shore A)	(DIN 53505)	75	74	75	–	75
Tensile stress/100% (N/mm²)	(DIN 53504)	>4,5	>5,5	>4	–	>4
Tensile strength (N/mm²)	(DIN 53504)	>10	>10	7,5	–	>10
Elongation at break (%)	(DIN 53504)	>300	>210	>230	–	>250
Classification per ASTM D 2000		M2 BG 710	M2 HK 710	M2 HK 810	–	M2 BG 710
Temperature range at sealing lip (°C)		–40/+100	–30/+200	–30/+200	–80/+200	–40/+120
Media to be sealed with specifications on continuous temperature (in °C)						
Mineral oils						
Engine oils		100	150	150	150	100
Transmission oils		100	150	150	150	100
Hypoid transmission oils		90	140	140	150	90
ATF oils		100	150	150	150	100
Hydraulic fluids as per DIN 51524		100	150	150	150	100
Greases		100	150	150	150	100
Fire-retardant fluids as per VDMA 24317 and DIN 24320**						
Group HFA ***		⊗	⊗	⊗	+	⊗
Group HFB ***		⊗	⊗	⊗	+	⊗
Group HFC ***		⊗	–	–	+	⊗
Group HFD ****		–	150	150	150	–
Other media						
Heating oil EL and L		90	+	+	+	90
Water ***		–	⊗	⊗	+	–
Washing lye ***		–	⊗	⊗	+	–

Tbl. 1

The values given are based on a limited number of tests on standard test specimens (2 mm sample sheets) from laboratory production.
The data determined on finished parts may vary from the above values depending on the production method and geometry of the part.

1) When using FKM materials in the synthetic lubricants polyalkylene glycols (PAG) and polyalphaolefins (PAO), the maximum operating temperature is to be defined by means of testing or a trial run.

** Operating limits defined by the medium

*** Additional lubrication recommended

**** Resistance depends on the HFD type

\+ Resistant, in general not used for these media

⊗ Of limited resistance

– Not resistant

Special materials for Simmerrings (on enquiry)

Material	Classification according to ASTM D2000	Hardness (Shore A)	Colour	Application examples
70 NBR 110558	M2 BG 710	70	Black	washing machines
70 NBR 803	M2 BG 708	70	Grey	use with foodstuffs
73 NBR 91589	M2 BG 710	73	Blue	2-stroke engines
80 NBR 94207	M7 BG 810	80	Black	sea water/marine shafts
90 NBR 129208	M7 BG 910	90	Black	special pressurised applications
80 HNBR 172267	M5 DH 806	80	Black	special pressurised applications, power steering systems

Tbl. 2

The properties of the different elastomers determines their important operating conditions (→ Fig. 19)

	NBR	FKM	PTFE	ACM	HNBR
Abrasion resistance	good	very good	moderate	moderate	very good
High temperature resistance	moderate max. +100 °C	Very good max. +200 °C (max. +150 °C continuous temperature)	max. +200 °C (max. +150 °C continuous temperature)	good (max. +130 °C continuous temperature)	good max. +100 °C (max. +140 °C continuous temperature)
Low temperature resistance	to −40 °C	to −25 °C	to −80 °C	to −30 °C	to −40 °C
Oil resistance	good	very good	very good	good	good

Tbl. 3 Properties of elastomer materials for Simmerrings

ACM – Polyacrylate elastomer

Special material for use predominantly in hydraulic steering; on enquiry.

FKM – Fluoro elastomer

Application examples:

- For requirements for higher thermal and chemical resistance and high circumferential speeds
- Broad application in mechanical engineering, gearboxes, hydro-units also in two-stroke engines
- In motors and engines.
- in drive trains for commercial vehicles
- in drive trains for agricultural and construction machinery

Media:

- Mineral oils and greases
- Synthetic lubricants if resistance is adequate
- Aromatic and chlorinated hydro-carbons
- Fuels, heating oils.

Temperatures:

−25 °C ... +160 °C

Standard materials:

75 FKM 585 (for the Types BAUM and BAUMSL):
Colour: Dark brown; hardness: 75 ±5 Shore A
75 FKM 595 (for the Type BABSL):
Colour: Red brown; hardness: 75 ±5 Shore A
Special materials on enquiry: e.g. for longer service life requirements.

HNBR – Hydrogenated NBR elastomer

Special material for use predominantly in hydraulic steering; on enquiry.

NBR – Nitrile-butadiene rubber

Application examples:

- Broad application in mechanical engineering, in industrial gearboxes, hydro-units (hydro-pumps, hydro-motors), 2-cycle engines and partially in drive trains of agricultural and construction machinery.

Media:

- Mineral oils and greases
- Synthetic lubricants

With synthetic oils (polyalkylene glycols, polyalphaolefins temperatures <80 °C.
The testing of the suitability in synthetic lubricants is recommended.

Temperatures:

−40 °C to +100 °C
transient up to 120 °C

Standard materials:

72 NBR 902: Colour: blue; hardness: 72 ±5 Shore A
75 NBR 106200: Colour: Black;
Hardness: 75 ±5 Shore A
Special materials on enquiry (→ Tbl. 2) for the application:

- Sea water (ship building)
- Water and washing lye (washing machines)
- Special pressure loads
- Foodstuffs industry.

PTFE – Polytetrafluoroethylene

- non-elastic, beak-like material
- use in aggressive media to which elastomers are not resistant
- Use for dry running (however: lubrication reduces wear!)
- Standard material PTFE 561/10 for Type B2PT, PTFE with 10% carbon filling
- Special materials on enquiry: for Type PTS and for the use in engines.

Influencing Factors

Circumferential speed of the shaft

The circumferential speed, given by the number of r.p.m. and shaft diameter, is the determining influence for the determination of type and material of the Simmerrings.

Determining circumferential speed "V" of the shaft using the formula:

$$V\ (m/s) = \frac{\text{shaft-Ø D(mm)} \times \text{r.p.m/rot. sp.(1 min)} \times \pi}{60\,000}$$

Permissible circumferential speed according to → Fig. 20.
The values given are recommended values. Satisfactory lubrication and good heat dissipation are a prerequisite. Correspondingly lower figures apply in less favourable conditions.
Three ranges indicate the permissible circumferential speed:

- Use of the material NBR
- Use of the material FKM
- Outside of both ranges, no use of Simmerrings.

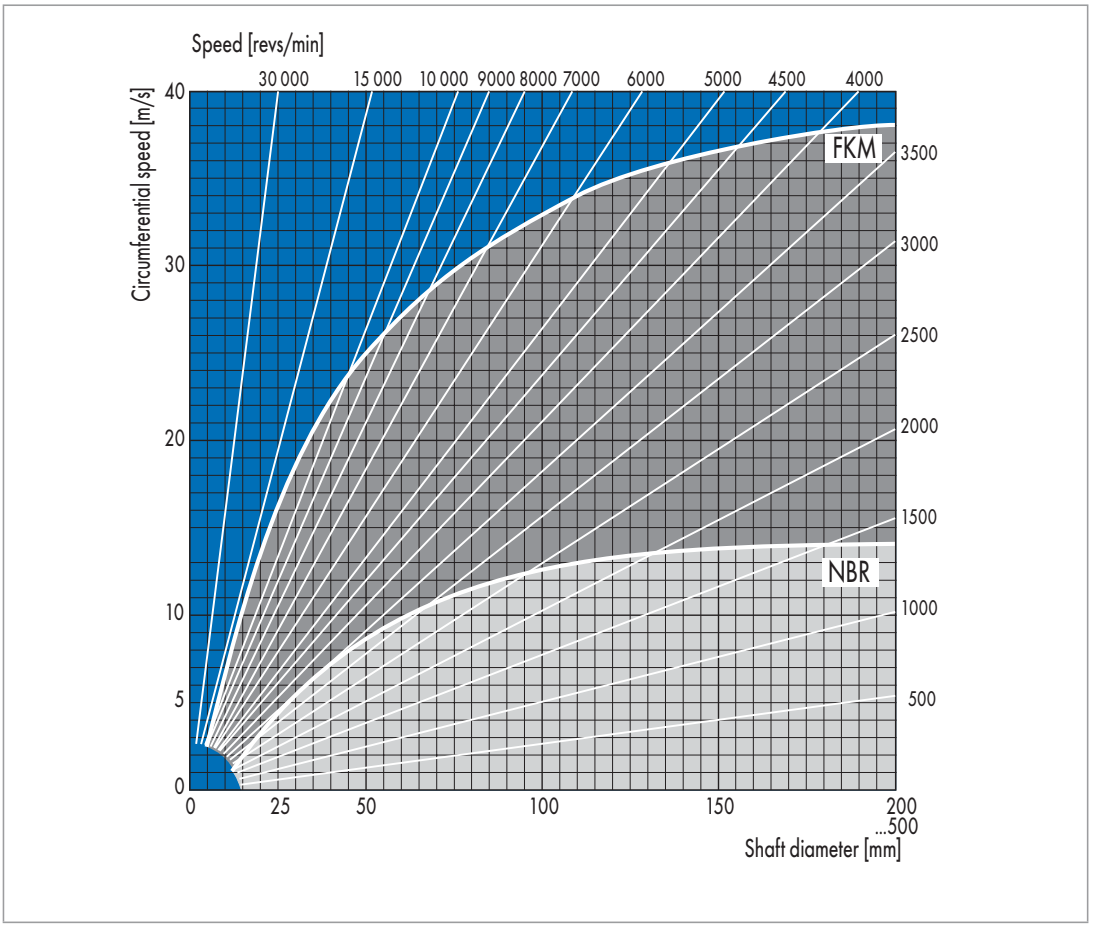


Fig. 20 Permissible circumferential speed for Simmerrings (recommended values) made of the materials NBR (72 NBR 902) and FKM (75 FKM 585) when sealing engine oil SAE 20

Temperature

The temperature at the sealing edge is higher than in the oil bath due to the rotation of the shaft and the friction produced.
The oil level in the unit defines the conditions for the dissipation of heat, and thus the temperature at the sealing edge. The area between upper and lower limits (→ Fig. 21) clearly shows the possible higher temperatures, in comparison to the oil bath, with differing dissipation of heat:

- Lower limit for full lubrication of the shaft
- Upper limit for lubrication of 25% the shaft.

The areas given for the individual media are based on their varying lubricating efficiency and different transport of heat.

With a rise in the rotational speed, and thus the circumferential speed, the temperature at the sealing edge rises (→ Fig. 22); good lubrication and heat transport are assumed.
With increasing pressure on the sealing lip, the temperature at the sealing edge also increases; recommended values for solid shaft and good lubrication (→ Fig. 23).
On the use of Simmerrings with a dust lip, a >20 °C overtemperature may occur.
Exceeding the permissible temperatures for individual materials leads to:

- Heavy wear
- Premature hardening of the sealing lip and
- Shortening of working life.

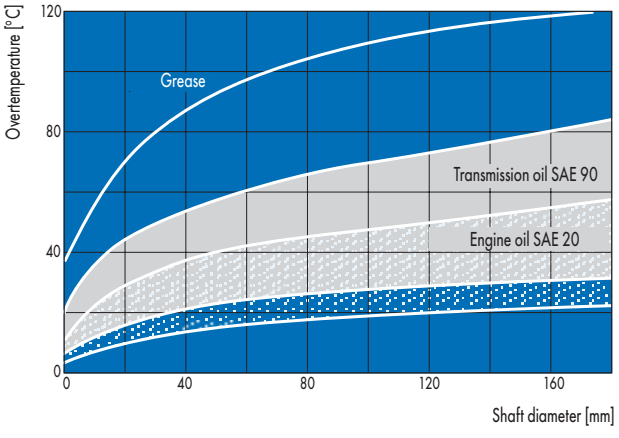


Fig. 21 Overtemperature at the sealing edge of a Simmerring when sealing differing media, temperature of oil bath 100 °C, rotational speed 3000 rpm

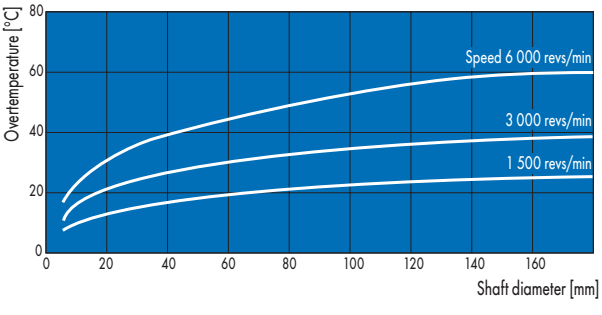


Fig. 22 Overtemperature at the sealing edge of a Simmerring as a function of the rotational speed
Engine oil SAE 20, oil bath temperature 100 °C, oil level: centre of shaft

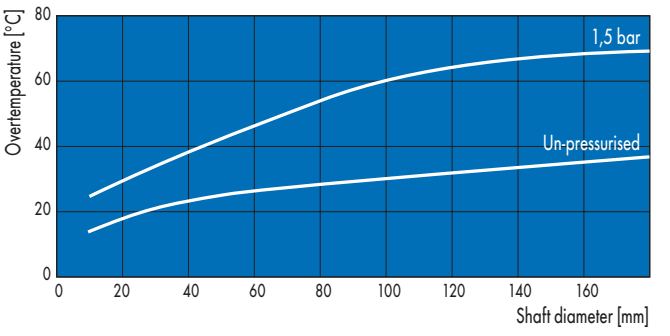


Fig. 23 Overtemperature at the sealing edge of a Simmerring with un-pressurised sealing and with application of pressure, Engine oil: SAE 20, rotational speed: 3000 U/min, oil level: centre of shaft

Tightness behaviour at low temperatures

With decreasing temperatures, elastomers lose elasticity up to the glass state. Depending on the material, the glass transition temperature lies between −10 and − 40 °C. The freezing process is reversible, i.e. the material returns to its original properties with increasing temperature.
On rotary seals, heat is produced by the friction that occurs during motion. At temperatures where there already exists the risk of hardening due to freezing, the frictional heat can suffice to keep the seal elastic, or quickly place the seal in a functional operating state after that start of the motion.
In practice, leakages at low temperatures occur very seldom due to the normally high lubricant viscosity. Exception: with very high shaft deflections.

ATEX applications

- The ATEX 100a (EU directive 94/9/EC) came into force on 01.07.2003
- ATEX 100a applies to the design of electrical equipment, devices and protection systems for use in areas with potentially explosive atmospheres.

Hot surfaces (EN 1127-1)

Here it is described, among other aspects, that in potentially explosive atmospheres ignition can be caused if hot surfaces (e.g. shafts) come into contact with the atmosphere. Standard Simmerrings with dust lips in contact with the surface of the shaft can, depending on the circumferential speed, transient reach shaft surface temperatures of > 120 °C.

Please contact us.

Pressure

With increasing pressure, the contact pressure of the sealing lip increases and with it, the malfunction of the hydrodynamics beneath the sealing edge, the friction and overtemperature at the sealing edge.
The operating pressure p and the circumferential speed v determine the operating limits of the seals (→ Fig. 25).
If the related limit values are exceeded, premature wear, early hardening of the sealing lip and a shortening of the useful service life is to be expected. Standard Simmerrings are primarily designed for un-pressurised operation or for operation at very low pressures. Maximum operating pressure: 0,02 to 0,05 MPa.
If the unit becomes so warm during operation that the enclosed air becomes pressurised, the installation of an air venting valve is recommended. The use of Type BABSL is recommended for a specific area of these loads.
A feature of this seal is a short, but nevertheless flexible, sealing lip. This design prevents an increase in the sealing lip contact pressure, and thus the friction loss (→ Fig. 25).

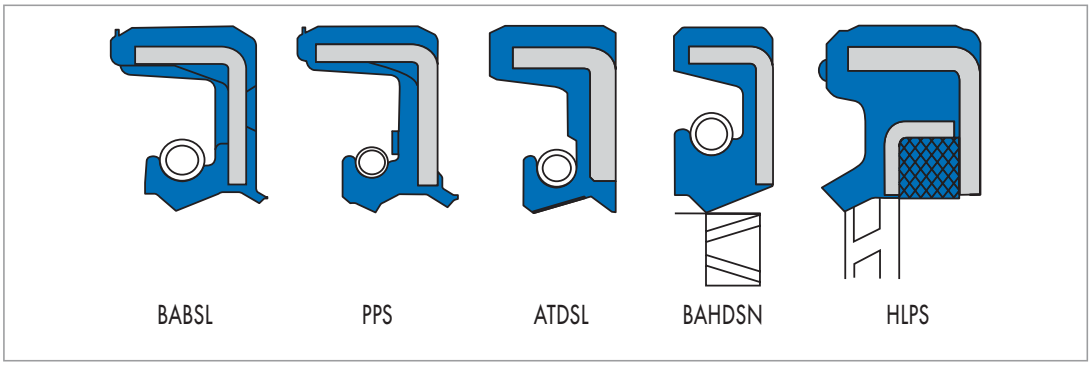


Fig. 24 Types for Simmerrings which can be pressurised

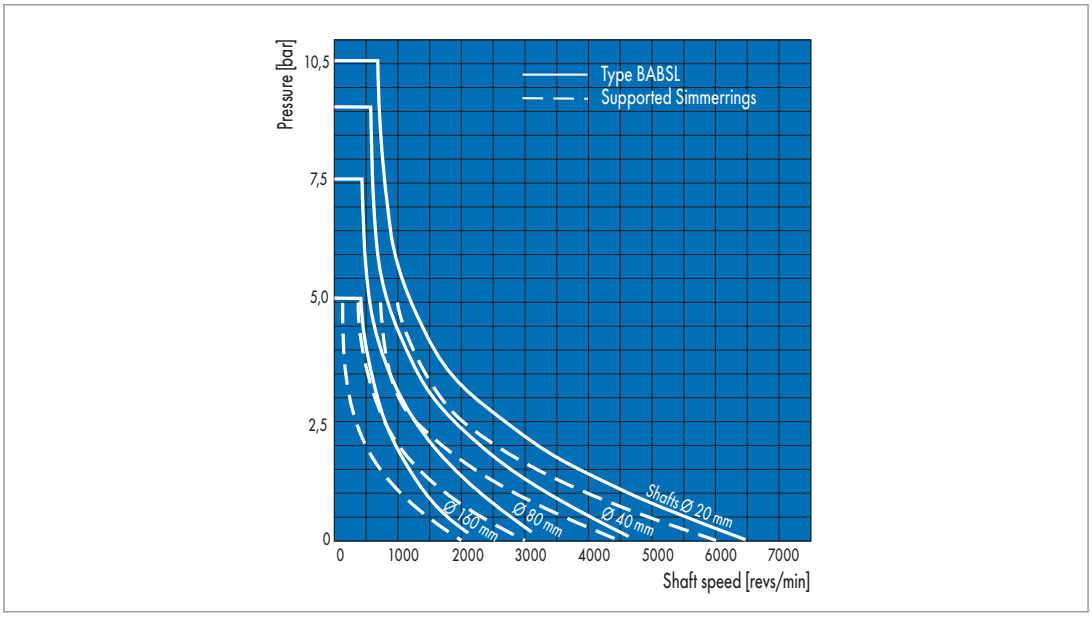


Fig. 25 Permissible pressure in the unit for Simmerrings (Type BABSL), as well as for Simmerrings with back-up rings

If a Simmerring BABSL is not available, the sealing lip on types designed without a dust lip can be supported using a back-up ring:
the back-up ring must be fitted individually matched to the sealing lip profile precisely (→ Fig. 26). Please request back-up ring drawing. Permissible loads: (→ Fig. 25).
For higher pressure/speed loads, special forms are utilised with an applicably higher but nevertheless restricted functional range in the p-v diagram (→ Fig. 24).

Type PPS:
Further development of the proven Type BABSL up to 25% higher performance range

Type PTS
p up to 10 bar, v_U up to 20 m/s, preferably for poor lubrication and critical media such as HFC fluids

Type BAHD:
p up to 150 bar, v_U up to 0,3 m/s.

Type HLPS:
p up to 220 bar, v_U up to 0,2 m/s.
In general it is to be noted that not all maximum values may occur together. Please enquire. The lubrication of the sealing lip with a barrier liquid is to be ensured to seal a vacuum. (→ Fig. 7). This works against the vacuum like the loading of the seal with pressure; the use of Type BABSL is recommended.

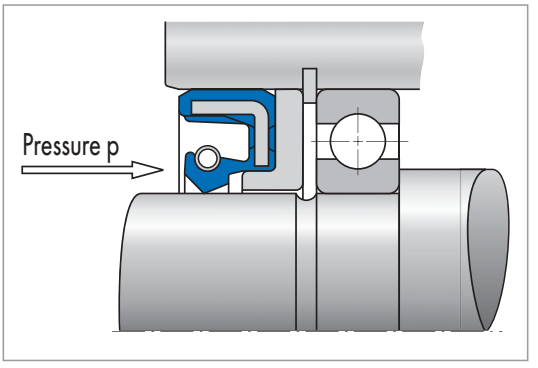


Fig. 26 Installation of a Simmerring with back-up ring

Sealing against dirt

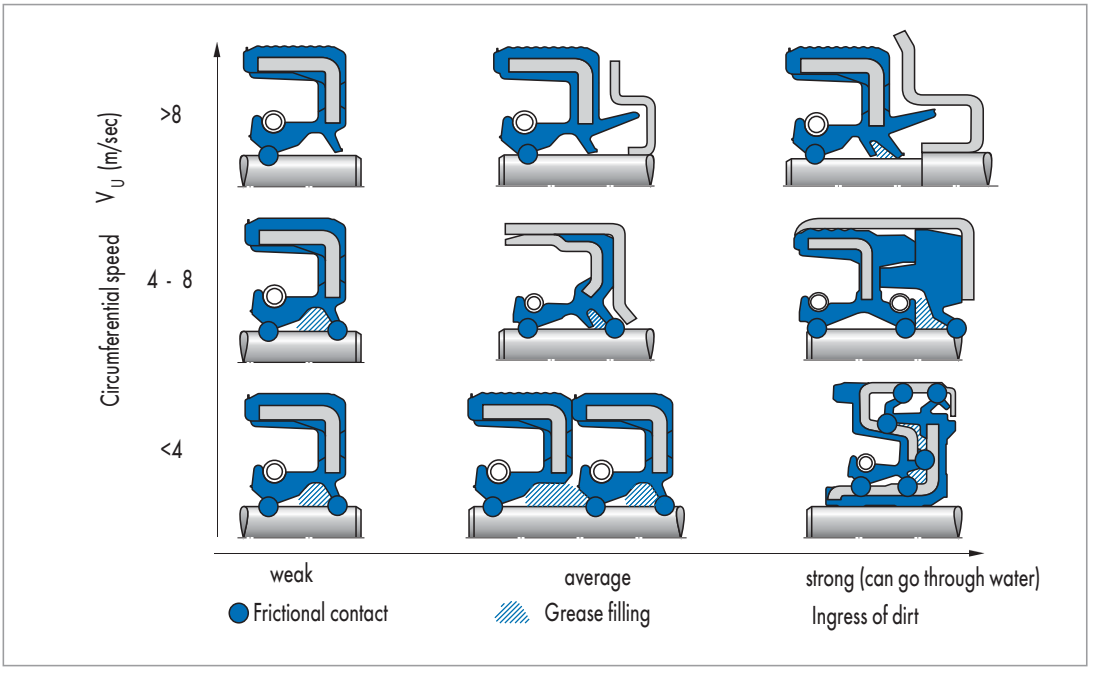


Fig. 27 Simmerrings for secure sealing against dirt

Sealing against dirt

A Simmerring with dust lip is recommended for sealing against dirt, dust and moisture on the air side.
With circumferential speeds >8 m/s it must be observed that the dust lip has no contact with the shaft.
Before the assembly, the space between the sealing lip and dust lip must be filled with approx. 40% grease for lubrication of the dust lip and for corrosion protection of the shaft. Recommendation: Grease (Petamo GHY 133 N) from Klueber in Munich.
Frequently, two consecutively installed seals are fitted for protection against the strong ingress of dirt.

Further solutions: (→ Fig. 27)

- Type with additional axially aligned dust lip:
  - At higher circumferential speeds, the axial dust lip forms a "labyrinth" against the dirt with the correspondingly matched thrower ring rotating with the shaft.
- Type with additional axially aligned dust lip:
  - Prevents the ingress of dirt through contact with the thrower ring or the radial shoulder of the drive flange.
- Type with two radial dust lips:
  - Partially integrated in additional metal part to impede the ingress of dirt.
- Type which is a combination of two seals built into each other:
  - Multiple additional dust lips.
- Simmerring Combi Seal
  - With additional dirt deflector made from wear-resistant polyurethane.
- Different Simmerring cassette seal designs:
  - Against the highest dirt loads.

With each additional dust lip having contact to the counter surface, the power consumed by friction increases and with it the created heat.
Therefore: Test that an optimal heat dissipation is ensured.

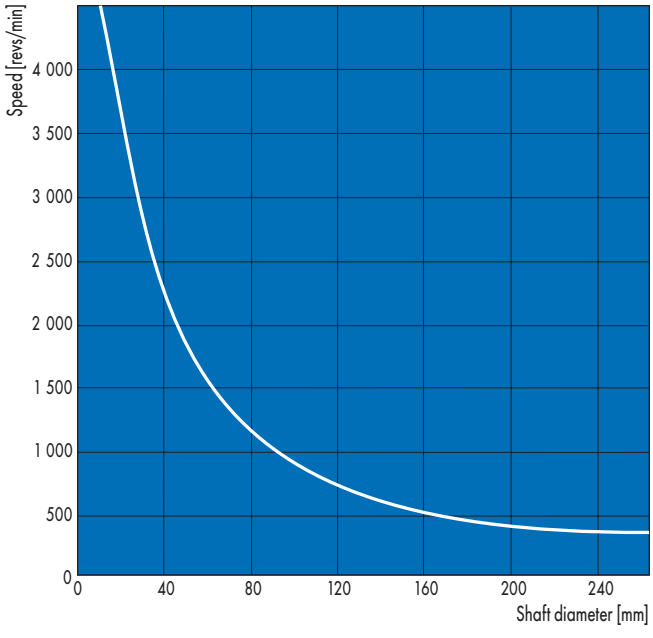


Fig. 28 Permissible rotational speeds with rotating Simmerrings on fixed shafts
If limits are exceeded, please consult us!

Rotating Simmerrings

On the installation of seals in rotating housings, the lower sealing lip contact pressure due to the centrifugal force must be taken into account.
Permissible rotational speeds (→ Fig. 28).
Permissible max. rotational speeds at which the sealing lip of standard Simmerrings lifts up (→ Fig. 28). If the max. rotational speed is exceeded, the contact pressure of the sealing lip must be increased.
Use of stiffer sealing lip profiles e.g. BABSL type Simmerrings or the use of a stronger spring.
A calculation program is available for determining the required information: Please enquire.

Leakage

A differentiation is to be made between different leakage states. Further information is available on enquiry:

- Sealed:
  no moisture can be seen on the seal
- Moist:
  film of moisture in the area around the sealing edge due to function, however not yet beyond back abutment face
- Wet:
  film of moisture beyond back abutment face with formation of droplets, but not dripping
- Measurable leakage:
  a small rivulet can be seen on the outside of the housing coming from the back abutment face of the seal
- Temporary leakage:
  short-term malfunction of the sealing system, e.g. due to small dirt particles beneath the sealing edge that will wash away with further use.
- Apparent leakage:
  temporary leakage that is due to excessive filling with grease between the sealing lip and dust lip. The overflowing grease escapes as an apparent leakage to the outside.

Causes of measurable leakage can be:

- Varied expansion of seal and housing on the static side on non-observance of the tolerances
- Cracks in the material, predominantly in the sealing edge due to excessively high operating conditions
- Increasing hardness of elastomer or elastomer hardness too high due to excessively high operating conditions and incompatibility with the media to be sealed
- Reducing hardness of elastomer or elastomer hardness too low due to swelling of the elastomer caused by medium to be sealed, with the consequence of premature wear to the seal
- Corrosion on the shaft underneath the sealing edge, and thus continuous sealing system malfunction
- Lubricant loss with the resulting dry running and rapid wear of the sealing lip
- Ageing of the combination: elastomer – medium to be sealed
- Formation of "oil carbons" in the area around the sealing edge; the edge will rise and cause a malfunction of the sealing system
- Vibration in the unit and shaft that the sealing lip can no longer follow
- Continuous ingress of dirt at the sealing lip from inside or outside with the consequence of premature sealing lip wear
- Premature sealing lip wear due to non-observance of the rules on the design of the contact area on the shaft (→ Shaft design, page 45)
- Damage to the sealing edge during transport, handling and assembly.

These causes are to be analysed and evaluated, depending on the operating hours as:

- Early failures
- Premature failures
- Failures during operation or

the end of the service life of the seal.

Design of the Shaft

The design of the shaft in the contact area for the sealing lip as a partner to the seal has a crucial effect on the sealing function and the working life of the sealing system (→ Fig. 30).

Roughness of surface

Permissible values:

R_Z = 1,0 ... 5,0 µm
R_a = 0,2 ... 0,8 µm
$R_{max} \leq$ 6,3 µm

at operating pressure >0,1 Mpa: R_a = 1,0 ... 3,0 µm
R_a = 0,2 ... 0,4 µm
R_{max} = 6,3 µm

Adherence to the values for the absolute surface roughness value is of vital importance for the function of the sealing system.
Too large surface roughness values cause a premature wear of the sealing lip and much leakage.
With too low surface roughness values (particularly with higher circumferential speed), there is a risk of a malfunction in the transport of the lubricant to the area around the sealing edge, with the consequence of hardening and crack formation, up to signs of burning at the sealing edge.

Tolerance levels

Tolerance for the shaft: ISO h 11
Tolerance for the runout: IT 8

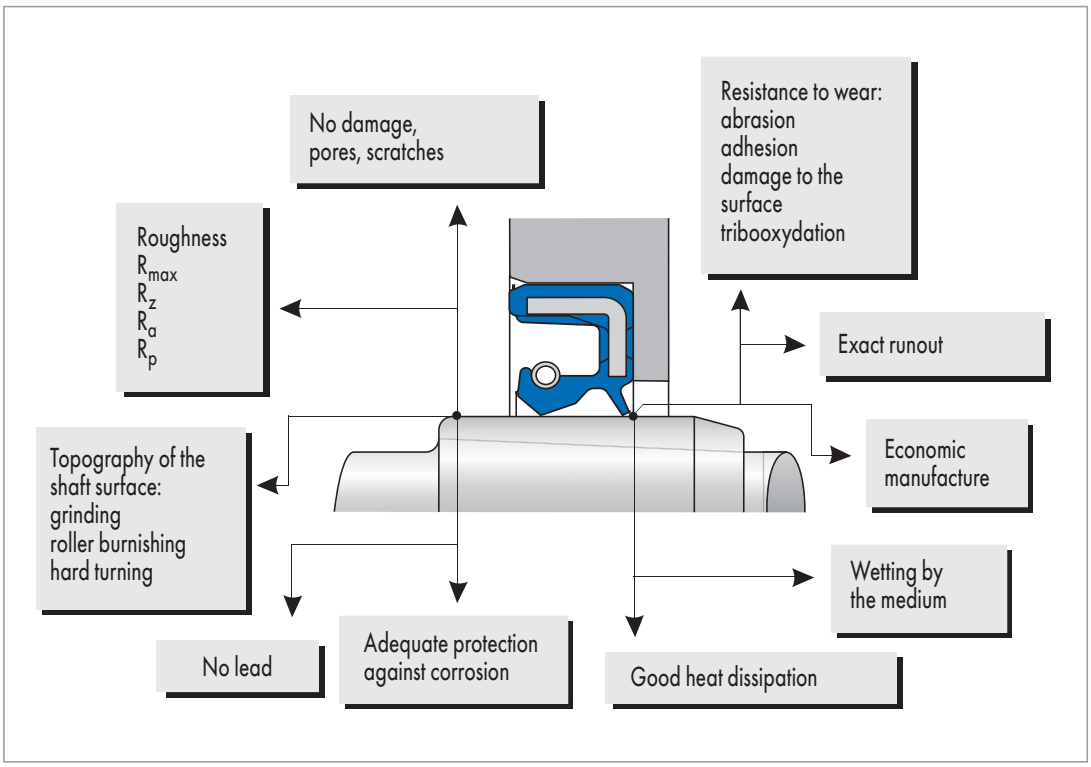


Fig. 29 Requirements on the shaft design as a counter surface for Simmerrings

Shaft materials

Suitable are:

- Steels usually found in mechanical engineering, e.g. C35 and C45
- Casting materials such as spheroid graphite cast iron and malleable cast iron (a prerequisite is freedom from blowholes and a pore depth <0,05 mm)
- Sprayed carbide coatings (a prerequisite is a pore depth <0,05 mm and good adhesion to base material)
- Coatings applied using CVD and PVD methods, as well as anodised coatings, are positively assessed.

The values for the roughness must be observed.
Use NE materials, for example MS 58 H, for sealing water at low circumferential speeds. Stainless steel is better, for instance material No. 1.4300 and 1.4112 (heat treatable). Ceramic bushings are very wear-resistant and the material has proven itself in exceptional cases.
The observance of the figures for the roughness and good adhesion to the base material are prerequisites.
Not generally suitable are:

- hard chrome coatings (due in part to irregular wear)
- plastic materials (due to very low thermal conductivity, the resulting problems with heat transfer and high temperatures produced at the sealing edge, as well as possible softening).

Hardness

For slower circumferential speeds (<4 ... 5 m/sec), it is frequently possible to run the sealing lip on untempered shafts. If the operating conditions increase collectively, the tempering of the shaft is essential.

- Hardness on the surface: >45 HRC

With soiled media, dirt from outside or circumferential speeds >12 m/s:

- hardness at the surface approx. 60 HRC
- depth of the hardening >0,3 mm.

Shaft machining

The correct machining of the shaft is a crucial factor for the function of the sealing system. Further information is available on enquiry:

Plunge-cut grinding

The method employed most often is plunge-cut grinding, as it provides the necessary absence of lead on the shaft in presence of a sparking out on completion of the grinding.
Process parameters and their effects (→ Tbl. 4)

Hard turning

Predominantly used for shafts rotating in one direction only to use the shaft lead produced by the turning in the form of a single threaded fastener to support the pumping action of the seal.
The success of the use of this method depends on:

- The adherence to the process parameters
- (→ Tbl. 4/Tbl. 5) Ensuring that the pumping action of the seal surpasses the effect of the remaining lead on the shaft (unit tests are highly recommended)

The reason for choosing this method is that it is cost saving.

Other methods are:

- Roller burnishing
- Blasting
- Honing, superfinishing and polishing.

These methods are only suitable on a few occasions as a contact area for Simmerrings. Further information on enquiry.

Absence of lead on the shaft

For ground shafts, the orientation-free final machining of the contact area is imperative. The surface should be checked for absence of leads.
The test methods for lead described in (→ Fig. 30) have proven themselves in practice.
Observe, however, that not all critical lead structures can be detected.

Process parameters	Result	Aim	Note
Rotational speed ratio Grinding disc/workpiece	can produce lead	fractions e.g. 10,5:1	inspect during process
Workpiece rotational speed Grinding disc rotational speed		30 ... 300 U/min 1500 ... 1700 U/min	tool and workpiece must rotate in opposite directions
Dressing feed	affects the pitch of the lead structure	<0,02 mm/rotation	only dress in one direction
Dressing tool	can produce lead structure	four-grain diamond, single-grain diamond	
Dressing tool cut	affects roughness values and lead structure	approx. 0,02 mm	
Sparking out time	affects cross-section of the lead structure	complete sparking-out at least 30 s	most frequent cause of surfaces with lead
Infeed depth	can cause leakage	> than R_{max} from previous machining process	
Grinding disc/grit size	affects the roughness parameters R_{max}, R_z and R_a	Example: 60 ... 100 pure corundum 60KL8V25 (white) dimensions 400 x 50 x 127	
Concentricity of tool and work-piece axes	can produce lead structure on the surface	concentricity as low as possible	

Tbl. 4 Machining guidelines for ground surface on the shaft

Parameters	Values
Feed	0,03 ... 0,10 mm
Cutting speed	100 ... 300 m/s
Radius	0,4 ... 1,2 mm
Cutting depth	max. 0,15 mm
Material on the indexable insert	CBN (Cubic-Boron-Nitride)
Hardness	55 ... 62 HRC
Requirements on the machined surface	R_a=0,1 ... 0,8 µm. R_z=1 ... 4 µm. R_{max}<8 µm
No damage from chips or blunt tool permissible	

Tbl. 5 Machining parameters for hard-turned shafts

Damage to the shaft

Scratches, indentations, rust and other damage in the contact area for the seal will result in leakage. Therefore: Therefore: take great care in protecting the shaft during production and through to final assembly by using protective sleeves and special transport devices.

Concentricity

Too large a deviation of the concentricity between shaft and locating bore, i.e. too little concentricity, leads to an uneven distribution of the contact pressure on the shaft circumference and thus to a heavier wear of the sealing lip on one side. The localised loss of contact pressure can impair the sealing function. Permissible values (→ Fig. 32).

Test method with the following parameters:		Test step
Shaft position:	arranged horizontally	1. Wet shaft lightly with oil
Lubricant:	wet shaft with low viscosity oil (e.g. Pentosin CHF 11S)	2. Attach cord with weight 3. Turn shaft several times
Cord:	horse hair, fishing line 0,1 mm	4. Draw axial line on shaft underside with pencil
Contact angle of the cord:	>180° , <270°	5. Let shaft turn approx. 20 revolutions
Weight:	30 g for shaft Ø <100 mm 50 g for shaft Ø >100 mm	6. Examine axial pencil line for wiping effect 7. Repeat process with reversed direction of rotation
Rotational speed:	approx. 20 r.p.m. with change of direction of rotation	8. If the shaft is free of lead, no wiping effect will be seen

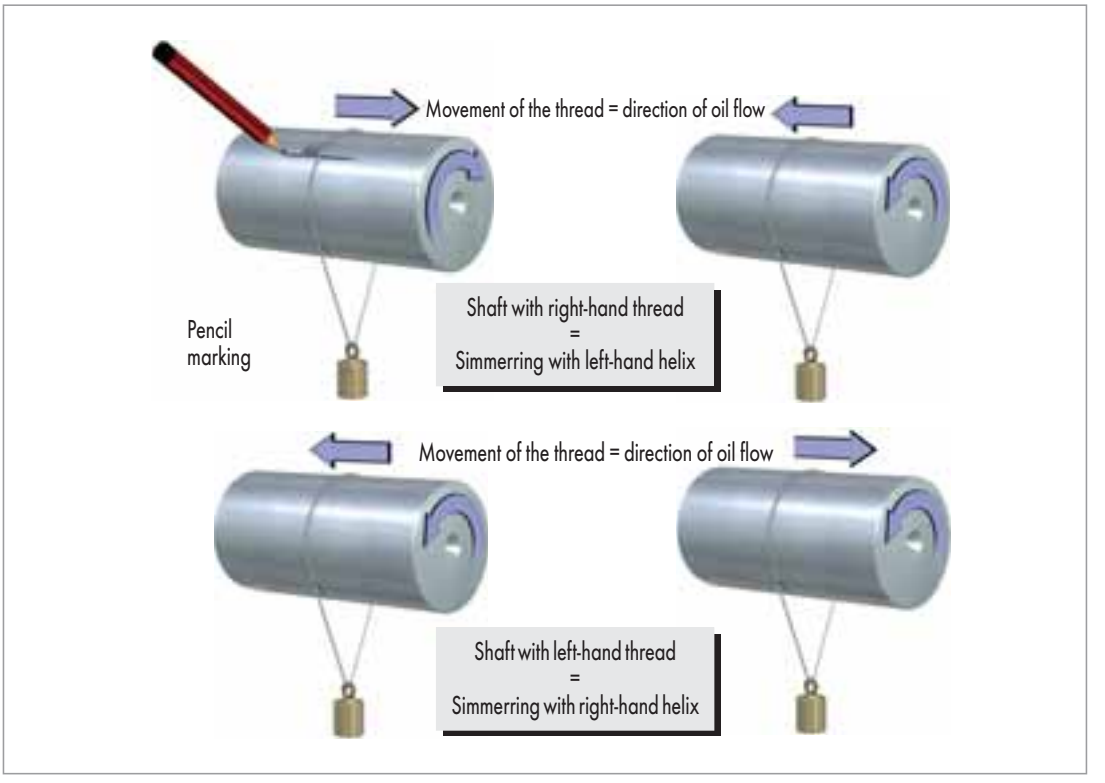


Fig. 30 Determining lead on the shaft

Runout deviation

Runout deviation, or dynamic eccentricity of the shaft is to be avoided as far as possible. At high rotational speeds there is a risk that the sealing lip, as a consequence of its inertia, is no longer able to follow the shaft. The resulting enlargement of the sealing gap between the sealing edge and the shaft leads to a specific level of leakage. Therefore, the bearing play is to be kept as small as possible. The seal is to be arranged in direct proximity to the bearing.

Permissible values for deviation of runout (→ Fig. 32). Limited values apply for Type BABSL (→ Fig. 33). The total offset and runout deviation should be <0,4 mm.

Chamfer

Recommended value: Angle 15° to 25° (→ Fig. 34) Diameter d_3 of the chamfer (→ Fig. 34 and → Tbl. 6).

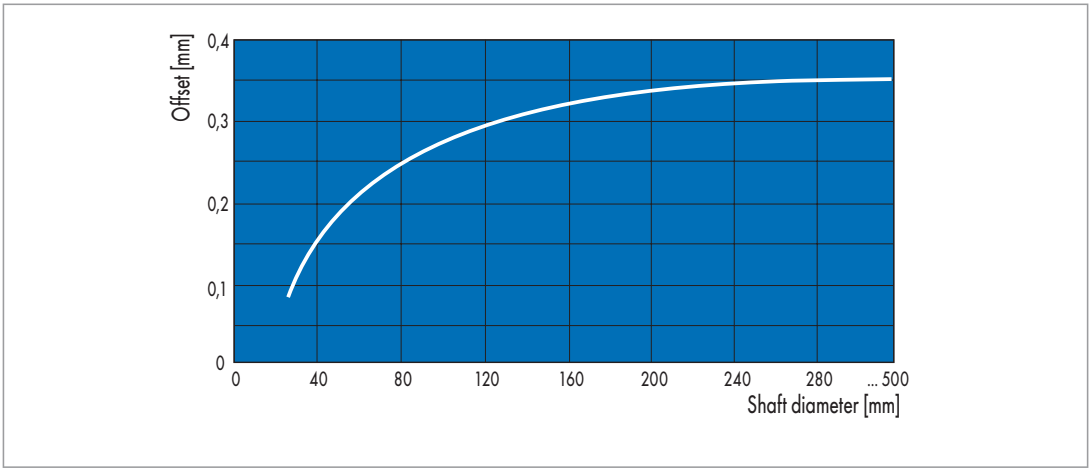


Fig. 31 Max. deviation of the concentricity as a function of the shaft diameter

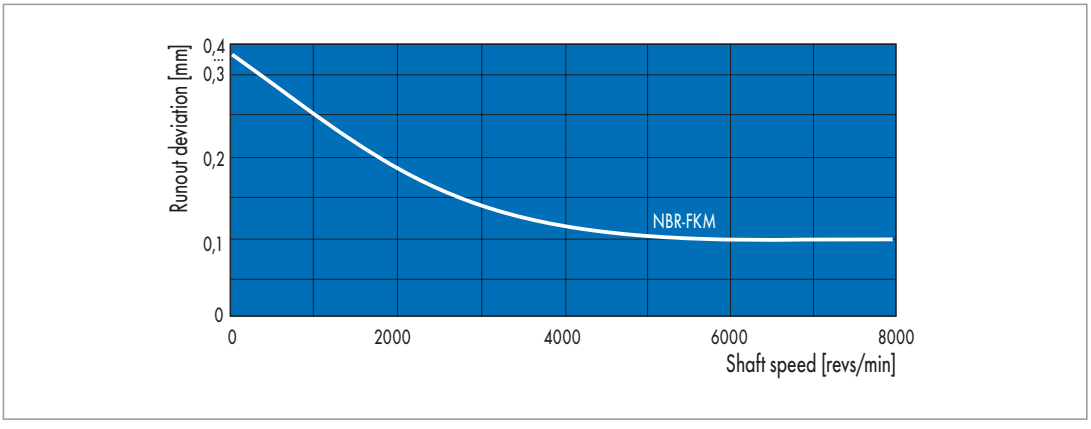


Fig. 32 Max. runout deviation of the shaft as a function of the rotational speed

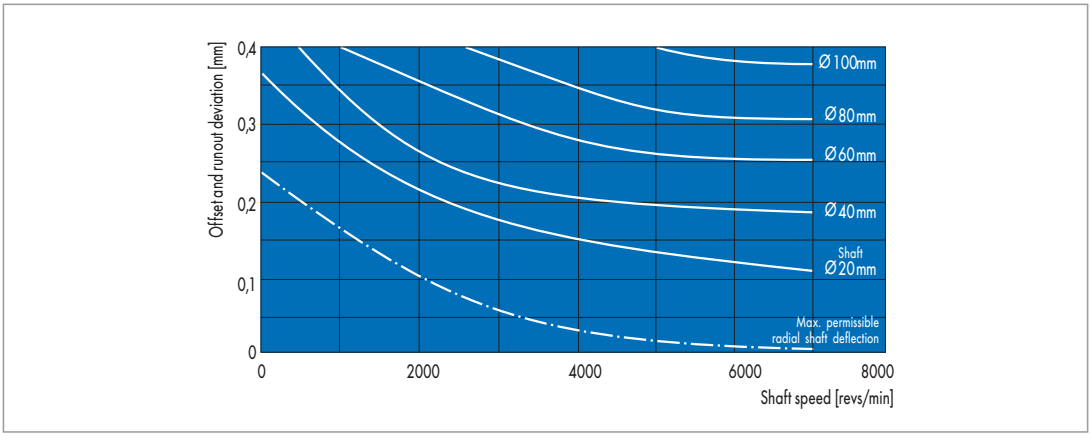


Fig. 33 Deviation of coaxiality and of runout as a function of rotational speed for Type BABSL

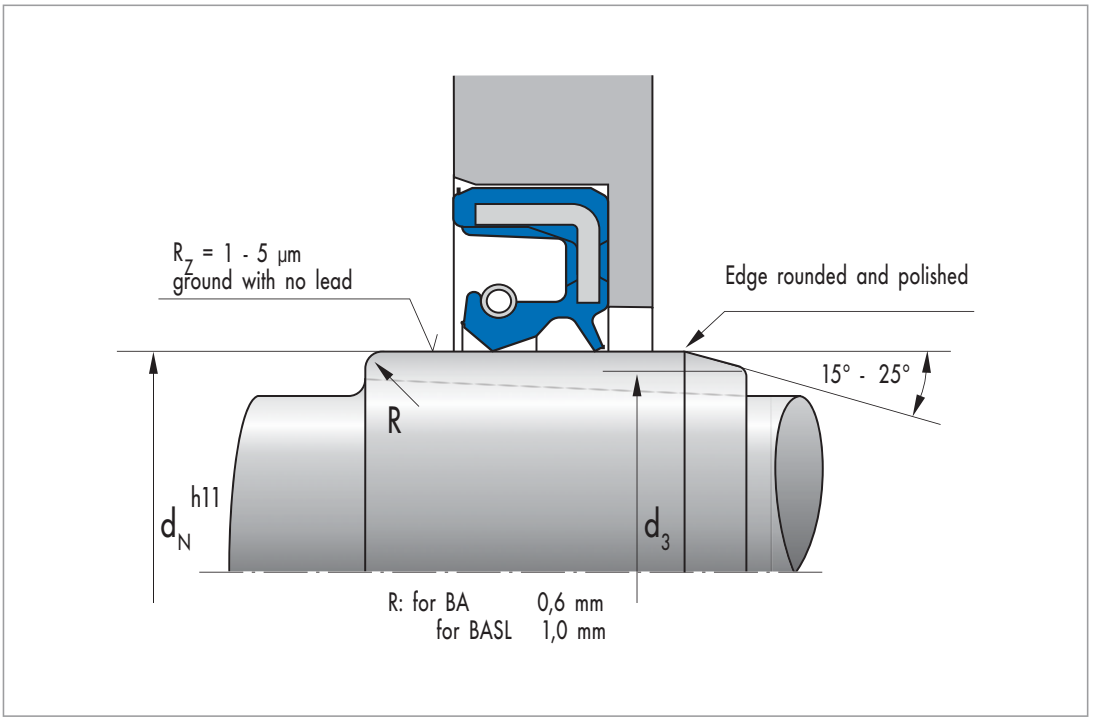


Fig. 34 Radius and chamfering of shaft

d_N [mm]	d_3 [mm]
up to 10	dN –1,5
10 ... 20	dN – 2,0
20 ... 30	dN – 2,5
30 ... 40	dN – 3,0
40 ... 50	dN – 3,5
50 ... 70	dN – 4,0
70 ... 90	dN – 4,5
90 ... 140	dN – 5,0
140 ... 250	dN – 7,0
>250	dN – 11,0

Tbl. 6 Diameter for the chamfering of shaft

Design of Locating Bore

Roughness

Permissible values: for Types BA and BASL

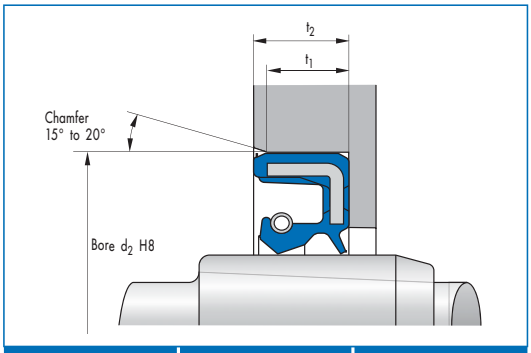
R_{max} < 25 µm
R_a = 1,6 ... 6,3 µm
R_z = 10 ... 25 µm

For Types B1 and B1SL, B2 and B2SL

R_{max} < 16 µm
R_a = 0,8 ... 3,2 µm
R_z = 6,3 ... 16 µm

Tolerance level and depth

ISO H8



b	t_{1min} (0,85 x b)	t_{2min} (b + 0,3)
7	5,95	7,30
8	6,80	8,30
10	8,50	10,30
12	10,30	12,30
15	12,75	15,30
20	17,00	20,30

Fig. 35 Depth and chamfer on the locating bore

Chamfer

- Recommended value: Angle 15° ... 20° (→ Fig. 35)
- Transitions are to be free of burrs
- Chamfer lengths based on DIN 3760.

Thermal expansion

The overlap between housing and seal reduces on heating, particularly on housings made of light alloy, plastics, amongst others
Therefore, in these cases the use of Type BA is recommended since this can better follow the expansion of the housing due to the larger overlap and greater coefficients of thermal expansion.

Split housing

The necessary compensation of any movement at the joint is best achieved with Type BA.

Stiffness

When installing Simmerrings in thin-walled locating bores or locating bores with low elasticity or tensile strength, there is a risk that the housing will expand or break apart.
Therefore use Type BA, and if necessary change the bore tolerance to F8.

Simmerrings with PTFE Sealing Lip

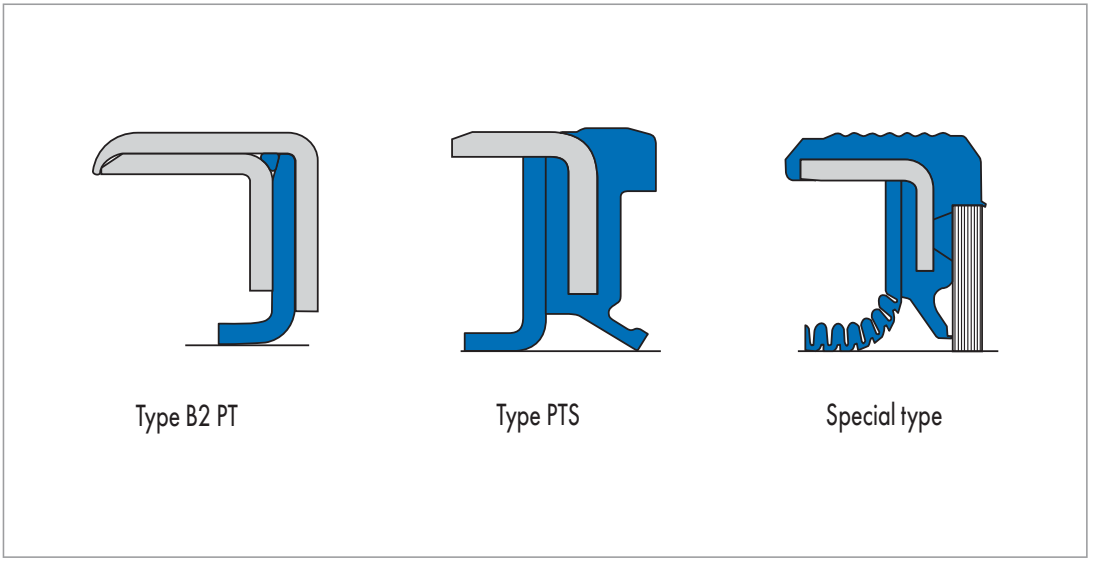


Fig. 36 Simmerrings with PTFE sealing lip

Types

Type B2PT

- Seal made of PTFE: Carbon-filled, highly wear-resistant, low friction
- Material: PTFE 561/10 firmly clamped between two metal housings, accurately centred to the outer diameter
- FKM O-Ring for static sealing
- Metal casing: DIN EN 10088.

Type PTS

- Partially rubberised outer casing for optimal static tightness in the housing, no bonding necessary
- Sealing lip made of special PTFE, vulcanised to the elastomer, no static leakage thus possible
- Integrated dust lip
- PTFE sealing lip with and without return pumping helix
- Use in hydrostatic drives subject to high pressures (amongst others)
- Also suitable for the sealing of biologically degradable fluids and HFC fluids.

Special Type

- Sealing lip made from special PTFE, vulcanised to the elastomer, with special return pumping helix for minimisation of the friction
- Optional non-wowen material dust lip to prevent the formation of underpressure behind the sealing edge and to minimise the friction
- Predominantly used as crankshaft seal in engines.

For all Simmerrings with PTFE sealing lips, additional application-specific, matched PTFE compounds are available, e.g. for the food processing industry. Please enquire.

Use/applications

PTFE is a proven, thermally high performance material that is in no way responsive to interactions with the lubricant.
Use of Simmerrings with a PTFE sealing lip:

- For exceeding the thermal operating limits of elastomers
- For chemical/physical incompatibility of elastomer and lubricant.

Typical applications:

- Pumps in the chemicals industry/process technology
- Engines (crankshaft),
- Hydrostatic drives (use of HFC fluids)
- Transmissions of all kinds
- Rotary joints (air).

Sealing mechanism:

- Achievement of the required contact pressure force by means of material-inherent memory effect
- The frictional heat produced in operation has a reforming action on the flexed sealing lip
- Consequently, a spring is not necessary
- PTFE sealing lip positioned on the shaft with a running track width of approx. 2,5 mm.

However: depending on the construction, the dynamic sealing behaviour is limited in some circumstances. Depending on operating conditions, slight leakages may occur with the use of PTFE seals without integrated return pumping helix.

Operating conditions

- Thermal loading from −130 °C to +200 °C
- Circumferential speed: up to max. 30 m/s
- "Stick-slip"-free behaviour compared to elastomers
- Suitability
  - For dry running and insufficient lubrication
  - In water mixed with cleaning agents,
  - In steams, cooling liquids and emulsions
  - Suitable in mineral oils, synthetic oils and greases
- Resistance
  - To aggressive media, such as acids, alkalis, solvents (amongst others). Exceptions are elementary fluorine and molten alkali metals
- Applicability
  - For sealing of powders, granules, adhesives and resins
- Application
  - In the pharmaceutical and foodstuff sectors.

Simmerring Encoder Components

Simmerring encoder components, together with active sensors, are used to acquire precise rotational speeds and angles of rotation.

Design:

- Simmerring with magnetisable elastomer or
- Metal insert with magnetisable elastomer.

Use:

- Anti-lock braking system
- Engine management
- Gearbox management.

Advantages:

- Integrated function of seal and encoder
- Compact design
- Higher accuracy of the signals compared to conventional, mechanical encoder wheels
- Detection of direction of rotation, rotational speed and angle
- Independence of the signal from the rotational speed
- Resolution down to "zero" speed
- Larger air gaps can be allowed
- Use of active sensors.

Materials:

- NBR or ACM elastomer for Simmerring and magnetisable encoders
- Metal insert made from steel DIN EN10027-1 or stainless steel DIN EN 10088
- Combination of various elastomers with optimum properties for sealing profile (NBR, HNBR, ACM, FKM) and encoder component (NBR, ACM) are admitted.

The design is defined with the aid of the latest design methods. Competence, from the design of the seal and the encoder component, to the magnetisation and to the production is performed in its entirety at Simrit.

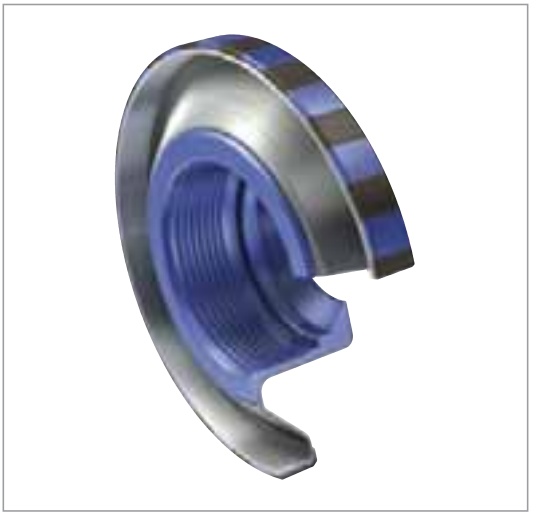


Fig. 37 Simmerring® encoder components

Pre-selection Simmerrings Cassette Seal and Combi Seal

Selection criteria for Combi and Cassette

The most important aspects for the selection of Simmerring Cassette and Combi Seals are:

- Temperature
- Circumferential speed
- Axial play
- Fitting procedure
- Degree of soiling of the surrounding area
- Special operating conditions must be agreed to with Simrit.

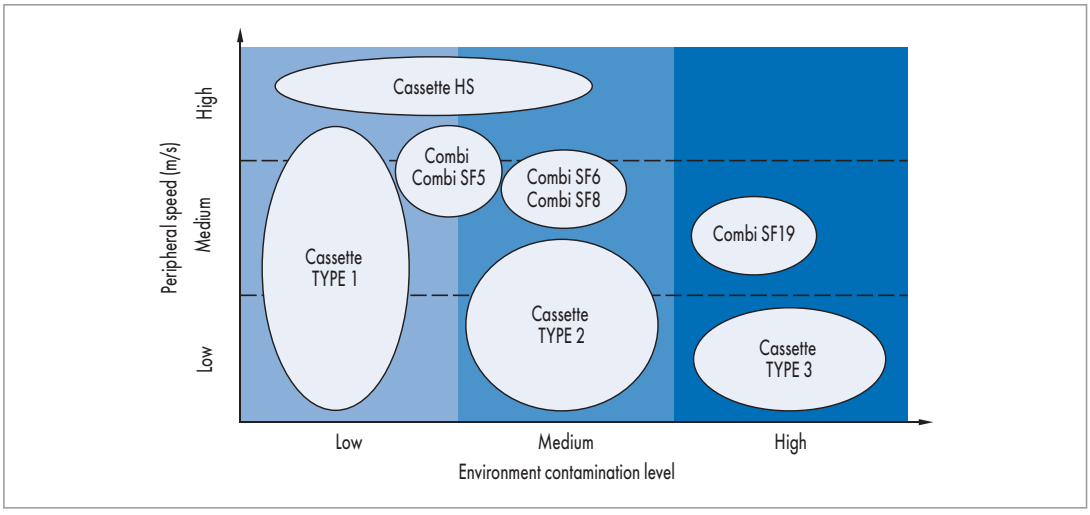


Fig. 38 Pre-selection Simmerrings Cassette Seal and Simmerrings Combi Seal

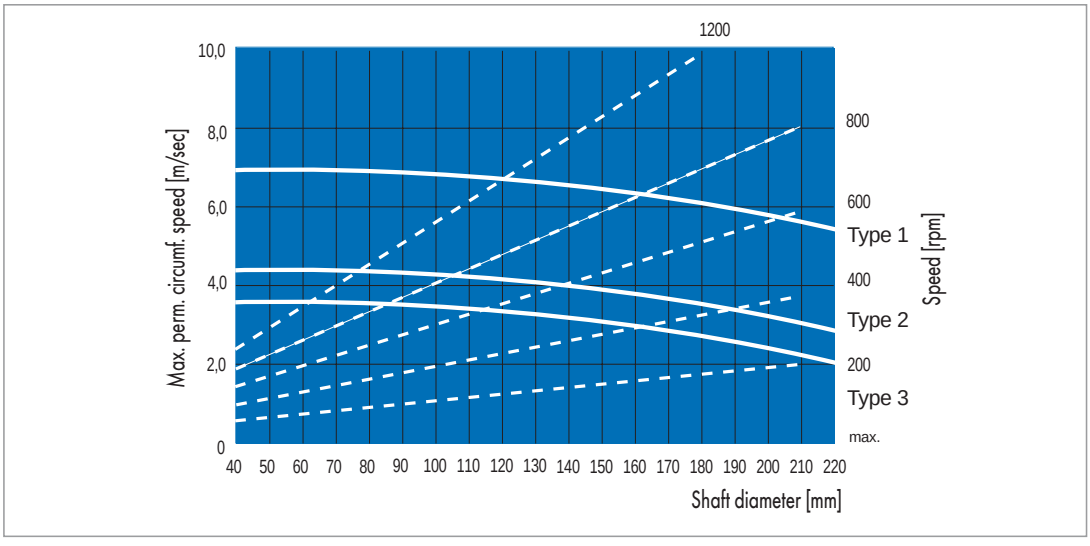
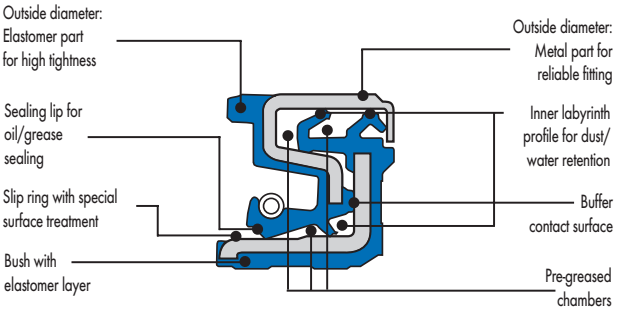


Fig. 39 Operating limits of the Simmerring Cassette Seal Types in NBR

Simmerring Cassette Seal

Properties

- High, medium and low protection against soiling
- Integrated labyrinth for protection against soiling
- Easy fitting; low risk that the seal will be damaged during fitting
- Easy handling; low risk that the seal will be damaged during handling
- Maximum 0,5 bar on the oil side permissible
- Oil sealing and protection against soiling for different environmental conditions and rotational speeds
- No axial movement during the rotation permissible
- Limited axial movement during the seal fitting permissible.



Design	Special features	Performance features	Drawing
Cassette Seal Type 1	– Simple labyrinth profile against soiling – Inside diameter made completely of elastomer – Fitting for "bearing stop" or "parallel"	– Low friction – Low protection against soiling – Developed for truck hubs	
Cassette Seal Type 2	– Double labyrinth profile against soiling – Inside diameter made completely of elastomer	– Moderate friction – Good protection against dust and mud Developed for truck and offroad hubs	
Cassette Seal Type 3	– Triple labyrinth profile against soiling – Inside diameter made completely of elastomer	– High friction Very good protection against dust and mud Developed for offroad hubs and industrial gearboxes	
Cassette Seal HS	– Double labyrinth profile against dust – Metal and elastomer inside diameter – Fitting for "bearing stop" or "parallel"	– Low friction – Good protection against dust and mud – Developed for hubs, drive shaft pinions, drives and industrial applications with high rotational speeds	

Design	Special features	Performance features	Drawing
Cassette Seal Soft Unitized	– Axial labyrinth profile against soiling – Inside diameter metal and elastomer – Sealing ring and slip ring	– Low friction – Good protection against dust and mud – Developed for hubs, pinions and drives, when the fitting does not permit the use of the Cassette HS	
Cassette Seal PTFE	– PTFE sealing lip with lead – Dust lip made from FKM or non-wowen material	– Good protection against dust or dirt ingress – Secure handling and easy fitting – Examples of use: Crankshaft seals in diesel engines	
Cassette Seal Casco	– Protection from the ingress of dust by non-wowen material or rubber lip – Axial sealing lip made of elastomer – Fitting must be performed "parallel"	– Extremely low friction – Low sensitivity to axial/radial eccentricity – Developed for diesel engines – Seal for only one direction of rotation of the shaft	

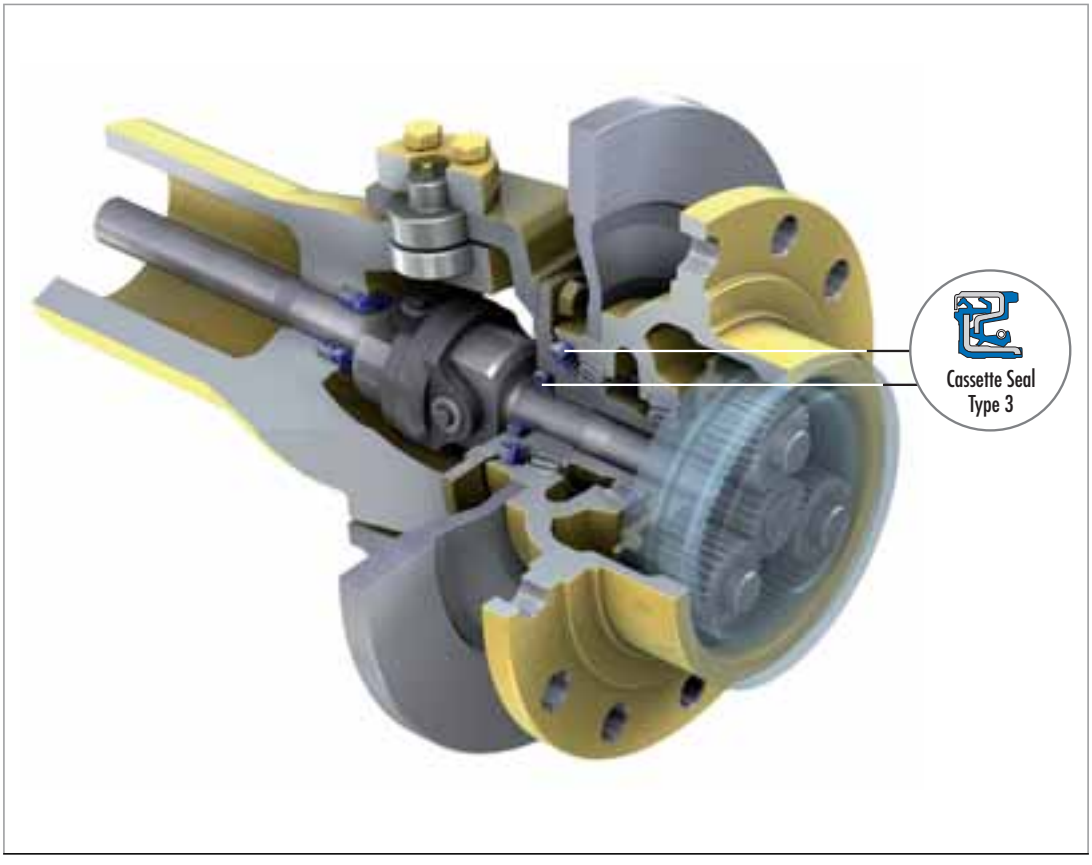


Fig. 40 Simmerring Cassette Seal in driven axles

Simmerring Cassette Seal HS

Properties

- Inside diameter made of metal and rubber
- High rotational speed and temperature permissible
- Good protection against soiling
- Seal for only one direction or both directions of rotation of the shaft
- Oil/grease sealing for high rotational speeds and temperatures
- For high heat dissipation from the sealing edge.

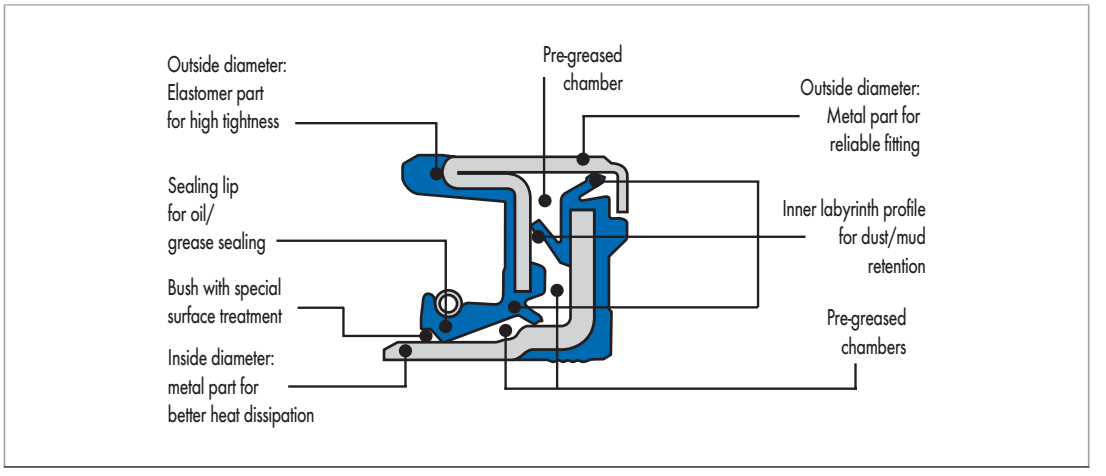


Fig. 41 Simmerring Cassette Seal HS (high speed)

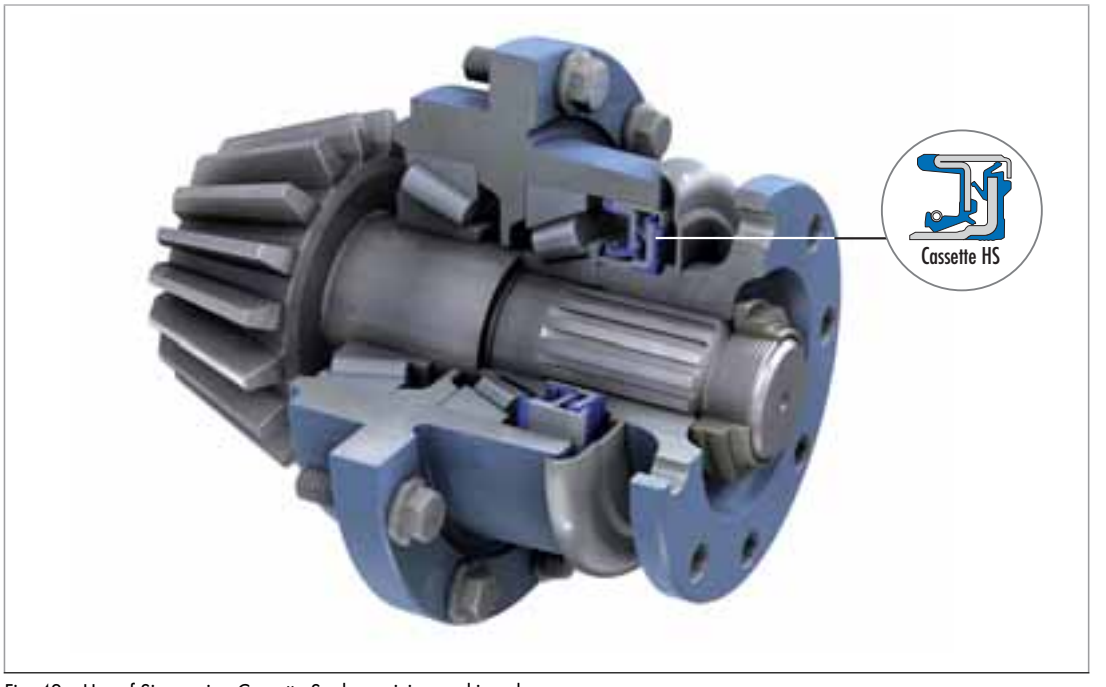


Fig. 42 Use of Simmerring Cassette Seals as pinion seal in axles

Simmerring Combi Seal

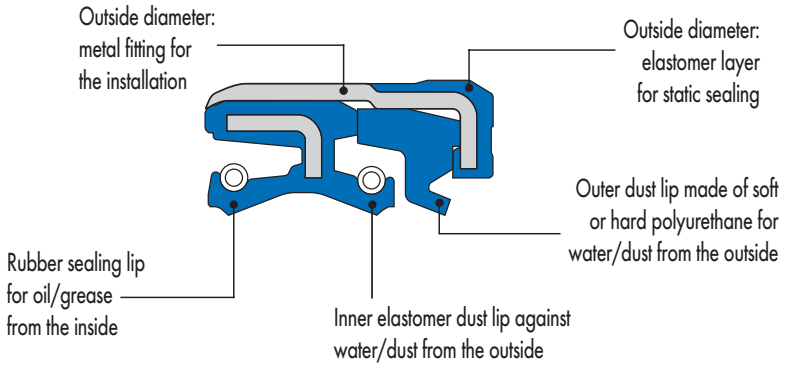
Properties

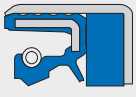
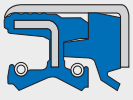
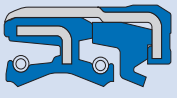
The Simmerring Combi Seal is a "unitized" seal for improved protection against soiling. In consists of:

- A sealing ring (standard type or Type BA DUO)
- A polyurethane dirt deflector
- A "Unitized" housing

- Oil seal for moderate rotational speeds and soiled environments.

Can tolerate axial shaft offset during rotation.



Types	Features	Performance features	Drawing
Combi Seal Standard	Outside diameter: only metal Dirt deflector made from polyurethane foam Simmerring standard design	Primarily for moderate/high rotational speeds, low axial offset.	
Combi Seal SF5	Outside diameter: only metal Dirt deflector made from polyurethane Simmerring standard design	For moderate/high rotational speeds, low axial offset, against moderate/strong dirt ingress from outside	
Combi Seal SF6	Outside diameter metal only Dirt deflector made from compact polyurethane BA-DUO-Simmerring design	For medium rotational speeds, medium axial offset, against medium/strong dirt ingress from outside	
Combi Seal SF8	Metal and rubber outside diameter Dirt deflector made from compact polyurethane BA-DUO-Simmerring design	Like Combi Seal SF6, with reinforced static sealing and higher possible axial offset.	
Combi Seal SF19	Metal and rubber outside diameter Dirt deflector made from compact polyurethane Rubber dust protection lip BA-DUO Simmerring design	For medium rotational speeds with high axial offset of the shaft, against very strong dirt ingress from outside	

Simmerring Combi Seal SF19

Properties

- Flexible dirt deflector made from polyurethane that follows the shaft dynamics
- Integrated elastomer dirt deflector, which as first component, prevents the ingress of dirt into the housing
- Higher axial shaft offset permissible
- Very good protection against soiling
- For environments with high requirements.

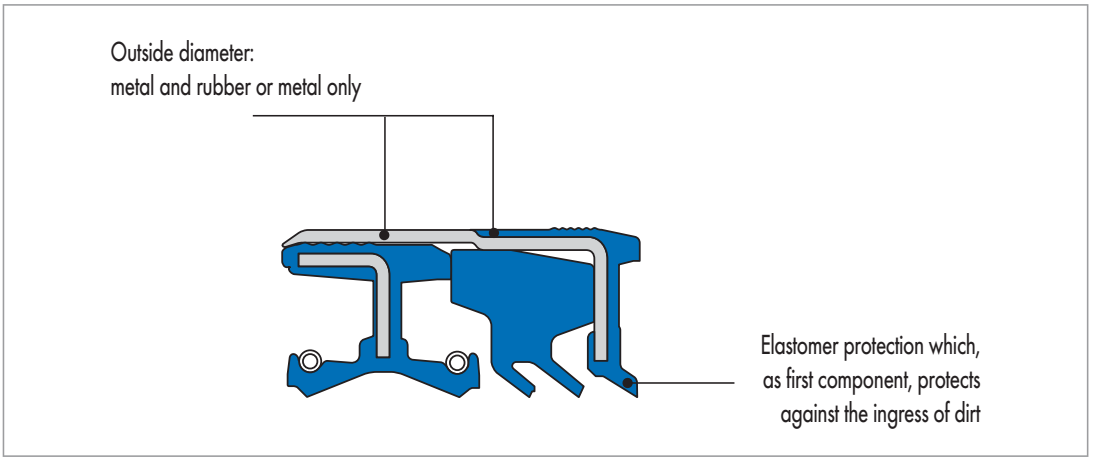


Fig. 43 Simmerring Combi Seal SF19

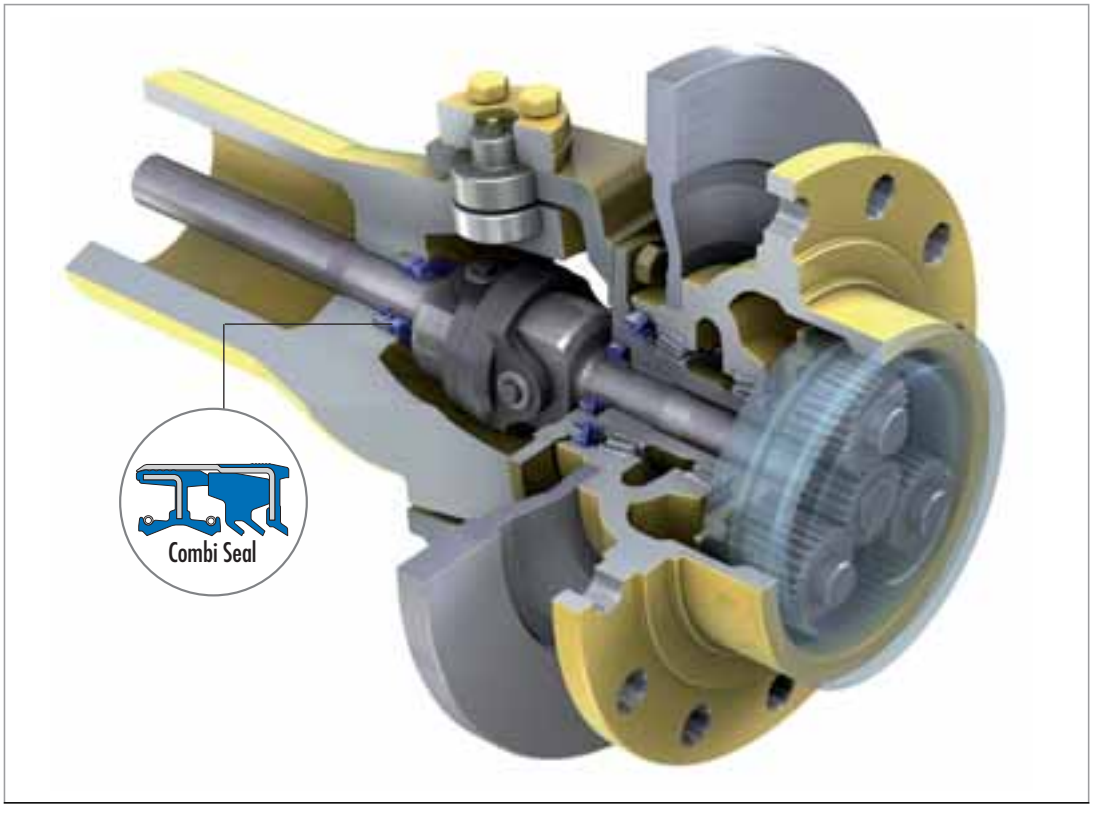


Fig. 44 Simmerring Combi Seal in driven axles

Handling and Assembly of Simmerrings

Preventing the Simmerring, particularly the sealing lip from contact with sharp edges and any kind of soiling is essential during handling and fitting.
The list of possible problems is intended to be of use to the user when handling and fitting Simmerrings so that the user can recognise problems and take remedial action in the following areas → Handling of defects, page 68.

Receipt of goods

- Storage
- Transport
- Temporary storage at assembly station
- Preparation for fitting
- Assembly station
- Contact surface of the Simmerring
- Housing bore
- Handling of units.

Handling

Numerous possible problems have causes that can easily be avoided following indications that may seem trivial at first sight. In practice, however, the care required during handling is frequently neglected. Some examples from the comprehensive list of indications are:

- Pay attention to damaged packaging
- Leave seals in packaging as far as possible until fitting
- Do not leave seals lying around loose
- Protect seals from dust and dirt.
- Safeguard seals in a sealed or covered state
- Only use clean grease or oil
- Avoid excessive greasing
- Do not bring sealing edge into contact with a sharp edge or with a damaged fitting tool
- Avoid metal chips
- Sharp-edged chamfers on the shaft and bore are not permitted
- Damage and corrosion of shaft and bore are not permitted
- Pay attention to alignment of bore and shaft.

Formation of the seal

For most uses only one single seal is necessary.
For positioning of vertical or inclined shafts, the installation of two seals, one behind the other in the same installed direction, is recommended for seals that lie below the oil level.
The space between the seals is to be used as a lubrication chamber. It is recommended to make provision for re-greasing.
The Simmerring can only fulfil sealing tasks and is not suitable as a guide for machine components or for the transmission of axial forces.
The Simmerring and accompanying shaft contact surface are greased before fitting in order to ensure lubrication for the initial revolutions of the shaft.
Excessively high pressure must not be permitted to build up in the unit. A pressure that is too high shortens the service life. The housing is to be ventilated if there is not sufficient room available for expansion.

Fig. 45 Fitting with hydraulic or pneumatic assembly press. Diameter of metal tool face 5 mm to 10 mm larger than seal outside diameter (d_2)

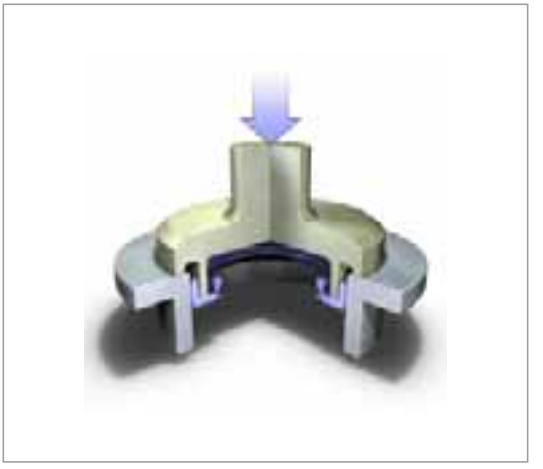


Fig. 46 Fitting "back abutment face to front". Outside diameter of the pilot shaft approx. 0,5 mm smaller than the inner lining diameter of the seal. Please enquire if necessary.

Pressing into the housing

We recommend pressing into the bore with the aid of a mechanical, pneumatic or hydraulic insertion equipment and an assembly press (→ Fig. 45).
The axis for the assembly press is the axis of the bore. An inclined position is not permitted (→ Fig. 47).
A metal face (assembly press – housing) must be present (→ Fig. 45, → Fig. 46). If this is not possible, a metal face must be provided on the underside of the fitting equipment. The press-in force, particularly when fitting "back abutment face to front", must be applied as near as possible to the outside diameter of the seal. The diameter of the assembly press must be chosen to suit (→ Fig. 45, → Fig. 46). If necessary, please enquire.
If the diameter of the assembly press is too small, there is a risk that the seal will bend (→ Fig. 48).

Fig. 47 Inclined fitting not permissible

WRONG!

Fig. 48 Diameter of assembly press too small

WRONG!

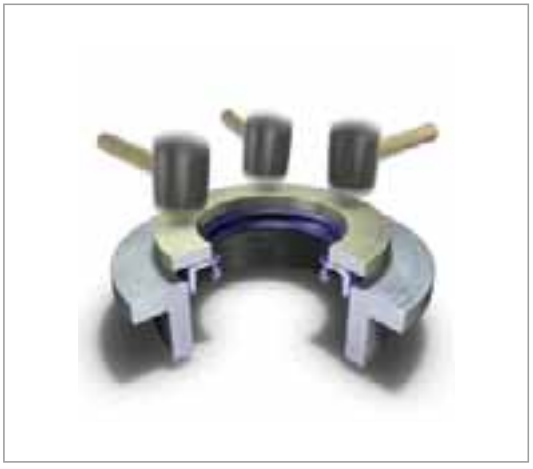


Fig. 49 Permissible hammer assembly

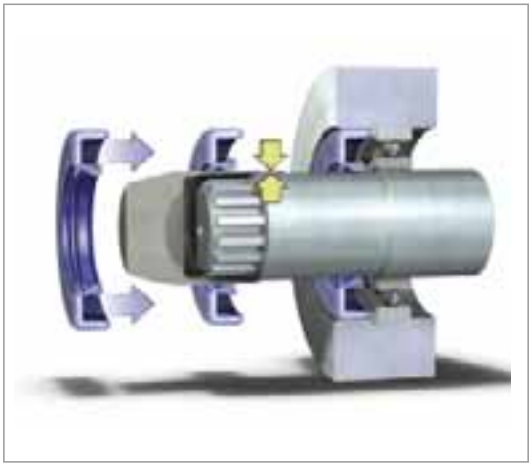


Fig. 50 Fitting over a shaft with a tongue and groove joint (also for a sharp-edged shoulder on shaft)

USE MOUNTING PLATE!

A mounting plate must be used for hammer assembly (frequently with large seals) (→ Fig. 49). In case of an excessively high load on a specific point during fitting, there is a risk that the seal will be bent (→ Fig. 47). When bonding the seal in the housing, the adhesive may not under any circumstances come into contact with the shaft or the sealing lip.

Fitting the shaft

- When fitting over a groove of a tongue and groove joint on the shaft, the groove on the shaft must be covered with a protective cap (→ Fig. 51), to avoid damage to the sealing lip
- Wall thickness of protective cap < 0,5 mm to avoid over-stretching the sealing lip
- When fitting part of a unit with a pre-assembled seal, a centering pin should be used to avoid tilting, which would damage the sealing lip
- When fitting a long shaft, the use of a guide plate to guide the shaft parallel is recommended to avoid impermissible deformation of the sealing lip.
- If parts of the unit with a press fitting and the same nominal diameter are pushed over the contact area, the diameter of the contact area is to be reduced by 0,2 mm to avoid damage to the contact area. The sealing function is not impaired by the reduction of the diameter.

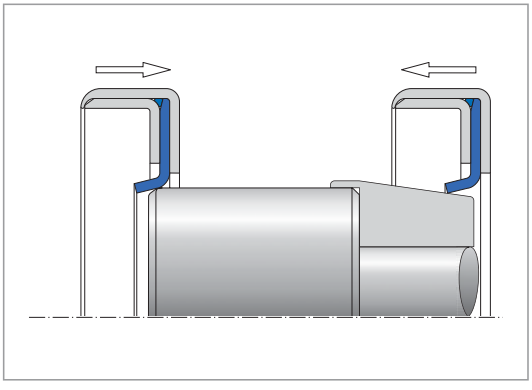


Fig. 51 Fitting a Simmerring with sealing lip made of PTFE

Fitting of Simmerrings with sealing lip made from PTFE

The same recommendations for Simmerrings with elastomer sealing lip according to DIN 3760 apply to fitting Simmerrings with PTFE sealing lip.

It is important that the PTFE sealing lip is not damaged, especially when assembling the front side in the direction of the fitting. The use of a pilot shaft with a chamfer angle of 10° ... 15° (→ Fig. 51 is recommended).

Replacement of Simmerrings

New seals must always be installed on the repair or overhaul of a unit. The sealing lip of the new ring must not be positioned over the old contact surface. Suitable measures for achieving this situation are:
Installation of spacer rings (→ Fig. 52) replacement of shaft sleeves or selection of different press-in depth in the bore.

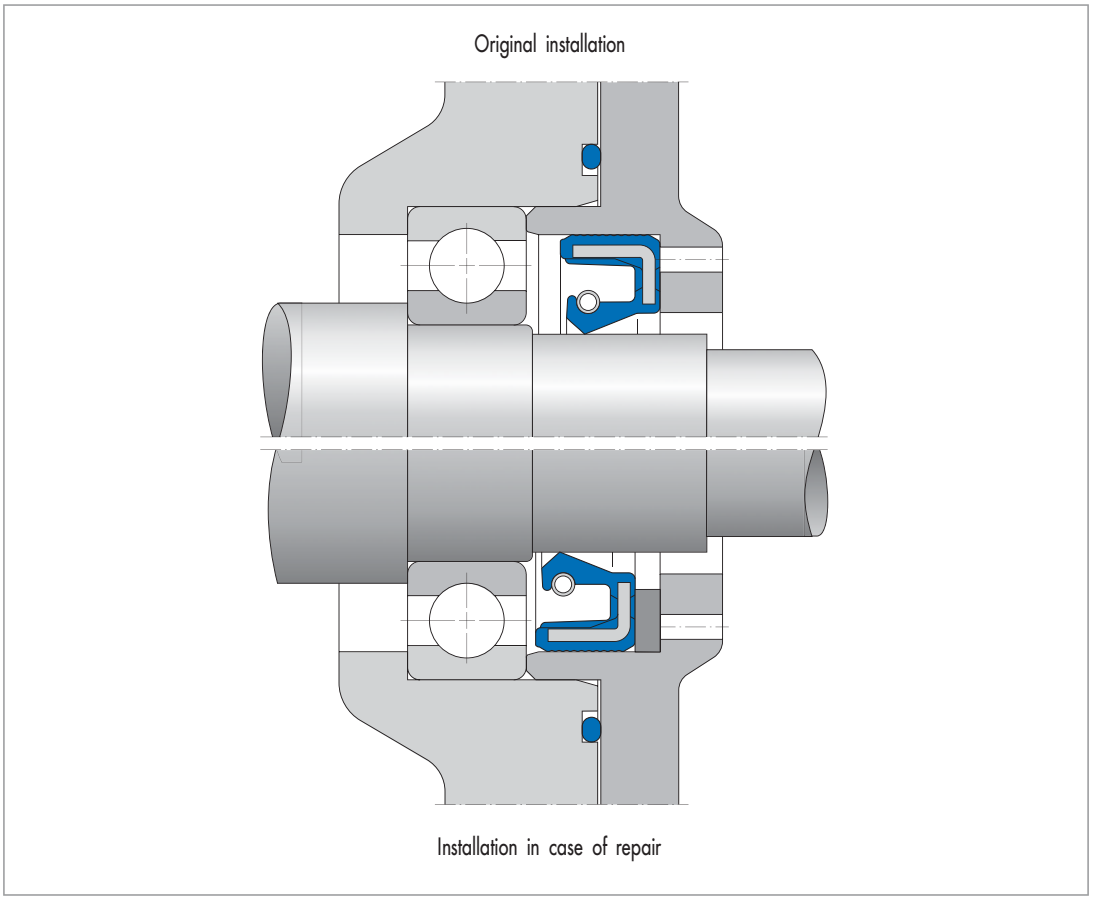


Fig. 52 Fitting on the repair and unit assembly

Fitting of Simmerring Combi Seal

Bore requirements for Standard, Simmerring Combi Seal SF5 and SF6

Tolerance:	ISO H8
Chamfer:	20° ± 5° x 1,5 mm
Roughness:	0,8 <R_a <3,2 µm
	6,3 <R_z <16 µm
	R_{max} <16 µm

Shaft requirements

- The requirements for Standard Simmerrings are valid
- Shaft hardening required.

Handling

- Proceed carefully and ensure that the sealing lips are not damaged during handling and when inserting the shaft (this applies especially to spline shafts).

Bore requirements for Simmerring Combi Seal SF8 and SF19

Tolerance:	ISO H8
Chamfer:	20° ± 5° x 1,5 mm
Roughness:	1,6 <R_a <6,3 µm
	10 <R_z <25 µm
	R_{max} <25 µm

Fitting procedure

- The same fitting instructions as for Standard Simmerrings are valid
- Use care when inserting the shaft so that the polyurethane lip does not bend
- Please enquire for removal instructions (air side first).

Replacement

- If a Simmerring Combi Seal is replaced, the shaft must be replaced/renewed to fulfil the roughness, hardness and tolerance requirements
- For Standard Simmerring Combi Seal SF5 and SF6, a sealant on the outside diameter is required.

Fitting of Simmerring Cassette Seal

Requirements for shaft and bore

Tolerance: ISO H8/h8
Bore chamfer: 20° ± 5° x 1 mm
Shaft chamfer: 20° ± 5° x 3 mm
Roughness: 0,8 <R_a <3,2 µm
10 <R_z <16 µm
R_{max} of the bore <16 µm
R_{max} of the shaft <25 µm

Handling

- The spring may not be removed
- Do not attempt to open the seal
- Store the seals stacked.

Types of fitting

- First step: Pressing into the housing bore,
  – Second step: Fitting of the shaft (→ Fig. 53, 54)
- First step: Fitting on the shaft
  – Second step: Pressing into the housing bore (this version must be agreed upon with Simrit)
- Parallel fitting (→ Fig. 55)
- Fitting for bearing stop
- For "soft unitized" designs:
  – First step: Fitting of the slip ring on the shaft
  – Second step: Fitting of the sealing ring in the housing bore. (this version must be agreed upon with Simrit).

Replacement

- No re-working or shaft replacement necessary
- For types that have a slip ring without elastomer layer on the inside diameter, a sealant on the inside diameter can be necessary.

Fitting Case A (with "bearing stop")

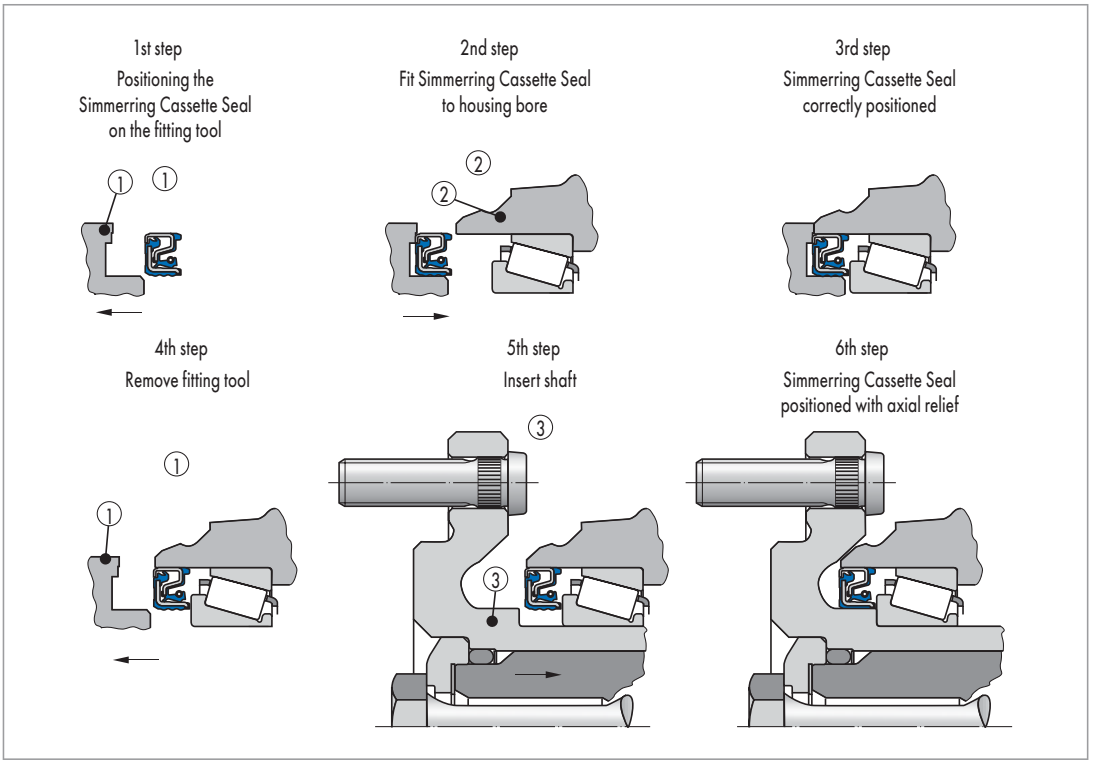


Fig. 53 Fitting of Simmerring Cassette Seal – Case A (with "bearing stop")

Fitting Case B (without "bearing stop")

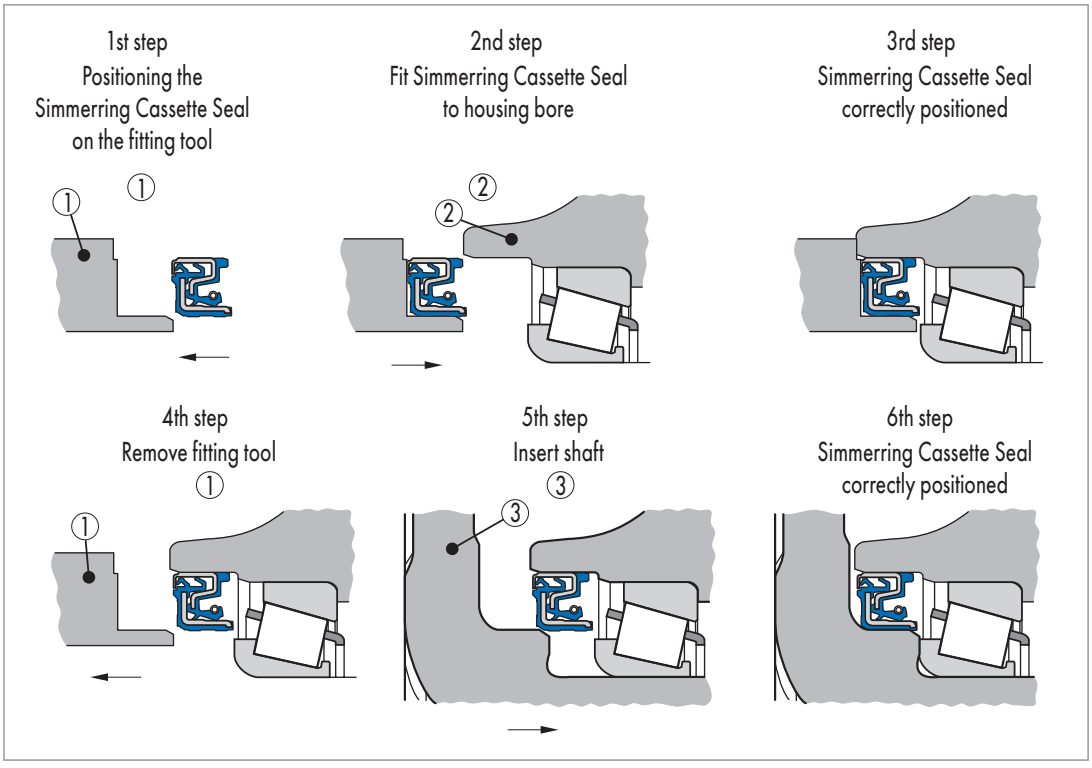


Fig. 54 Fitting of Simmerring Cassette Seal – Case B (without "bearing stop")

Fitting Case Fall C ("parallel")

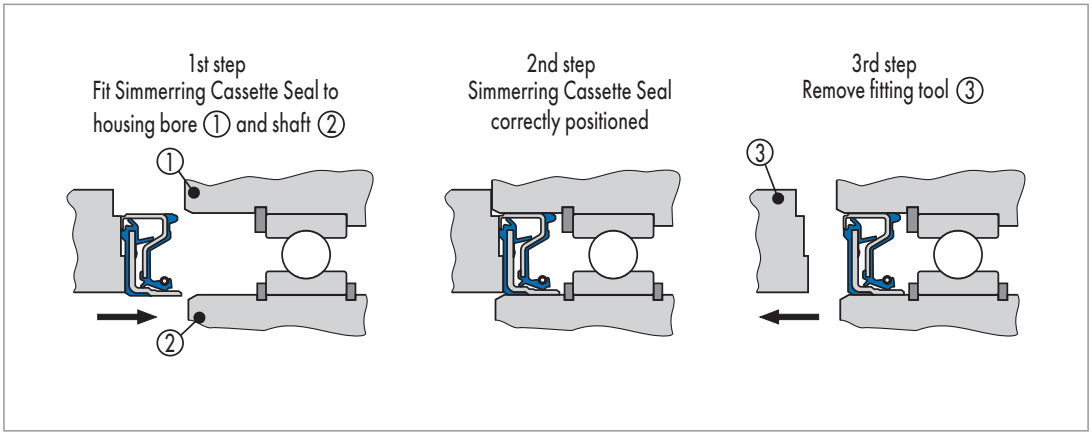


Fig. 55 Fitting of Simmerring Cassette Seal – Case C ("parallel")

Handling of Defects

(Sources of errors and recommended remedial actions) The compilation of possible problems during the fitting process and the handling of Simmerrings by the user is intended to aid our customers to recognise these problems and to take appropriate remedial action. Please make use of our technical advice.

Source of defect	Possible error	Consequences for sealing function	Cause of the deficiency	Remedial action
Receipt of goods				
Damage to packaging	Soiling of Simmerrings	Shortened service life to immediate leakage	Transportation packaging incorrect	Improve inspection of parts for soiling, visual and dimensional changes, handling; optimise packaging
Storage (larger quantities over a longer period)/ intermediate storage (consumable amounts, preparation for fitting)				
failure to observe storage conditions in accordance with DIN 7716	Installation of defective Simmerrings	Shortened service life	Failure to adhere to storage conditions	Observe storage conditions in accordance with DIN 7716
Soiling of Simmerrings	Fitting and use of soiled Simmerrings	No effect to immediate leakage as well as shortened service life	Dust, dirt	Clean Simmerring with suitable cleaning agent before installation (DIN 7716), original packaging only to be opened at assembly station
Damaged Simmerring	installation of damaged Simmerrings	Immediate leakage or shortened service life	Premature ageing due to improper storage	Original packaging only to be opened at assembly station
Transport (from intermediate storage to assembly station)				
Damage to packaging	Soiling of Simmerrings	Shortened service life to immediate leakage	Improper handling	Blocking and special authorisation of parts in damaged cartons. Inspection for soiling

Source of defect	Possible error	Consequences for sealing function	Cause of the deficiency	Remedial action
Intermediate storage at assembly station (consumable amount)				
Soiling of Simmerrings	Fitting of a soiled Simmerring	No effect to immediate leakage as well as shortened service life due to increased wear through dust, dirt	Dust, dirt from the surroundings	Clean Simmerring with suitable cleaning agent before installation (DIN 7716)
Open storage of pregreased Simmerrings	Contamination of grease	No effect to immediate leakage and shortened service life as a result of increased wear	Dust, dirt from the surroundings	Always cover packaged unit, protect from dust and dirt, only draw the quantity needed for immediate use
Unsuitable storage bin	Soiling, damage of the Simmerring, spring jumps off	No effect to immediate leakage as well as shortened service life as a result of increased wear	Collection of dirt and moisture in the storage bin, sharp edges in corners	Containers to be used are open underneath and easy to clean without sharp edges
Preparation of the Simmerring for fitting				
Improper opening or removal from packaging	Cuts or similar damage on outside diameter, spring jumps off, installation of Simmerring without spring	Immediate leakage to shortened service life, shortening of service life	Sharp-edged or unsuitable tools or methods for opening	Suitable packaging and tools, special care by fitter and special instruction of the fitter
Greasing of the Simmerring with contaminated oil or grease	Soiled Simmerring	Immediate leakage to shortened service life due to increased wear	Dirt, dust	Grease container to be protected from soiling and sealed when not in use
Unsuitable oil for wetting the shaft or the static part of the Simmerring	Chemical effect on seal material, squeaking (stick-slip)	Shortened service life due to increased wear	Unfavourable lubrication, no (customer complaint) contact oil with Simmerring material	Consult customer advisor about the oil type. In no circumstances use graphite grease
Too much grease between sealing edge and dust lip	Grease escapes on installation or during operation	"Apparent leakage"	incorrect grease dosage	Max. amount of grease: approx. 40% of grease chamber

Source of defect	Possible error	Consequences for sealing function	Cause of the deficiency	Remedial action
No grease or too little grease	Insufficient lubrication of dust lip, increased ingress of dirt, abraded rubber	Shortened service life due to excessively high temperatures in the dust lip area, or due to premature wear	Incorrect instruction or incorrect dosages	Position grease at dust lip
Greasing in wrong place	Insufficient lubrication of dust lip	Shortened service life due to excessively high temperatures in the dust lip area, or due to premature wear, apparent leakage	Incorrect instruction or incorrect dosage incorrect greasing equipment or incorrect greasing mandrel	Use pre-greased Simmerrings, change design of grease dosing equipment
Applying the grease	Soiling, chemical influences, damages	Immediate leakage to shortened service life	Dirt, dust, job tool, cleaning tool, damage or sharp edges on greasing mandrel	Maintain cleanliness, use suitable tooling. Information and training of assembly staff
Greasing of a Simmerring without grease chamber	Apparent leakage	None	Insufficient/incorrect information	Select other seal type
Fitting: Pilot shaft/fitting equipment/assembly station/assembly staff				
Incorrect design of pilot shaft	Damage to the seal, spring snaps out of position. Skewed Simmerring	No leakage to immediate leakage, shortened service life, none to shortened service life due to uneven wear	Fit: Simmerring shaft housing pilot shaft. fitting equipment incorrect	Consult Freudenberg, observe the proposals in DIN 3761, Simrit catalog recommendation
Soiled pilot shaft	Soiling of the Simmerring to damage	Early failures or shortened service life	Dust and dirt at the workstation	Pay attention to cleanliness, regular cleaning of pilot shaft
Damaged pilot shaft	Damaged Simmerring	Immediate leakage to shortened service life	pilot shaft incorrect	Regular inspection
Wrong pilot shaft	Damaged Simmerring	Immediate leakage to shortened service life	Confusion/no allocation: Simmerring pilot shaft	Correct fitting instruction

Source of defect	Possible defect	Consequences for sealing function	Cause of the deficiency	Remedial action
Maximum assembly speed too high	Spring back and/or inclined positioning of the Simmerring, damage to outside diameter, spring snaps out of position	Uneven wear, shortened service life, static leakage	Assembly speed/hammer assembly	Observe recommended max. speed
Press-in force too high when fitting to stop	Simmerring damage (bending of metal part)	Immediate leakage to shortened service life	Press-in force too high/fitting to stop	Reduce press-in force/ force limiting/end stop on pilot shaft/do not press in to stop: limit path
Press-in distance too short/too long	Sealing lip and dust lip running at wrong position	No effect to immediate failures/early failures	Pilot shaft or fitting equipment incorrect	Check Simmerring for correct seating, then adjust press-in distance
Hammer assembly	Simmerring and housing damage/spring snaps out, inclined positioning	Immediate failure to shortened service life	Incorrect fitting	Hammer assembly should not be used in series production/select stable seal design for hammer assembly in the event of repairs
Assembly station is dirty (cigarette ash)/sharp edges/metal shavings	Seal or fitting equipment is dirty or damaged	Immediate failures to shortened service life	Dirt, sharp edges	Keep assembly station clean and damage-free. qualification/clear and simple instructions: drawings/ familiarisation with sealing component

Source of defect	Possible defect	Consequences for sealing function	Cause of deficiency	Remedial action
Simmerring contact surface (shaft) at assembly station				
Scratched shaft	Damage to sealing lip when introducing shaft	Immediate failures to shortened service life	Transportation damage/ defective shaft protection/improper shaft storage and handling	Inspect shaft prior to installation/observe DIN 3761/use suitable protective sleeves and transportation containers/ shafts not stored or transported as bulk cargo
Soiled shaft	Damage and soiling of sealing lip when introducing shaft	Immediate failures to shortened service life	No shaft protection/ unsuitable transportation containers/messy handling	Clean shaft before installation/use the right protective covers and right transportation containers
Corroded shaft	Damage and soiling of sealing lip when introducing shaft	Immediate failures to shortened service life	No corrosion protection or inadequate corrosion protection/humidity level too high/storage too long/unsuitable transportation container or defective covering	Inspect shafts for corrosion before assembly/do not use corroded shafts in any circumstances/use suitable anticorrosive agent/re-work corroded shafts
anticorrosive agent	Chemical reaction with Simmerring material or with oil to be sealed	Shortened service life	Unsuitable materials combination or anticorrosive agent	Consult Simrit/ anticorrosive agent to be tested in laboratory for compatibility with Simmerring material
Fitting of shaft, poor sliding on shaft of Simmerring sealing lip or dust lip	spring snaps out of position/everting of the dust lip	Shortened service life	Inadequate lubrication/chamfer on the shaft unsatisfactory/DL overlap too big/wrong design for Simmerring	Ensure adequate lubrication of Simmerring and shaft/observe Simrit recommendation for chamfer of shaft/match Simmerring design to fitting as well as the housing
Concealed fitting: long shafts/heavy shafts/tilting of the shaft	Spring snaps out of position/everting of the sealing lip or dust lip/inclined positioning or damage to Simmerring	Shortened service life to immediate failure	Inadequate guidance of shaft	Match Simmerring design with the fitting as well as the housing/choose a suitable sealing concept

Source of defect	Possible defect	Consequences for sealing function	Cause of deficiency	Remedial action
Housing bore				
Split housing	Combination with incorrect design for Simmerring static part	Static leakage	Unsuitable design for static part	One-piece housing/chose external rubber covering or partial rubber covering/sealing lacquer or adhesive are not suitable
Cast-metal housing	Pores/blow-holes/cast sand	Static leakage/increased wear to shortened service life due to casting sand	Casting quality not sufficient/insufficient cleaning	Pores and blow-holes maximum one third of width of static part/ improve cleaning
Diecast housing (Al, Mg)	Press fit insufficient/inclined position/springing back or wandering out of the Simmerring (with external rubber covering)	Instable assembly/shortened service life	Housing bore roughness too fine/unsuitable design for static part	R_z >10 µm and < 25 µm/select external rubber covering
Diecast housing (Al, Mg)	Electro-chemical corrosion (with metal press fit)	Static leakage/damage to metal part or housing	Stress potential (equilibrium rest potential)	Suitable materials combination/select external rubber covering
Diecast housing (Al, Mg)	Damage to the bore with metal press fit	Static leakage/shortened service life/bore scratched during repair (incorrect)	Unsuitable design for static part	Choose external rubber covering
Plastic housing	Damage to bore with metal press fit/effect of thermal expansion or surface too smooth	Static leakage/shortened service life	Unsuitable materials combination or design for static part	Choose external rubber covering
Insertion chamfer in the housing in combination with a rubberised covering on the Simmerring	Shearing off of rubber at external rubber covering/inclined position/springing back of the Simmerring	Static leakage	Burr formation on the transition from chamfer to bore/chamfer to large or too small/Simmerring is not round	Ensure freedom from burrs/observe the recommendation in DIN 3761 in the chamfer
Housing bore	Shearing off of rubber/ Simmerring cannot be fitted	Static leakage	Chamfer too big	Choose chamfer = 15–20°

Source of defect	Possible defect	Consequences for sealing function	Cause of deficiency	Remedial action
Handling of units with seal already installed on the production line				
Seal is open or unprotected	Soiling/hardening of elastomeric material	Shortened service life to immediate leakage	Dirt and dust in the surroundings, UV light/ ozone	Suitable covering of seal for protection against damage and for protection against detrimental environmental effects such as ozone or UV light/choose suitable sealing system that provides self-protection/careful fitting/detailed instructions
Seal is open or unprotected	Damage	Shortened service life to immediate leakage	Mechanical effects of workpieces, objects or works processes on the seal/insufficient securing of loose parts during transport	Suitable covering of seal for protection against damage and for protection against detrimental environmental effects such as ozone or UV light/choose suitable sealing system that provides self-protection/careful fitting/detailed instructions
Corrosion of shaft or housing	Corrosion on the sealing lip contact surface	Shortened service life	High atmospheric humidity/insufficient corrosion protection	Corrosion protection/ cover seal contact area/ limit humidity
Transport	Spring saps out of position	Shortened service life	Unsuitable transportation containers	Suitable transportation containers/inspect spring seating prior to fitting
Fitting	Damage to sealing lip	Shortened service life to immediate leakage	Key-way splines	Use mounting sleeve

Products

Pre-Selection Simmerrings

	DIN	A	AS	A	AS	AS		B	BS
	Type	BA...+	BA...SL+	BAUM X7+	BAUM SLX7+	BABSL NBR	BABSL FKM	B1...	B1...SL
									
Special requirements	High housing roughness	○	○	○	○	○	○		
	High thermal expansion of the housing	○	○	○	○	○	○		
	Usage in split housings	○	○	○	○	○	○		
	Tightness against pressure	○	○	○	○	○	○		
	Very secure Simmerring press fit	○	○	○	○	○	○	●	●
	High Simmerring rigidity, rough fitting								
Media to be sealed and operating conditons	Mineral oils < +100 °C	●	●	●	●	○	○	○	○
	Synthetic oils < +80 °C	●	●	○	○	○	○	○	○
	Mineral oils > +100 °C			●	●		●		
	Synthetic oils > +80 °C			●	●		●		
	Greases	●	●	●	●	○	○	○	○
	Aggressive media								
	Circumferential speed < approx. 10 m/s (→ Diagram 1, page 80)	●	●	○	○	○	○	○	○
	Circumferential speed > approx. 10 m/s (→ Diagram 1, page 80)			●	●				
	Operation pressure in MPa (→ type information)	0,02 ... 0,05	0,02 ... 0,05	0,05	0,05	→ Diagr. 2 p. 80	→ Diagr. 2 p. 80	0,02 ... 0,05	0,02 ... 0,05
	High operating pressure	Please enquire about special designs							
Ingress of dirt	Normal ingress of dirt from the outside								
	Moderate to medium ingress of dirt from the outside		●		●	●	●		●
	Large ingress of dirt from the outside								
	Foreign bodies on the inside								

○ = possible usage
● = preferred usage
\+ = preferred Design
B1 = one-piece metal housing
BAB = operating pressure

SL = dust lip (v = max. 8 m/s)
X7 = grooved outer casing
FUD = sealing lip produced in the tool
UM = sealing lip machined on the front face (predominantly for FKM)
U ... X2 = sealing lip machined on the front face (predominantly for NBR)

	DIN	C	CS						
	Type	B2...	B2...SL	B2PT	BAOF	B10F	BADUO	BAHD	ESS
									
Special requirements	High housing roughness				○		○	○	○
	High thermal expansion of the housing				○		○	○	○
	Usage in split housings				○		○	○	○
	Tightness against pressure				○		○	●	
	Very secure Simmerring press fit	●	●	●		●	○	○	○
	High Simmerring rigidity, rough fitting	●	●	○					
Media to be sealed and operating conditons	Mineral oils < +100 °C	○	○	○	○	○	○	●	○
	Synthetic oils < +80 °C	○	○	○	○	○	○	●	○
	Mineral oils > +100 °C						●	○	●
	Synthetic oils > +80 °C						●	○	●
	Greases			○	●	●	○	○	○
	Aggressive media			●					
	Circumferential speed < approx. 10 m/s (→ Diagram 1, page 18)	○	○	○	... 6 m/s	... 6 m/s	... 5 m/s	... 2 m/s	○
	Circumferential speed > approx. 10 m/s (→ Diagram 1, page 80)			○					●
	Operation pressure in MPa (→ type information)	0,02 ... 0,05	0,02 ... 0,05	... 1	0,02 ... 0,05	0,02 ... 0,05	0,02	15	0,02
	High operating pressure	Please enquire						●	
Ingress of dirt	Normal ingress of dirt from the outside						○		○
	Moderate to medium ingress of dirt from the outside		●		○	○	○		●
	Large ingress of dirt from the outside						●		
	Foreign bodies on the inside								

○ = possible usage
● = preferred usage
B2 = metal housing with metal insert

OF = without spring
PT = PTFE sealing lip

DIN										
	Type	HLPS	PPS	PTS	MSS 1	MSS 1+	MSS 7	MSC 01	MSC 02	GA, GSA
										
Special requirements	High housing roughness	○	○	○	○	○	○			○
	High thermal expansion of the housing	○	○	○	○	○	○			○
	Usage in split housings	○	○	○	○	○	○			○
	Tightness against pressure	●	●	○	○	○	○			○
	Very secure Simmerring press fit	○	○	●		○	○			○
	High Simmerring rigidity, rough fitting									
Media to be sealed and operating conditons	Mineral oils < +100 °C	●	●	○	●	○	○			○
	Synthetic oils < +80 °C	●	●	○	●	○	○			○
	Mineral oils > +100 °C	○	○	●	●					
	Synthetic oils > +80 °C	○	○	●	●					
	Greases	○	○			○	○	○	●	○
	Aggressive media			○						
	Circumferential speed < approx. 10 m/s (→ Diagram 1, page 80)	... 2 m/s	●	○	... 6 m/s	○	○	... 6 m/s		
	Circumferential speed > approx. 10 m/s (→ Diagram 1, page 80)		○	●						
	Operation pressure in MPa (→ type information)	22	1,5	1,0	0,05	0,05	0,05			
	High operating pressure	●								
Ingress of dirt	Normal ingress of dirt from the outside		○	○						
	Moderate to medium ingress of dirt from the outside		●	●		○	○	●	●	
	Large ingress of dirt from the outside					●	●	○	○	
	Foreign bodies on the inside				●					

○ = possible usage
● = preferred usage

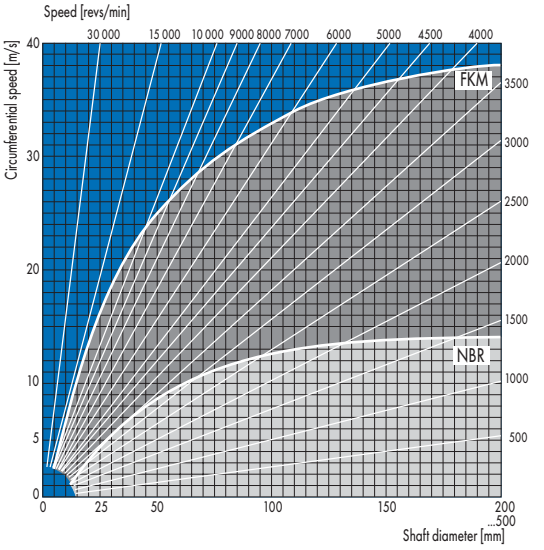
DIN										
	Type	Cassette Seal Typ 1	Cassette Seal Typ 2	Cassette Seal Typ 3	Cassette Seal HS	Combi Seal	Combi Seal SF5	Combi Seal SF6	Combi Seal SF8	Combi Seal SF19
										
Special requirements	High housing roughness	○	○	○	○				○	○
	High thermal expansion of the housing	○	○	○	○					
	Usage in split housings	○	○	○	○					
	Tightness against pressure*	○	○	○		○	○	○	○	○
	Very secure Simmerring press fit	○	○	○	○	●	●	●	●	●
	High Simmerring rigidity, rough fitting	○	○	○						
Media to be sealed and operating conditons	Mineral oils < +100 °C	●	●	●	●	●	●	●	●	●
	Synthetic oils < +80 °C	●	●	●	●	●	●	●	●	●
	Mineral oils > +100 °C	○	○	○	●					
	Synthetic oils > +80 °C	○	○	○	●	○	○	○	○	○
	Greases	●	●	●	○	●	●	●	●	●
	Aggressive media**									
	Special operating conditons									
	Circumferential speed < approx. 10 m/s*** (→ Diagram 1, page 80)	9 m/s	7 m/s	6 m/s	○	5 m/s	○	○	○	○
	Circumferential speed > approx. 10 m/s*** (→ Diagram 1, page 80)				12 m/s		10 m/s	10 m/s	10 m/s	10 m/s
	Operation pressure in MPa (→ type information)	0,05	0,05	0,05	0,05	0,02	0,02	0,02	0,02	0,02
	High operating pressure									
Ingress of dirt	Normal ingress of dirt from the outside[1]	●	○	○	●	●	●			○
	Moderate to medium ingress of dirt from the outside[1]		●	○	○	○	○	●	●	○
	Large ingress of dirt from the outside[1]			●					○	●
	Foreign bodies on the inside									

○ = possible usage
● = preferred usage

* = special design on enquiry (please contact LC)
** = specific material mixture necassary
*** = depending on the material mixture

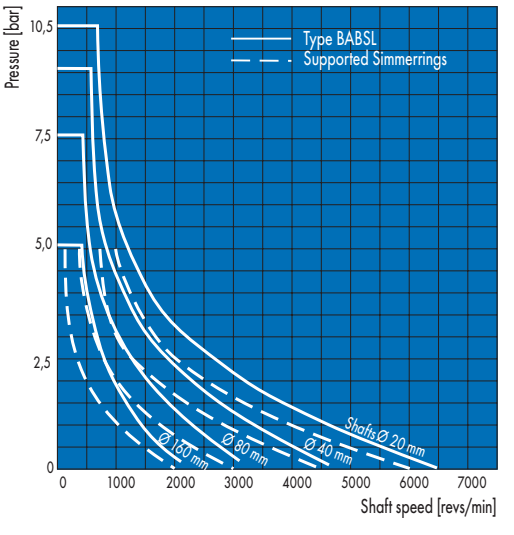
[1] In comparison to normal Simmerrings (→ S. 76/77), the definition "normal dirt ingress", "moderate/medium dirt ingress" and "massive dirt ingress" is to be rated higher for Simmerringe Cassette Seal and Combi Seal since they have been specifically developed for extremely dirty applications.

Diagram 1



Permissible circumferential speed for Simmerrings made of the material NBR (72 NBR 902) and FKM (75 FKM 585) when sealing engine oil SAE 20. Usage of Simmerring with SL (dust lip): v = max. 8 m/s.

Diagram 2

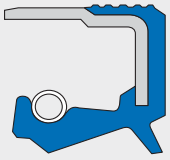
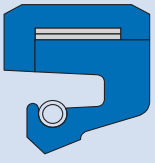
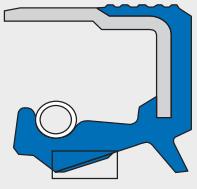
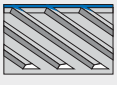
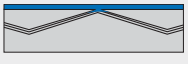
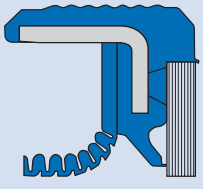


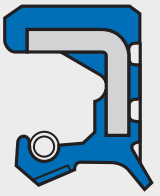
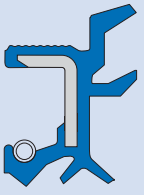
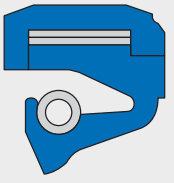
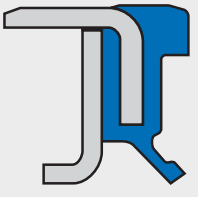
Permissible pressure in the unit for Simmerrings (type BABSL), as well as for Simmerrings with back-up rings.

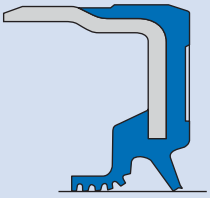
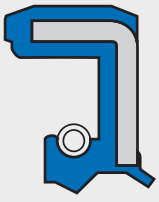
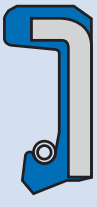
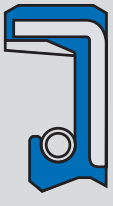
Types for special requirements

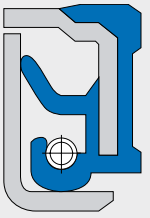
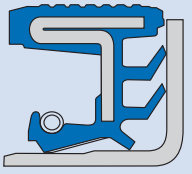
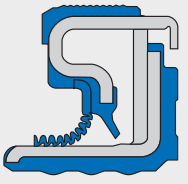
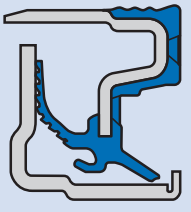
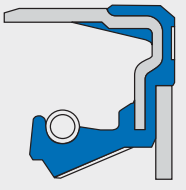
The seal should be defined in consultation with us in case of high or special loads; trials for checking the reliability are often indispensable.

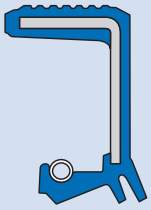
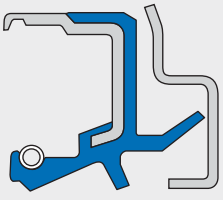
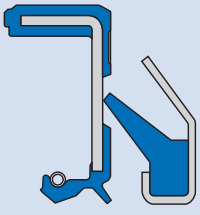
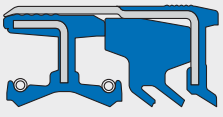
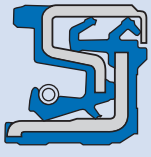
For specific operating conditions and applications, a broad range of special types not listed in the catalogue is available on enquiry.

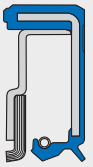
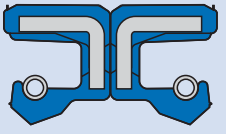
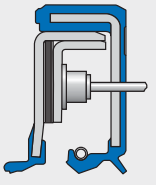
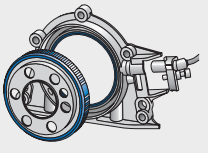
Type	Special aspects	Special properties	Examples of use
Special static part design			
 **BD**	Static part design: partially metal, partially elastomer	Secure and tight seating in the housing	Series design with wide application range
 **Radiamatic RS 85**	Static part: NBR 90 Sh A Metal part: steel band insert	Secure seating in the housing for large dimensions	Mills, cement mills
Special sealing lip design			
 **BDRK/BDLK**	 Uni-directional lead: Left-hand lead LK Right-hand lead RK  Bi-directional lead: Left-hand lead LK Right-hand lead RK	High sealing properties for high circumferential speeds and temperatures. Uni-directional lead: for one direction of rotation of the shaft Bi-directional lead: for both directions of rotation of the shaft	Engines, transmissions, axle drives
 **BAPTSLV**	PTFE sealing lip with lead Dust lip made of non-wowen material	best sealing properties for very high circumferential speeds, temperatures and high performance oils	Engines, crankshaft seals

Type	Special aspects	Special properties	Examples of use
 **AT, AT SL**	PTFE coated sealing lip: Coating on the air side of the sealing lip	For use with poor lubrication and high circumferential speeds	Industrial drives
 **BAE SL X6**	Special design of the sealing lip; two dust lips against washing lye; additional static dust lips	Use for the separation of water/ washing lye and grease-lubricated bearings	Washing machines
Special sealing lip design			
 **Radiamatic RHS 51**	Static parts: 90 FKM Sealing lip: 80 FKM Metal part: steel band insert	Special construction of the sealing lip; two intertwined springs made of Nitrosteel for even distribution of the radial force around the circumference; for high circumferential speeds and eccentricities	Fast running mill trains
 **Special design**	Material: 75 FKM 595	Special design of the entire construction; for the integration in roller bearings	Paper industry, rolling mills, large gearboxes
 **PTS**	Sealing lip: newly developed PTFE Static part: FKM Metal part: DIN EN 10088	Very strong tightness compared to other PTFE rings; Sealing lip with partial spiral lead assures a secure and tight seating in the housing	Use for special liquids, with poor lubrication and dry running; in 2-stroke engines, compressors, in the foodstuffs industry, in the chemicals industry

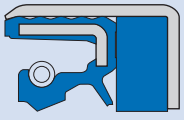
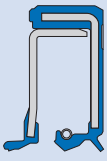
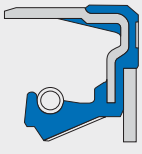
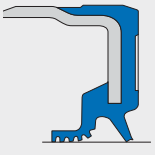
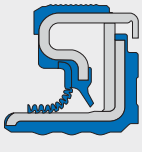
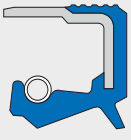
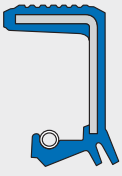
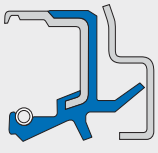
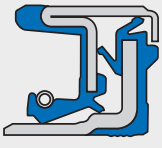
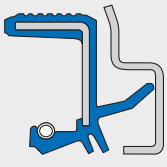
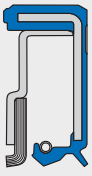
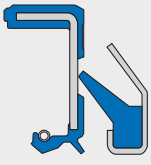
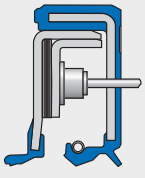
Type	Special aspects	Special properties	Examples of use
 **ESS (Energy Saving Seal)**	Springless, profiled sealing lip	Sealing lip with return pumping helix, very low friction	Engines, transmissions
Types for special pressure loads			
 **PPS (Premium Pressure Seal)**	Profile optimisation of the of the pressure loaded sealing lip	Pressure load as for type BAB SL; high reliability; longer service life	Hydro-pumps, hydro-motors
 **Type BAHD SN**	Sealing texture on the air side of the sealing lip; short, very stable sealing lip	Usage with high pressures or pressure pulsations and low speeds Material hardness: 90 Sh A	High pressure pumps with low rotational speeds
Types for special pressure loads			
 **ATD, ATD SL**	Short, stable sealing lip; PTFE coating on the air side of the sealing lip	Operating pressure; low friction Usage also with poor lubrication	High stress
 **Type HLPS (High Low Pressure Seal)**	Springless lip; Integrated back-up ring	High reliability, specifically for very high pressures	Hydro-pumps subject to high stress

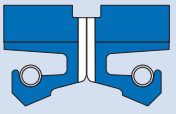
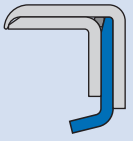
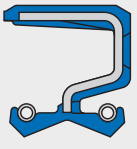
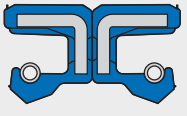
Type	Special aspects	Special properties	Examples of use
Cassette Seals for special requirements			
 **Bearing Unit Cassette Seal**	Special type cassette; material FKM; slip ring in Nitrosteel	Integrated type in roller bearings for high ingress of dirt	Grease-lubricated wheel hubs
 **Soft Unitized Cassette Seal**	Special type cassette double axial dirt lip; material FKM or NBR	Type for large dirt ingress; the slip ring can be installed separately from the RWDR during the fitting	Wheel hubs and pinions in axles for agricultural and construction machinery and commercial vehicles
 **Cassette Seal PTFE**	Special type cassette with PTFE sealing lip with lead; dust lip made from FKM or non-wowen material	Good protection against dust or dirt ingress	Crankshaft seals in diesel engines
 **Cassette Seal Casco**	Special type cassette with axial sealing lip and double lead; material FKM; dust lip in FKM or non-wowen material	Developed for long service life; very low friction and very good resistance with high-load resistant oils; secure handling and easy fitting	Crankshaft seals in diesel engines
Performance in relation to dirt from the outside			
 **BDSVV**	SLV dust lip made of non-wowen material	Non-wowen material prevents the ingress of dirt underneath the sealing lip, but is permeable to air; prevents the formation of underpressure behind the sealing lip with lead rings	Engines

Type	Special aspects	Special properties	Examples of use
 **BA SL X6**	Two dust lips	Against moderate dirt ingress Note: preferably grease filling between the sealing lips up to approx. 40 %	Gearboxes Axles: pinion seal
 **BA SL SF**	With axial dust lip	Against moderate dirt ingress; axial dust lip in conjunction with a thrower ring (Labyrinth)	Transmissions Axles: pinion seal
 **Combination of BA SL und MSC**	Combination of BA SL and MSC	Against massive ingress of dirt; MSC turns with the shaft Pay attention to elastomer-free surface on the back of the BA SL in the contact area of the MSC lip	Drives in transmissions
 **Combi SF**	Combi Seal with additional dirt deflector made from hydrolysis-resistant polyurethane	Use with very high dirt and mud ingress; usage with additional axial shaft movements possible	Axles in particular propeller shafts in driven, steerable axles
 **Cassette Seal Typ 3**	Cassette Seal with labyrinth structure Specific processing of the slip ring surface on which the sealing lip functions Different material combinations in Viton or NBR possible	Use for extreme onset of soiling and for general applications with soiling Secure fitting and handling due to the integrated contact area	Wheel hubs for agricultural and construction machinery Rotary harrows Disc harrows Various units

Type	Special aspects	Special properties	Examples of use
Special types for soiled media to be sealed			
 **MSS 2 (Modular Sealing Solution)**	Inner seal made from non-wowen material	Non-wowen material sealing disc prevents contact of the sealing edge with particles in the contaminated media	Drives in industrial gearboxes
Types for separation of two media			
 **BA DUO**	Two sealing lips	For the separation of two media; narrow design; can also be used for moderate dirt ingress from the outside	Circumferential speed <5 m/sec Grease filling between the sealing lips max. 40%
 **Two standard types e.g. BAU X2, BAUM**	Two standard types e.g. BAU X2, BAUM with back to back installation	For the separation of two media; narrow design; can also be used for moderate dirt ingress from the outside	If possible, intermediate ring with boreholes between the seals for drainage
Types with additional functions			
 **MSS 1 + CM**	(Condition Monitoring)	Integrated leakage detection through absorbent non-wowen material and optical sensor; usage for poorly accessible seals, where early detection of the leakage is necessary	Transmissions in escalators, wind power plants
 **Seal integrated into the roller bearing with signal transmitter**	Seal integrated into the roller bearing with signal transmitter	Magnetised elastomer layer for speed detection	Wheel hubs for speed detection
 **IWDS**	IWDS (integrated shaft seal ring with sensor)	Seal ring integrated in the drive flange, combined with magnetised encoder part for the detection of the rotational speed and angle of rotation	Engines

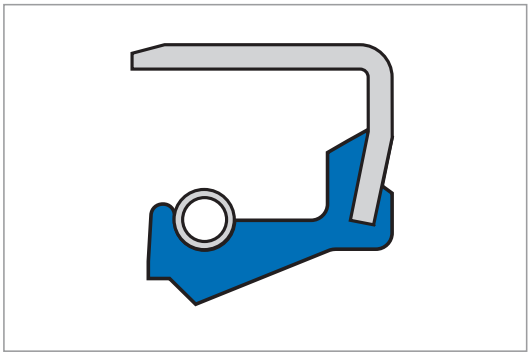
Applications in general industry

Application range	Industrial engines	Drive train in agricultural and construction machinery		Industrial gearboxes
Location of seal	Crankshaft Camshaft	Transmissions Input Output Control shaft	Axle Pinions Wheel hub Propeller shaft	Geared motor Spur wheel gearbox Worm gear gearbox
Standard types	Small engines; 2-stroke engines: in NBR and FKM  **BABSL**	Control shafts: NBR Input: FKM  **BAUM (SL)**	 **Cassette Seal**  **Combi Seal**	NBR, FKM  **BAUM X7**  **MSS 1**
Special types on enquiry	FKM/Non-wowen material  **BDSVV** PTFE/Non-wowen material Sealing lip with lead  **ESS** **(Energy Saving Seal)**  **Cassette Seal PTFE**  **Cassette Seal Casco**	Input/Output  **BD**  **BA SL X6** Axial dust lip  **BA SL SF**	Pinions  **Cassette HS** Axial dust lip  **BA SL**	Drive  **MSS 2**  **BAUSLX2 + MSC**  **MSS 1 + CM**

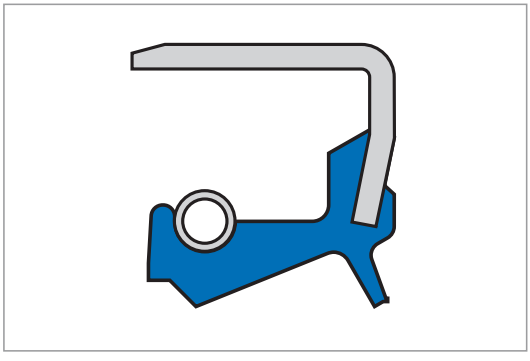
Application range	Hydro-units	washing machines	Heavy machinery manufacture	General mechanical and household appliance manufacturing
Location of seal	Pumps Transmissions	Household appliances Industrial machines	Steel and mill works Ship shafts Cement mills etc.	
Standard types	BABSL in NBR and FKM 	in part in NBR	NBR/FKM  	NBR/FKM Chemistry: PTFE  
Special types on enquiry	 **PTS**  **BAHD** **ATD** Special materials  **HLPS**	**BAESLSFX 6** Special NBR	Ship shafts Rolling mills Large bearings  **Special type**  **Radiamatic RHS 51**	 **BDPT** Separation two media  **BA DUO**  **two BAUX 2**

Simmerring B1.../SL to DIN 3761 B/BS

Simmerring B1FUD, B1FUDSL, B1U, B1USL, B1, B1SL



Simmerring B1FUD



Simmerring B1FUDSL

Product description

- Outer casing: metal, machined
- Spring-loaded sealing lip
- Additional dust lip (B1...SL)
- Sealing lip profile, sealing lip machined on the front face
- Sealing lip profile, finished sealing lip (B1FUD/B1FUDSL).

Product advantages

- Broad range of applications in every sector of industry
- Metal housing for especially firm and precise seating in the bore
  (Note: limited static sealing on the outer casing for low viscosity and gaseous media)
- Additional dust lip as additional seal against moderate to medium dust and dirt ingress from outside (B1FUDSL).
  (Note: can lead to temperature increase from frictional heat).

Application

- Industrial gearboxes
- Axles (when subject to moderate dirt)
- Power tools.

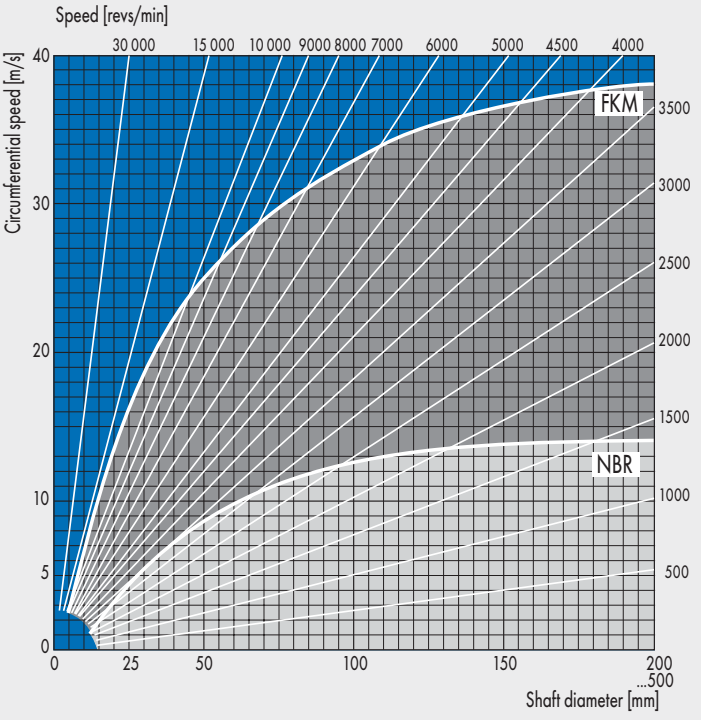
Material

Acrylonitrile-butadiene rubber

Code	72 NBR 902
Colour	Blue
Hardness	72 Shore A
Metal housing	Unalloyed steel DIN EN 10027-1
Spring	Spring steel DIN EN 10270-1

75 FKM 585 and 75 FKM 595 on enquiry.

Operating conditions

Media	Mineral oils, synthetic oils*, greases
T	–40 ... +100 °C short term up to... +120 °C
v	 Permissible circumferential speed for Simmerrings made from the materials NBR (72 NBR 902) and FKM (75 FKM 585) for the sealing of motor oil SAE 20. Use Simmerring® with SL (dust lip): v = max. 8 m/s.
p	up to 0,05 MPa/0,5 bar up to 0,02 MPa/0,2 bar (B1FUD/B1FUDSL)

* With synthetic oils (polyalkylene glycols/polyalphaolefins) it is to be noted that the maximum operating temperature of 80 °C must not be exceeded.

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

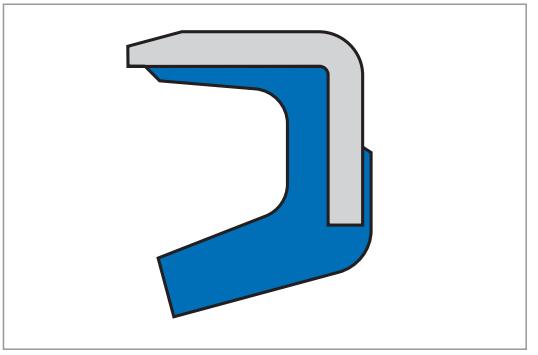
Tolerance	ISO H8
Roughness metal outer surface OD	R_z = 6,3 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

Simmerring B1...	5 ... 500 mm
Simmerring B1...SL	12 ... 290 mm

Simmerring B1OF



Simmerring B1OF

Product description

- Outer casing: metal housing
- Sealing lip without spring.

Product advantages

- Simple sealing component for secondary applications
- As a seal against grease
- As additional seal against moderate to medium dust and dirt ingress.

Application

- Power tools
- Sealing of pivot bearings
- Sealing of control elements.

Material

Acrylonitrile-butadiene rubber

Code	72 NBR 902
Colour	Blue
Hardness	72 Shore A
Metal insert	Unalloyed steel DIN 1624

Operating conditions

Media	Greases
T	–40 ... +100 °C
v	to 6 m/s
p	–

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

Tolerance	ISO H8
Roughness	R_z = 6,3 ... 16 µm

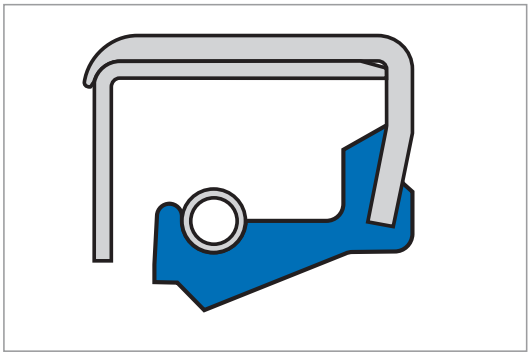
Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø D_1

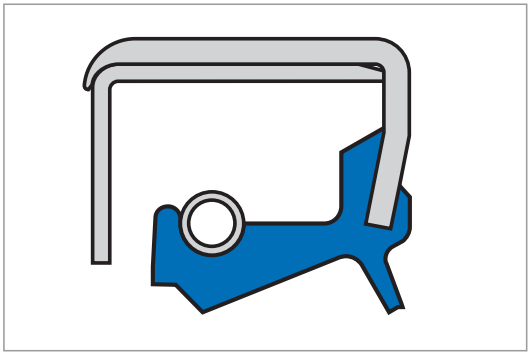
Simmerring B1OF	8 ... 65 mm

Simmerring B2.../SL to DIN 3761 C/CS

Simmerring B2FUD, B2FUDSL, B2U, B2USL, B2, B2SL



Simmerring B2FUD



Simmerring B2FUDSL

Product advantages

- Broad range of applications in every sector of industry
- For larger dimensions and with rough fitting in the locating bore (Note: limited static sealing on the outer casing for low viscosity and gaseous media)
- Additional dust lip as additional seal against moderate to medium dust and dirt ingress (B2...SL) (Note: can lead to temperature increase from frictional heat).

Application

- Heavy industry (cranes, calendar roll gearboxes).

Material

Acrylonitrile-butadiene rubber

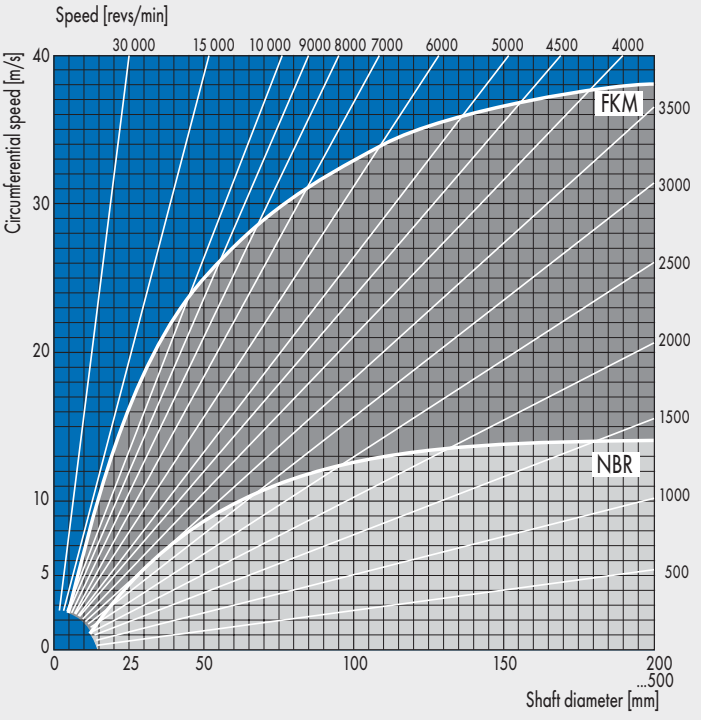
Code	72 NBR 902
Colour	Blue
Hardness	72 Shore A
Metal housing	Unalloyed steel DIN 1624
Metal insert	Unalloyed steel DIN 1624
Spring	Spring steel DIN 17223

75 FKM 585 and 75 FKM 595 on enquiry.

Product description

- Outer casing: metal, machined
- Metal insert
- Spring-loaded sealing lip
- Additional dust lip (B2...SL)
- Sealing lip profile, sealing lip machined on the front face
- Sealing lip profile, finished sealing lip (B2FUD/B2FUDSL).

Operating conditions

Media	Mineral oils, synthetic oils*, greases
T	–40 ... +100 °C short term up to... +120 °C
v	 Permissible circumferential speed for Simmerrings made from the materials NBR (72 NBR 902) and FKM (75 FKM 585) for the sealing of motor oil SAE 20. Use Simmerring with SL (dust lip): v = max. 8 m/s.
p	up to 0,05 MPa/0,5 bar
	up to 0,02 MPa/0,2 bar (B2FUD/B2FUDSL)

* With synthetic oils (polyalkylene glycols/polyalphaolefins) it is to be noted that the maximum operating temperature of 80 °C must not be exceeded.

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

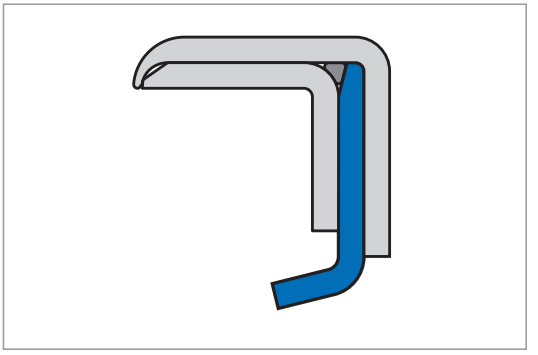
Tolerance	ISO H8
Roughness, metal outer surface OD	R_z = 6,3 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

Simmerring B2...	10 ... 710 mm
Simmerring B2...SL	25 ... 185 mm

Simmerring B2PT



Simmerring B2PT

Product description

- Outer casing: metal housing
- Sealing lip made of PTFE.

Product advantages

- Special range of applications in general mechanical engineering and in the chemical industry
- High temperature resistance
- For dry running and insufficient lubrication
- High chemical resistance
- In case of requirements for stick/slip-free behaviour (Note: for limited requirements on dynamic sealing behaviour! Static sealing at the outer casing limited with low viscosity and gaseous media).

Application

- Rotary joints
- Centrifuges
- Pumps
- Mixers.

Material

Sealing lip	PTFE 10/F56101 carbon-filled, exactly centred and pre-stretched
Metal housing	Stainless steel as per material No. 1.4571
O-ring	Fluoro elastomer

Operating conditions

Media	Mineral oils, synthetic oils, greases, water, acids, alkalis, solvents, gases
T	–80 ... +200 °C
v	to 30 m/s
p	to 1 MPa/10 bar

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,4 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

Tolerance	ISO H8
Roughness	R_z = 6,3 ... 16 µm

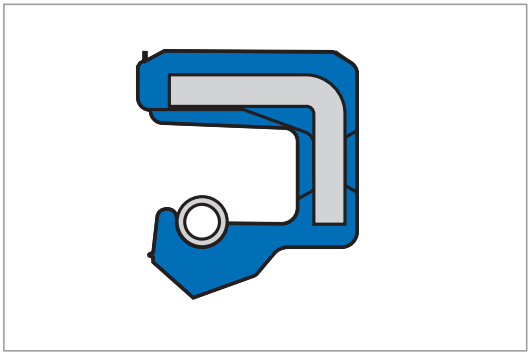
Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

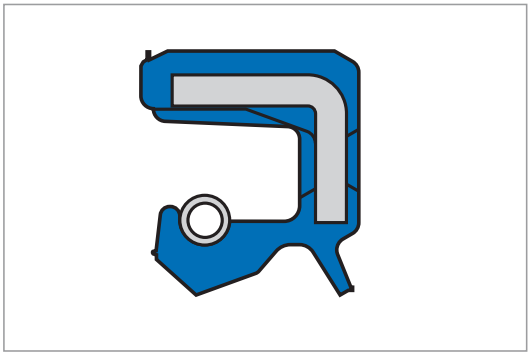
Simmerring B2PT	10 ... 125 mm

Simmerring BA.../SL to DIN 3760 A/AS

Simmerring BAUX2, BAUSLX2, BAFUDX7, BAFUDSLX7, BA, BASL, BAU, BAUSL



Simmerring BA...



Simmerring BA...SL

Product description

- Outer casing: elastomer (smooth or grooved = X7)
- Spring-loaded sealing lip
- Additional dust lip (BA...SL)
- Sealing lip profile, sealing lip machined on the front face (BAUX2, BAUSLX2 = preferred type)
- Sealing lip profile, finished sealing lip (BAFUDX7/BAFUDSLX7).

Product advantages

- Broad range of applications in every sector of industry
- Reliable sealing of the housing bore, even with increased roughness of the bore, thermal expansion and split housings, thus a sealing of low viscosity and gaseous media also possible
- Additional dust lip as additional seal against moderate and medium dust and dirt ingress from outside (BA...SL). (Note: can lead to temperature increase from frictional heat).

Application

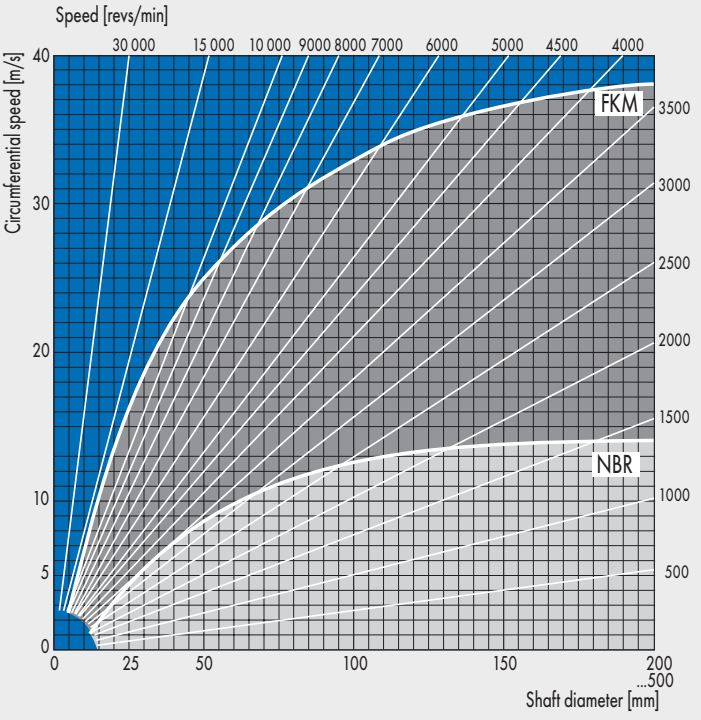
- Industrial gearboxes
- Axles (when subject to moderate dirt)
- Power tools.

Material

Acrylonitrile-butadiene rubber

Code	72 NBR 902
Colour	Blue
Hardness	72 Shore A
Metal insert	Unalloyed steel DIN 1624
Spring	Spring steel DIN 17223

Operating conditions

Media	Mineral oils, synthetic oils*, greases
T	–40 ... +100 °C short term up to... +120 °C
v	 Permissible circumferential speed for Simmerrings made from the materials NBR (72 NBR 902) and FKM (75 FKM 585) for the sealing of motor oil SAE 20. Use Simmerring® with SL (dust lip): v = max. 8 m/s.
p	up to 0,05 MPa/0,5 bar for >0,05 MPa/0,5 bar, a Simmerring with back-up ring can be used.
	up to 0,02 MPa/0,2 bar (BAFUDX7/BAFUDSLX7)

* With synthetic oils (polyalkylene glycols/polyalphaolefins) it is to be noted that the maximum operating temperature of 80 °C must not be exceeded.

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

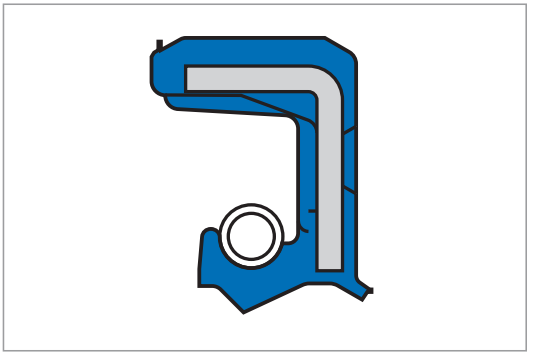
Tolerance	ISO H8
Roughness rubber OD covering	R_z = 10 ... 25 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

Simmerring BA...	4 ... 600 mm
Simmerring BA...SL	8 ... 300 mm

Simmerring BABSL to DIN 3760 AS (Classical Pressure Seal)



Simmerring BABSL

Product description

- Outer casing: elastomer
- Short, flexible, spring-loaded sealing lip
- Additional dust lip.

Product advantages

- Used preferably in pressurised units
- Reliable sealing of the housing bore, even with increased roughness of the bore, thermal expansion and split housings
- Advantages when sealing low viscosity and gaseous media
- Increased thermal stability and chemical resistance when 75 FKM 595 is used
- Additional dust lip as additional seal against moderate to medium dust and dirt ingress from outside
- Small axial dimensions (Note: can lead to temperature increase from frictional heat).

Application

- Hydrostatic drives (pumps, engines of all kinds)
- 2-stroke engines.

Material

Acrylonitrile-butadiene rubber

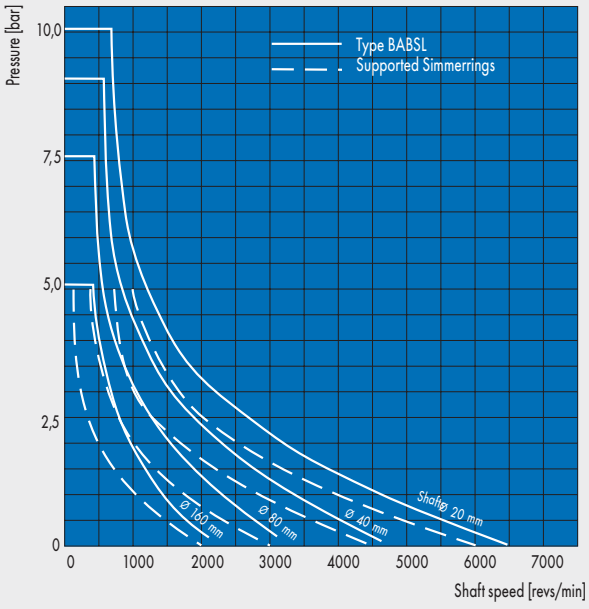
Code	72 NBR 902
Colour	Blue
Hardness	75 Shore A

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown
Hardness	75 Shore A

Metal insert	Unalloyed steel DIN EN 10027-1
Spring	Spring steel DIN EN 10270-1

Operating conditions

Media	Mineral oils, synthetic oils*
T	−40 ... +100 °C (72 NBR 902) −25 ... +160 °C (75 FKM 595)
p	

Permissible pressure in the unit for Simmerrings (type BABSL), as well as for Simmerrings with back-up rings

* With synthetic oils (polyalkylene glycols/polyalphaolefins) it is to be noted that the maximum operating temperature of 80 °C must not be exceeded (only for use of NBR).

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,4 µm
	R_z = 1,0 ... 3,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

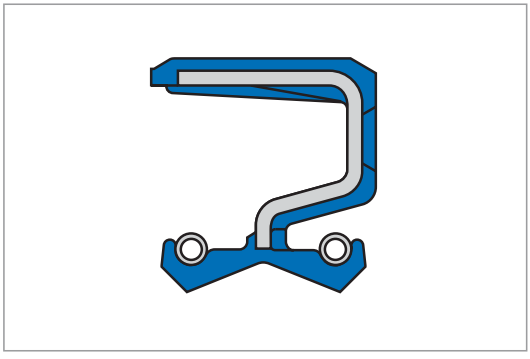
Tolerance	ISO H8
Roughness	R_z = 10 ... 25 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

Simmerring BABSL (NBR)	8 ... 340 mm
Simmerring BABSL (FKMZ)	8 ... 170 mm

Simmerring BADUO



Simmerring BADUO

Product description

- Outer casing: elastomer
- Two spring-loaded sealing lips.

Product advantages

- Sealing for the separation of two media
- Small housing
- Two spring-loaded sealing lips (one spring-loaded dust lip against moderate to medium dust and dirt ingress)
- Reliable sealing of the housing bore, even with increased roughness of the bore, thermal expansion and split housings.

Application

- Machine tools
- Power take-off gears in agricultural and construction machinery transmissions and axles.

Material

Acrylonitrile-butadiene rubber

Code	72 NBR 902
Hardness	72 Shore A
Metal insert	Unalloyed steel DIN EN 10027-1*
Spring	Spring steel DIN EN 10270-1*

* Individual dimensions have two metal inserts or one metal insert in the matched form.

75 FKM 585 and 75 FKM 595 on enquiry.

Operating conditions

Media	Mineral oils, synthetic oils*, greases
T	−40 ... +100 °C short term up to... +120 °C
v	to 5 m/s
p	to 0,05 MPa/0,5 bar

* With synthetic oils (polyalkylene glycols/polyalphaolefins) it is to be noted that the maximum operating temperature of 80 °C must not be exceeded.

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

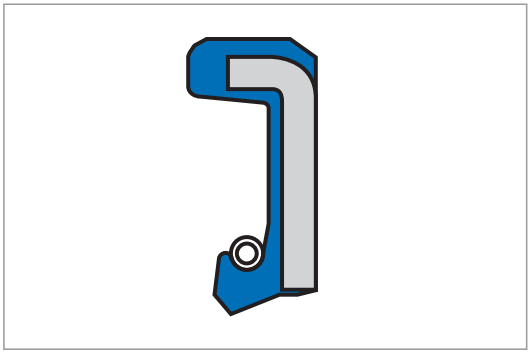
Tolerance	ISO H8
Roughness	R_z = 10 ... 25 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

Simmerring BADUO	25 ... 150 mm

Simmerring BAHD



Simmerring BAHD

Product description

High pressure seal.
Type BA with short, very stable sealing lip for high pressures, oil groove on the air side of the sealing lip.

Product advantages

- For use against high pressures
- Extremely stable sealing lip
- Low wear
- Long service life.

Application

All hydrostatic drives with low rotational speed.

Material

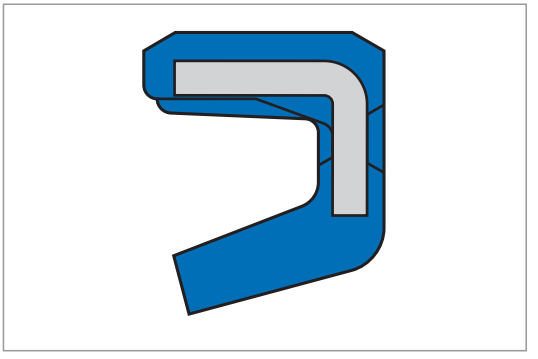
Code	90 NBR 129208 88 FKM 107725

Operating conditions

T	−40 ... +100 °C (NBR) −25 ... +160 °C (FKM)
$v_{U\ max}$	2 m/s
p_{max}	0,15 MPa/150 bar

Max. permissible values depend on the other operating conditions.

Simmerring BAOF



Simmerring BAOF

Product description

- Outer casing: elastomer
- Sealing lip without spring.

Product advantages

- Simple sealing component for secondary applications
- As a seal against grease
- As additional seal against moderate to medium dust and dirt ingress.

Application

- Power tools
- Sealing of pivot bearings
- Sealing of control elements.

Material

Acrylonitrile-butadiene rubber

Code	72 NBR 902
Colour	Blue
Hardness	72 Shore A
Metal insert	Unalloyed steel DIN 1624

Operating conditions

Media	Greases
T	–40 ... +100 °C
v	to 6 m/s
p	–

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

Tolerance	ISO H8
Roughness	R_z = 10 ... 25 µm

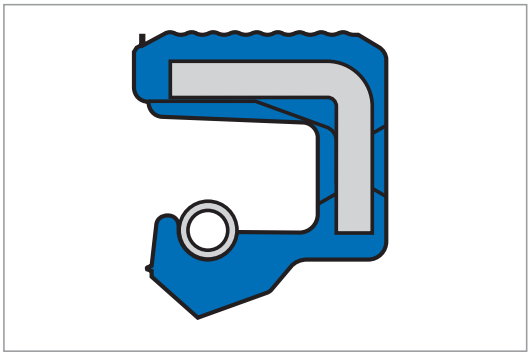
Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø D_1

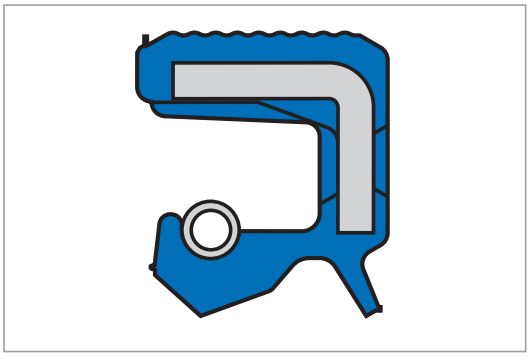
Simmerring BAOF	3 ... 230 mm

Simmerring BAUM.../SL to DIN 3760 A/AS

Simmerring BAUMX7, BAUMSLX7, BAUM, BAUMSL



Simmerring BAUM...



Simmerring BAUMSL...

Product description

- Outer casing: elastomer (smooth, grooved = X7)
- Spring-loaded sealing lip
- Additional dust lip (BAUMSL, BAUMSLX7)
- Friction-optimised sealing lip profile.

Product advantages

- Broad range of possible applications in every sector of industry
- Increased thermal stability and chemical resistance
- Reliable sealing of the housing bore, even with increased roughness of the bore, thermal expansion and split housings, thus a sealing of low viscosity and gaseous media also possible
- Advantages when sealing low viscosity and gaseous media
- Additional dust lip as additional seal against moderate and medium dust and dirt ingress from outside (BAUMSLX7).
  (Note: can lead to temperature increase from frictional heat).

Application

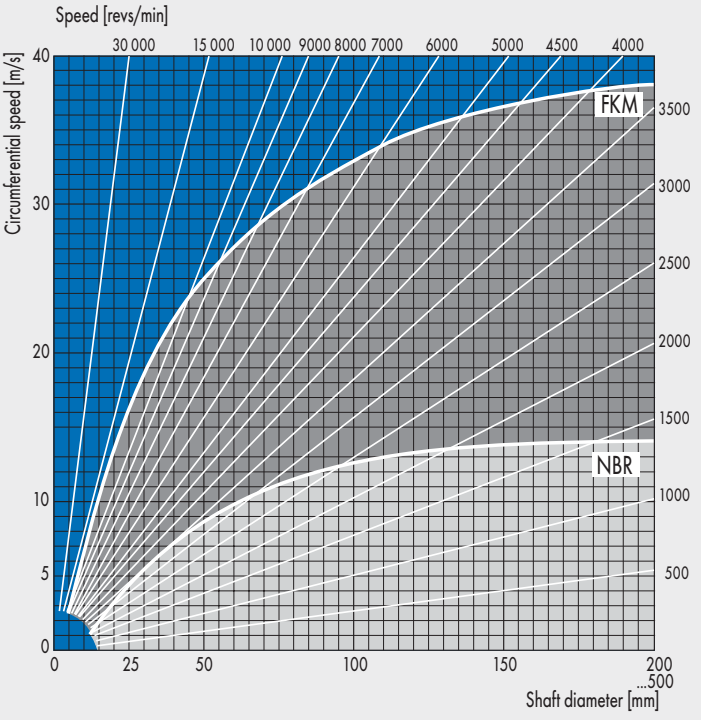
- Agricultural and construction machinery transmissions
- Industrial gearboxes
- Axles (when subject to moderate dirt)
- Power tools.

Material

Fluoro elastomer

Code	75 FKM 585
Colour	Dark brown
Hardness	75 Shore A
Metal insert	Unalloyed steel DIN EN 10027-1
Spring	Spring steel DIN EN 10270-1

Operating conditions

Media	Mineral oils, synthetic oils, aromatic and chlorinated hydro-carbons, fuels, heating oils
T	–25 ... +160 °C
v	 Permissible circumferential speed for Simmerrings made from the materials NBR (72 NBR 902) and FKM (75 FKM 585) for the sealing of motor oil SAE 20. Use Simmerring with SL (dust lip): v = max. 8 m/s.
p	up to 0,05 MPa/0,5 bar for >0,05 MPa/0,5 bar, a Simmerring with back-up ring can be used.

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

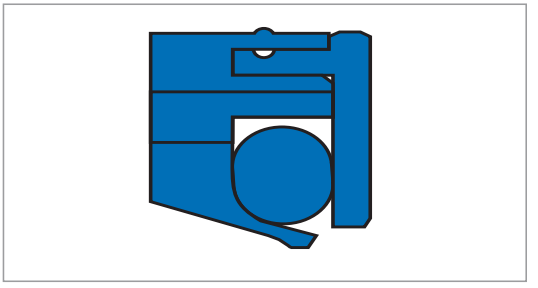
Tolerance	ISO H8
Roughness	R_z = 10 ... 25 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

Simmerring BAUM...	6 ... 220 mm
Simmerring BAUMSL...	8 ... 220 mm

Simmerring Radiamatic® EWDR made of PTFE



Simmerring Radiamatic® EWDR

Product description

Pressure-relieved Simmerring with a pressure ring made of PTFE compound, a stainless steel clamping ring and an O-ring (FKM) as a secondary seal.

Product advantages

Secure with simultaneous high pressure and high speed

- Low losses
- Low leak rate
- Easy fitting
- The shaft must not be machined on maintenance or seal replacement.

Application

- Primary seal in pumps and compressors
- Rotary joints for coolants and hydraulic fluid as well as gases
- Safety seal in addition to floating ring seals.

Material

PTFE carbon (standard quality)	Approved to KTW (drinking water) and BAM (oxygen)
PTFE Ekonol	Positively assessed by TNO, Nutrition and Food Research Laboratory (NL), for foodstuffs
Clamping ring	Usage of stainless steels

Operating conditions

Media	Resistance per FKM
Temperature	–20 ... +200 °C
Circumferential speed	max. 20 m/s for 1 MPa
Pressure difference	max. 3 MPa ... 0,2 MPa
For vacuum or pressure reversal	up to 0,2 MPa, housing closed

Surface, hardness

Peak-to-valley heights	**R_a**	**R_t**
Housing	<1,8 µm	<10,0 µm
Shaft, ground with no lead	0,1 ... 0,2 µm	0,5 ... 1,0 µm
Hardness of the contact area*	50–65 HRC, >0,5 mm depth of hardening	

* depending on material

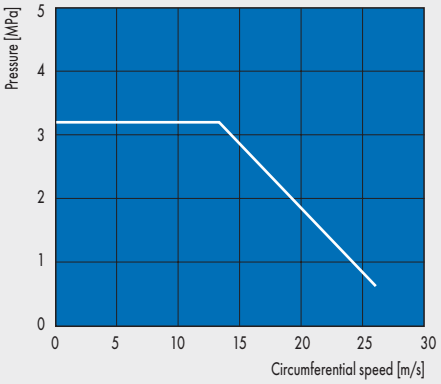
Design notes

Tolerances

Shaft	Radial shaft deflection, max.*
h11	±0,05 mm

* depending on increase in rotational speed, the radial shaft deflection may need to be more tightly limited. Please enquire.

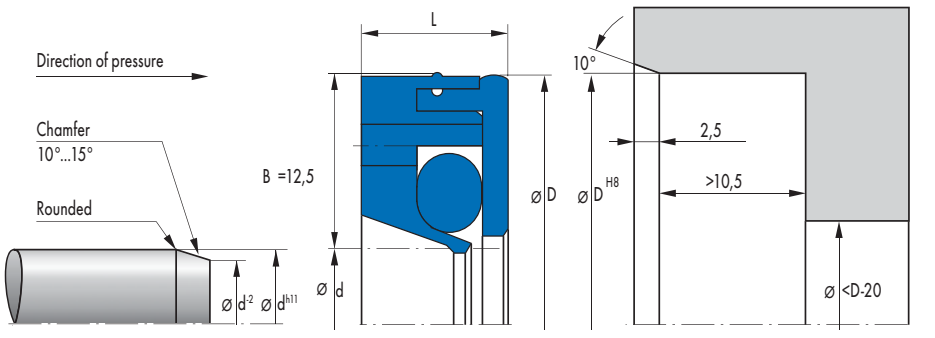
p · v-Diagram



Test time	5–6 h dynamic; 4–16 h static/un-pressurised
Medium	Heat transfer oil
Temperature	85 °C at the seal

Fitting & installation

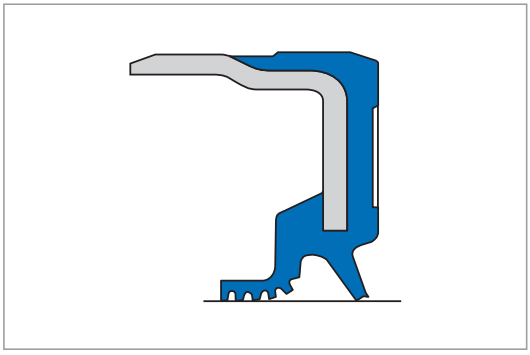
Fitting sequence: press Simmerring Radiamatic EWDR into housing; insert shaft.



Ø d	Ø D	L
20	45	10,5
25	50	10,5
28	53	10,5
30	55	10,5
35	60	10,5
40	65	10,5
45	70	10,5
50	75	10,5
55	80	10,5
60	85	10,5
65	90	10,5
70	95	10,5
75	100	10,5
80	105	10,5
90	115	10,5
100	125	10,5

Other dimensions on enquiry.

Simmerring Energy Saving Seal (ESS)



Simmerring Energy Saving Seal (ESS)

Product description

Springless Simmerring with return pumping helix.

Product advantages

- Very low friction
- Reduction of dissipation loss and production of heat
- Low wear
- Long service life.

Application

Engines, automobile and industrial gearboxes.

Material

Code	75 NBR 106200 75 FKM 595 70 ACM 121433

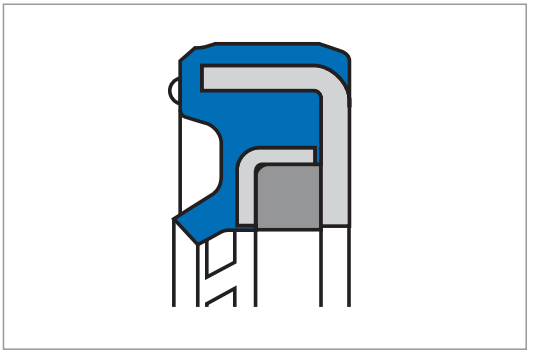
Operating conditions

For one direction of rotation of the shaft:

T	–40 ... +100 °C (NBR) –30 ... +150 °C (ACM) –25 ... +160 °C (FKM)
$v_{U\ max}$	30 m/s
p_{max}	0,02 MPa/0,2 bar

Max. permissible values depend on the other operating conditions.

Simmerring High Low Pressure Seal (HLPS)



Simmerring High Low Pressure Seal (HLPS)

Material

Code	HNBR
Back-up ring	PTFE

Operating conditions

T	−40 ... +120 °C
$v_{U\ max}$	2 m/s
p_{max}	0,22 MPa/220 bar

Max. permissible values depend on the other operating conditions.

Product description

Special type BA with springless sealing lip and integrated special back-up ring.

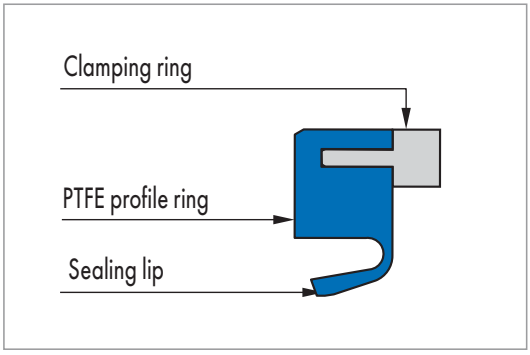
Product advantages

- Reliably seals under the most extreme pressures
- Long service life
- Low wear
- Compact design.

Application

Hydrostatic drives subject to very high stress.

Simmerring Radiamatic® HTS II made to PTFE



Simmerring Radiamatic® HTS II

Product description

Simmerring for open housings. Significantly reduced lip pre-load compared to conventional geometries with high level of protection against leaks.

Product advantages

- Low friction torque
- Good dry running properties
- Low clearance volume
- Easy to clean
- Type can be easily matched to housing.

Application

Rotary pumps, agitators, gearboxes, fans, compressors, mixers, machine tools.

Material

PTFE carbon (standard quality)	Approved to KTW (drinking water) and BAM (oxygen)
PTFE Ekonol	Positively assessed by TNO, Nutrition and Food Research Laboratory (NL), for foodstuffs
Clamping ring	Usage of stainless steels

Operating conditions

Temperature range	–20 ... +200 °C
Circumferential speed	18 m/s for 0,15 MPa
Abs. pressure	0,6 MPa

When used un-pressurised, significantly higher circumferential speeds are possible. Special versions are available for alternating operation in pressure/vacuum.

Surface, hardness

Peak-to-valley heights	R_a	R_t
Housing	<1,8 µm	≤10,0 µm
Shaft, ground with no lead	0,1 ... 0,2 µm	0,5 ... 1,0 µm
Hardness of the contact area	50 ... 65 HRC, >0,5 mm depth of hardening	

The surface hardness of the running surface must be approx. 30 HRC.

Percentage contact area M_r > 50% up to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0 %.

Design notes

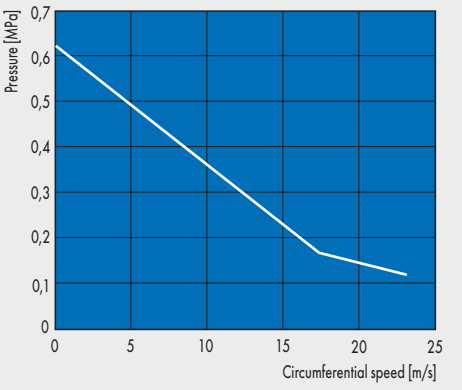
Please observe our general design notes.

Tolerances

Housing bore	Shaft	Radial shaft deflection, max.*
H8	h11	±0,05 mm

* depending on increase in rotational speed, the radial shaft deflection may need to be more tightly limited. Please enquire.

p · v Diagram

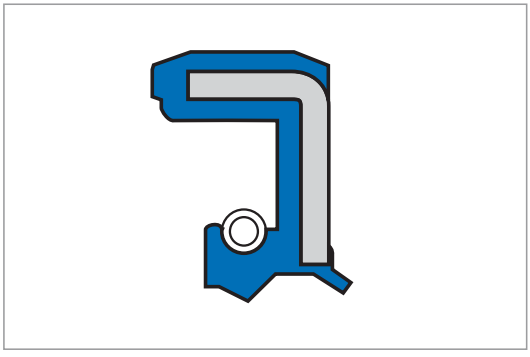


Test time	5 ... 6 h dynamic; 4 ... 16 h static/un-pressurised
Medium	Heat transfer oil
Temperature	85 °C at the seal

Fitting & installation

Careful fitting is a prerequisite for the correct function of the seal.

Simmerring Premium Pressure Seal (PPS)



Simmerring Premium Pressure Seal (PPS)

Product description

Type BA with patented sealing lip pressure loads.

Product advantages

- Low wear
- Low friction
- Long service life.

Application

Hydrostatic drives, retarders.

Material

Code	72 NBR 902 75 FKM 595

Further information about elastomers on enquiry.

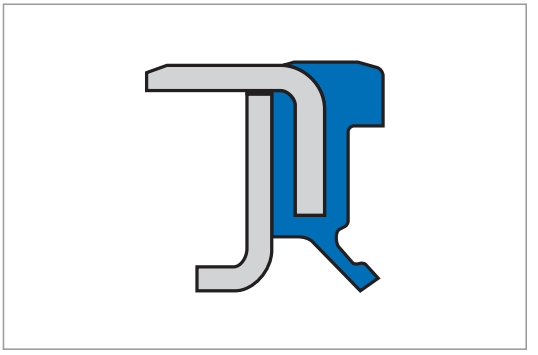
Operating conditions

T	–40 ... +100 °C (NBR) –25 ... +160 °C (FKM)
$v_{U\ max}$	15 m/s
p_{max}	0,1 MPa/10 bar

Max. permissible values depend on the other operating conditions.

In comparison to the standard BABSL design, up to 25% higher loads are permissible depending on the operating conditions.

Simmerring Poly Tech Seal (PTS)



Simmerring Poly Tech Seal (PTS)

Product description

Type BA or BD with vulcanised PTFE sealing lip with and without return pumping helix, with optional elastomer or fleece dust lip.

Product advantages

- Good static tightness through elastomer joining
- Low friction
- Low wear even during dry running
- High temperature resistance
- Pressure resistance
- With return pumping helix for reliable sealing even with special fluids.

Application

Hydrostatic drives, compressors, foodstuffs and chemicals industry, household appliances.

Material

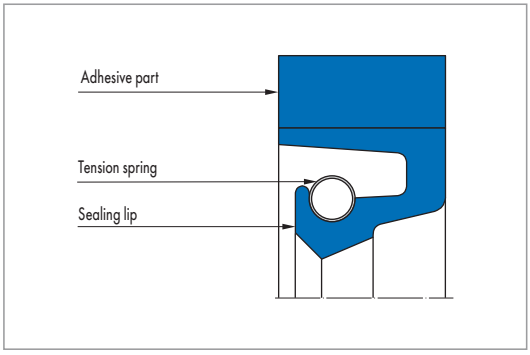
Code	NBR, FKM, HNBR, ACM PTFE: diverse special compounds depending on application

Operating conditions

T	−60 ... +200 °C (depending on combination of materials)
$v_{U\ max}$	30 m/s
p_{max}	1,0 MPa/10 bar

Max. permissible values depend on the other operating conditions.

Simmerring Radiamatic® R 35



Simmerring Radiamatic® R 35

Product description

Simmerring with a fabric reinforced static part that is securely joined to the elastomer sealing lip. The sealing lip is also pre-loaded with a garter spring.

Product advantages

Sealing ring is used, in case of adequate lubrication by the medium to be sealed, preferably where shafts pass through walls in mills and large gearboxes in heavy machinery manufacture.

- Particularly robust static part
- Lasting radial contact pressure
- Highly wear-resistant.

Application

Mills, ship building, steel hydraulics engineering, wind power plants.

Material

Sealing lip	Static part	Tension spring
80 NBR B241	Impregnated cotton fabric B4 B248	ST 1.4571
80 FKM K670	Impregnated aramide fabric C2 K670	ST 1.4571
75 HNBR U467	Impregnated aramide fabric C2 U464	ST 1.4571

Operating conditions

Material	80 NBR B241	80 FKM K670	75 HNBR U467
	Temperature range in °C		
Mineral oils	−30 ... +100	−10 ... +180	−20 ... +140
Water	+5 ... +100	+5 ... +80	+5 ... +100
Lubricating greases	−30 ... +100	−10 ... +180	−20 ... +140
Rolling oil emulsion	on enquiry		
Pressure p in MPa	0,05		
Running speed v in m/s	20	25	25

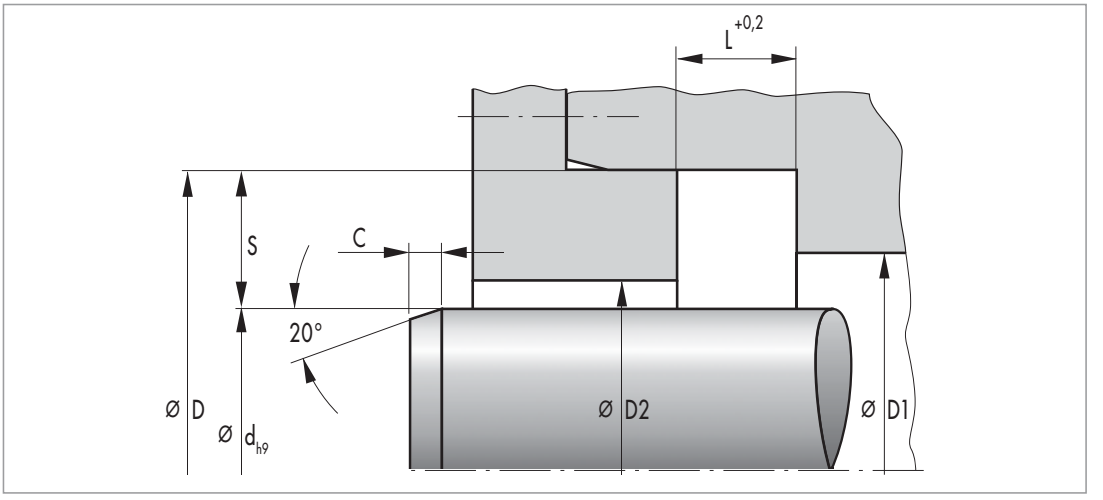
Other media on enquiry. Application parameters are recommended values, do not utilise all parameters simultaneously.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	≤0,6 µm	≤2,5 µm
Housing	≤4 µm	≤15 µm

The contact area is machined by plunge grinding, i.e. without feed. The surface hardness must be approx. 60 HRC (depth of hardening min. 0,5 mm). With increasing circumferential speed the contact area should be manufactured with increasing peak-to-valley heights R_a. The surface should not be too smooth so that an adequate film of lubricant can form. Recommended value: $R_{a\ min}$ = 0,1 µm. Percentage contact area M_r >50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%. Abrasive surfaces, ridges, scratches and blow-holes are to be avoided.

Design notes



Lead-in chamfers

See dimension "C" in the article list.

Tolerances

D	Tolerance
<500	H8
>500	+0,0004 x D

Overall eccentricity

The permissible overall eccentricity (static and dynamic eccentricity) between shaft and housing is dependent on the seal profile and circumferential speed.
If necessary, we will provide recommended values.

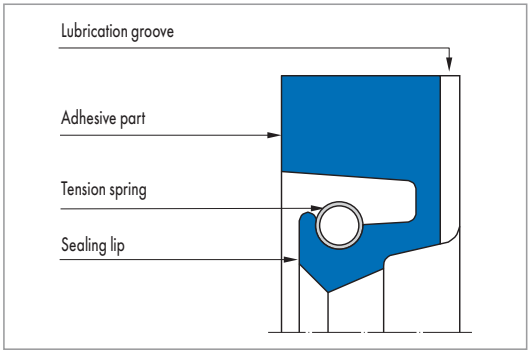
Housing recommendations for new designs

d	S (Profile)	L
>100	20	16
>250	22	20
<450	25	22
>750	32	25

Fitting & installation

For Simmerring Radiamatic R 35 an axially accessible housing is necessary, as the rings must have low inclination. The Radiamatic R 35 rings are supplied with oversize seal width. For reliable function the Radiamatic R rings must be axially compressed to the dimension "L". An open housing with cover plate and tightening screws is necessary. Specific deformation forces are necessary for the compression. The cover plate and the tightening screws are to be designed appropriately. Please request recommended values.

Simmerring Radiamatic® R 36



Simmerring Radiamatic® R 36

Product description

Simmerring with a fabric reinforced static part that is securely joined to the elastomer sealing lip. The sealing lip is also pre-loaded with a garter spring.

Product advantages

Sealing ring is used, in case of adequate lubrication by the medium to be sealed, preferably where shafts pass through walls in mills and large gearboxes in heavy machinery manufacture.

- Particularly robust static part
- Lasting radial contact pressure
- Highly wear-resistant
- With design measures, e.g., metal support for the sealing lip, higher pressures are possible
- Overpressure requires the usage of endless seals
- Back-up ring drawings and installation instructions for open seals are available.

Application

Mills, ship building, steel hydraulics engineering, wind power plants.

Material

Sealing lip	Static part	Tension spring
80 NBR B241	Impregnated cotton fabric B4 B248	ST 1.4571
80 FKM K670	Impregnated aramide fabric	ST 1.4571
75 HNBR U467	Impregnated aramide fabric C2 U464	ST 1.4571

Operating conditions

Material	80 NBR B241	80 FKM K670	75 HNBR U467
	Temperature range in °C		
Mineral oils	−30 ... +100	−10 ... +180	−20 ... +140
Water	+5 ... +100	+5 ... +80	+5 ... +100
Lubricating greases	−30 ... +100	−10 ... +180	−20 ... +140
Rolling oil emulsion	on enquiry		
Pressure p in MPa	0,05		
Running speed v in m/s	20	25	250

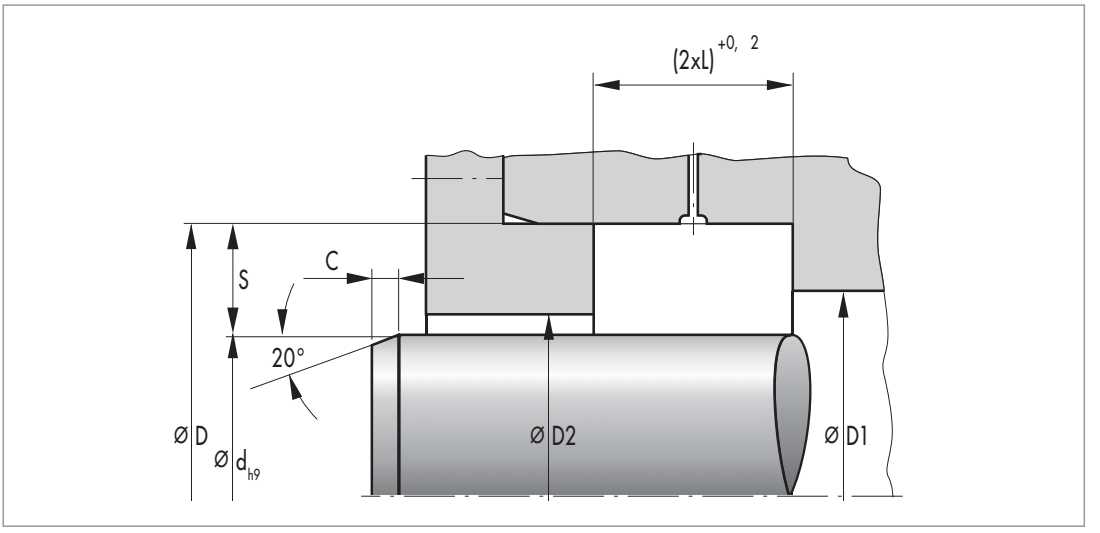
Other media on enquiry. Application parameters are recommended values, do not utilise all parameters simultaneously.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	≤0,6 µm	≤2,5 µm
Housing	≤4 µm	≤15 µm

The contact area is machined by plunge grinding, i.e. without feed. The surface hardness must be approx. 60 HRC (depth of hardening min. 0,5 mm). With increasing circumferential speed the contact area should be manufactured with increasing peak-to-valley heights R_a. The surface should not be too smooth so that an adequate film of lubricant can form. Recommended value: $R_{a\ min}$ = 0,1 µm. Percentage contact area M_r >50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%. Abrasive surfaces, ridges, scratches and blow-holes are to be avoided.

Design notes



Lead-in chamfers

See dimension "C" in the article list.

Tolerances

D	Tolerance
<500	H8
>500	+0,0004 x D

Overall eccentricity

The permissible overall eccentricity (static and dynamic eccentricity) between shaft and housing is dependent on the seal profile and circumferential speed. If necessary, we will provide recommended values.

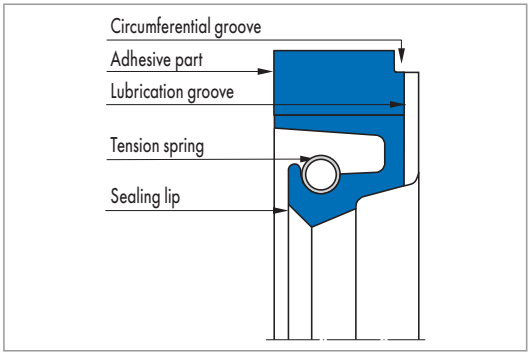
Housing recommendations for new designs

d	S (Profile)	L
>100	20	16
>250	22	20
<450	25	22
>750	32	25

Fitting & installation

For Simmerring Radiamatic R 36 an axially accessible housing is necessary, as the rings must have low inclination. The Radiamatic R 36 rings are supplied with oversize seal width. For reliable function the Radiamatic R rings must be axially compressed to the dimension "L". An open housing with cover plate and tightening screws is necessary. Specific deformation forces are necessary for the compression. The cover plate and the tightening screws are to be designed appropriately. Please request recommended values.

Simmerring Radiamatic® R 37



Simmerring Radiamatic® R 37

Product description

Simmerring with a fabric reinforced static part that is securely joined to the elastomer sealing lip. The sealing lip is also pre-loaded with a garter spring.

Product advantages

Sealing ring is used, in case of adequate lubrication by the medium to be sealed, preferably where shafts pass through walls in mills and large gearboxes in heavy machinery manufacture.

- Particularly robust static part
- Lasting radial contact pressure
- Highly wear-resistant.

Application

Mills, ship building, steel hydraulics engineering, wind power plants.

Material

Sealing lip	Static part	Tension spring
80 NBR B241	Impregnated cotton fabric B4 B248	ST 1.4571
80 FKM K670	Impregnated aramide fabric C2K670	ST 1.4571
75 HNBR U467	Impregnated aramide fabric C2U464	ST 1.4571

Operating conditions

Material	80 NBR B241	80 FKM K670	75 HNBR U467
	Temperature range in °C		
Mineral oils	−30 ... +100	−10 ... +180	−20 ... +140
Water	+5 ... +100	+5 ... +80	+5 ... +100
Lubricating greases	−30 ... +100	−10 ... +180	−20 ... +140
Rolling oil emulsion	on enquiry		
Pressure p in MPa	0,05		
Running speed v in m/s	20	25	250

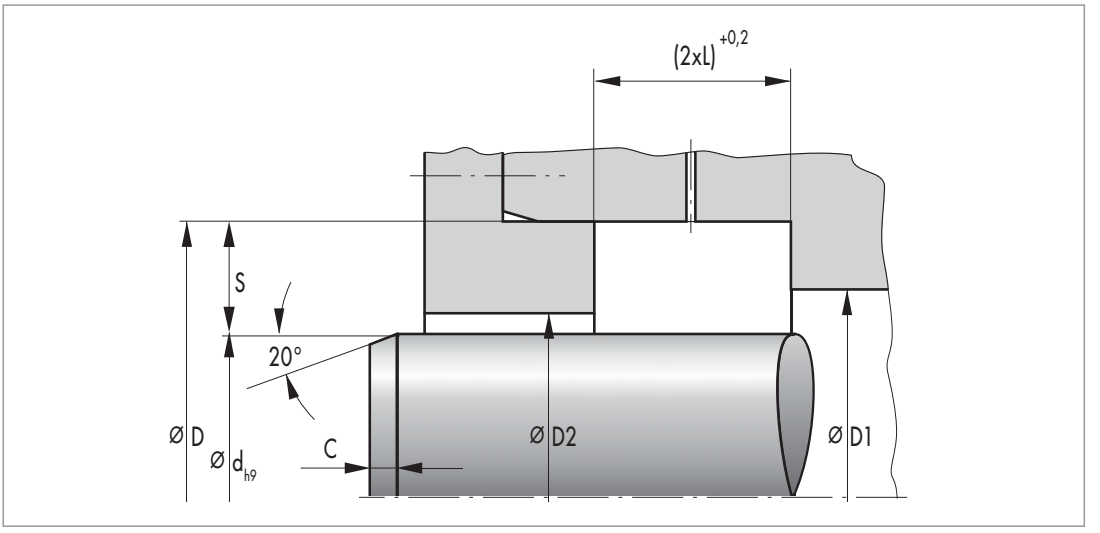
Other media on enquiry. Application parameters are recommended values, do not utilise all parameters simultaneously.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	≤0,6 µm	≤2,5 µm
Housing	≤4 µm	≤15 µm

The contact area is machined by plunge grinding, i.e. without feed. The surface hardness must be approx. 60 HRC (depth of hardening min. 0,5 mm). With increasing circumferential speed the contact area should be manufactured with increasing peak-to-valley heights R_a. The surface should not be too smooth so that an adequate film of lubricant can form. Recommended value: $R_{a\ min}$ = 0,1 µm. Percentage contact area M_r >50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%. Abrasive surfaces, ridges, scratches and blow-holes are to be avoided.

Design notes



Lead-in chamfers

See dimension "C" in the article list.

Tolerances

D	Tolerance
<500	H8
>500	+0,0004 x D

Overall eccentricity

The permissible overall eccentricity (static and dynamic eccentricity) between shaft and housing is dependent on the seal profile and circumferential speed. If necessary, we will provide recommended values.

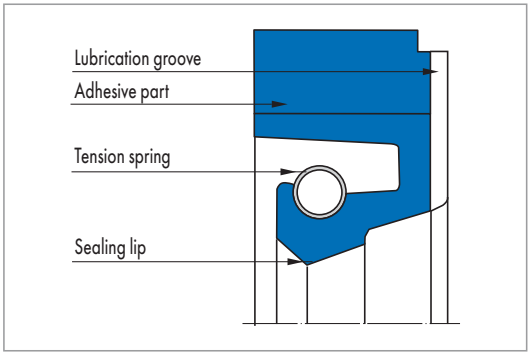
Housing recommendations for new designs

d	S (Profile)	L
>100	20	16
>250	22	20
<450	25	22
>750	32	25

Fitting & installation

For Simmerring Radiamatic R 37 an axially accessible housing is necessary, as the rings must have low inclination. The Radiamatic R 37 rings are supplied with oversize seal width. For reliable function the Radiamatic R rings must be axially compressed to the dimension "L". An open housing with cover plate and tightening screws is necessary. Specific deformation forces are necessary for the compression. The cover plate and the tightening screws are to be designed appropriately. Please request recommended values.

Simmerring Radiamatic® R 58



Simmerring Radiamatic® R 58

Product description

Simmerring with a fabric reinforced static part that is securely joined to the elastomer sealing lip. The sealing lip is also pre-loaded with a garter spring.

Product advantages

The sealing ring has a groove around the circumference to facilitate additional lubrication from the outside. The Simmerring Radiamatic R 58 was developed for the special requirements of grease-lubricated bearings in mill manufacture.

- Particularly robust static part
- Lasting radial contact pressure
- Highly wear-resistant.

Application

Mills.

Material

Sealing lip	Static part	Tension spring
80 NBR B241	Impregnated cotton fabric B4 B248	ST 1.4571

Other materials on enquiry.

Operating conditions

Material	80 NBR B241
	Temperature range in °C
Mineral oils	−30 ... +100
Water	+5 ... +100
Lubricating greases	−30 ... +100
Rolling oil emulsion	on enquiry
Pressure p in MPa	0,05
Running speed v in m/s	15

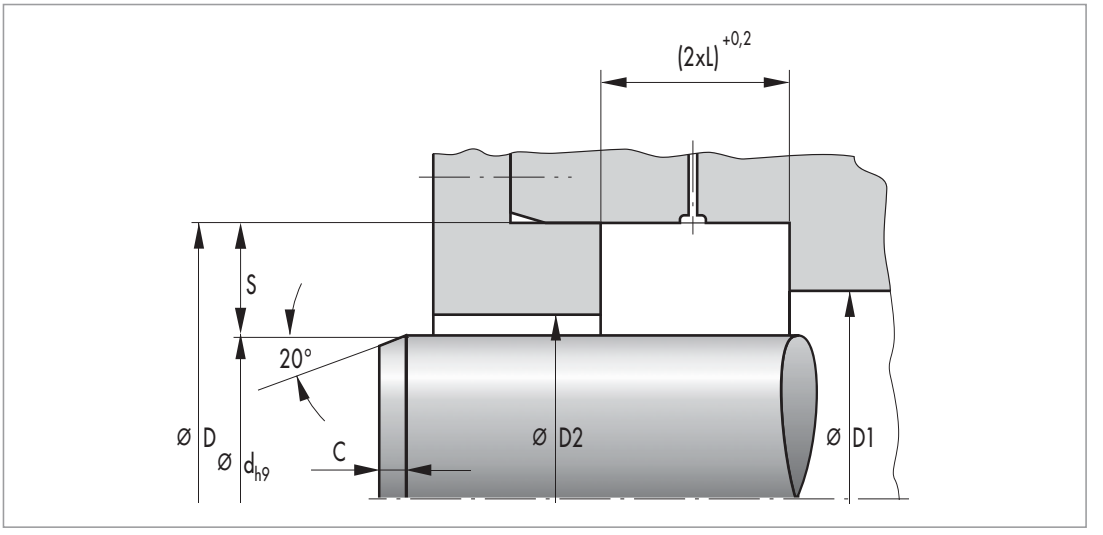
Other media on enquiry. Application parameters are recommended values, do not utilise all parameters simultaneously.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	≤0,6 µm	≤2,5 µm
Housing	≤4 µm	≤15 µm

The contact area is machined by plunge grinding, i.e. without feed. The surface hardness must be approx. 60 HRC (depth of hardening min. 0,5 mm). With increasing circumferential speed the contact area should be manufactured with increasing peak-to-valley heights R_a. The surface should not be too smooth so that an adequate film of lubricant can form. Recommended value: $R_{a\ min}$ = 0,1 µm. Percentage contact area M_r >50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%. Abrasive surfaces, ridges, scratches and blow-holes are to be avoided.

Design notes



Lead-in chamfers

See dimension "C" in the article list.

Tolerances

D	Tolerance
<500	H8
>500	+0,0004 x D

Overall eccentricity

The permissible overall eccentricity (static and dynamic eccentricity) between shaft and housing is dependent on the seal profile and circumferential speed. If necessary, we will provide recommended values.

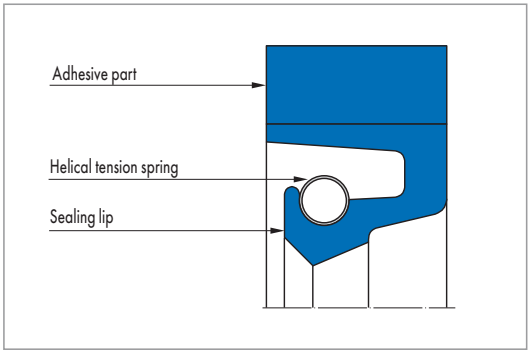
Housing recommendations for new designs

d	S (Profile)	L
>100	20	16
>250	22	20
<450	25	22
>750	32	25

Fitting & installation

For Simmerring Radiamatic R 58 an axially accessible housing is necessary, as the rings must have low inclination. The Radiamatic R 58 rings are supplied with oversize seal width. For reliable function the Radiamatic R rings must be axially compressed to the dimension "L". An open housing with cover plate and tightening screws is necessary. Specific deformation forces are necessary for the compression. The cover plate and the tightening screws are to be designed appropriately. Please request recommended values.

Simmerring Radiamatic® R 35 LD



Simmerring Radiamatic® R 35 LD

Product advantages

Sealing ring is used, in case of adequate lubrication by the medium to be sealed, preferably where shafts pass through walls in mills and large gearboxes in heavy machinery manufacture.

- Particularly robust static part
- Lasting radial contact pressure
- Highly wear-resistant.

Higher pressures are possible with design measures, e.g. metal support for the sealing lip. Overpressure requires the usage of endless seals. Back-up ring drawings and installation instructions for open seals are available.

Product description

Simmerring with a fabric reinforced static part that is securely joined to the elastomer sealing lip. The sealing lip is also pre-loaded with a garter spring.

Application

Mills, ship building.

Material

Sealing lip	Static part	Tension spring
80 NBR B241	Impregnated cotton fabric B4 B248	ST 1.4571
70 HNBR U467	Impregnated cotton fabric C2 U464	ST 1.4571

Operating conditions

Material	80 NBR B241	75 HNBR U467
	Temperature range in °C	
Mineral oils	−30 ... +100	−20 ... +140
Water	+5 ... +100	+5 ... +100
Lubricating greases	−30 ... +100	−20 ... +140
Rolling oil emulsion	on enquiry	
Pressure p in MPa	0,05	
Running speed v in m/s	20 (NBR), 25 (HNBR)	

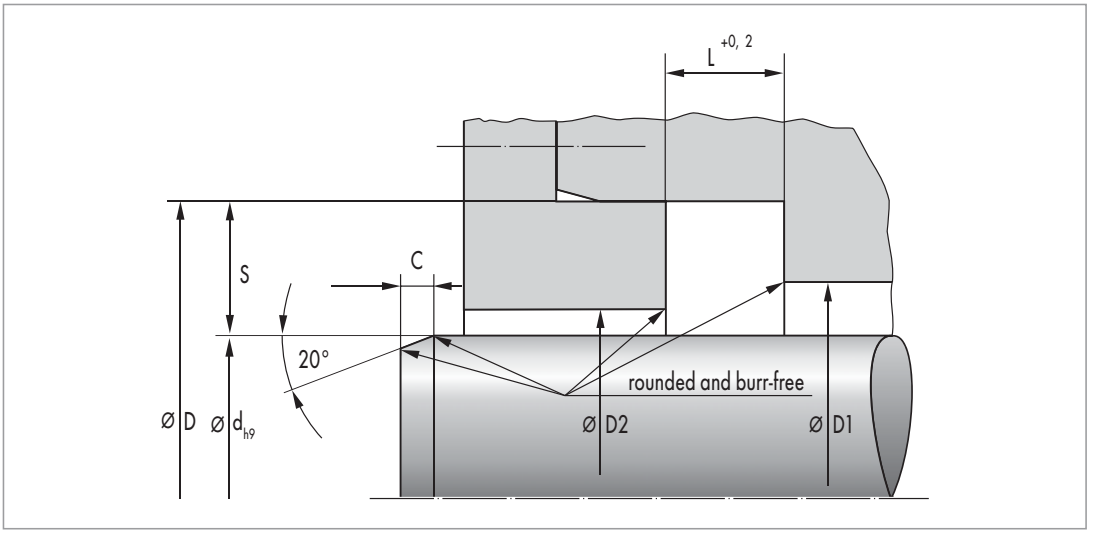
Other media on enquiry. Application parameters are recommended values, do not utilise all parameters simultaneously.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	≤0,6 µm	≤2,5 µm
Housing	≤4,0 µm	≤15,0 µm

The contact area is machined by plunge grinding, i.e. without feed. The surface hardness must be approx. 60 HRC (depth of hardening min. 0,5 mm). With increasing circumferential speed the contact area should be manufactured with increasing peak-to-valley heights R_a. The surface should not be too smooth so that an adequate film of lubricant can form. Recommended value: $R_{a\ min}$ = 0,1 µm. Percentage contact area M_r >50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%. Abrasive surfaces, ridges, scratches and blow-holes are to be avoided.

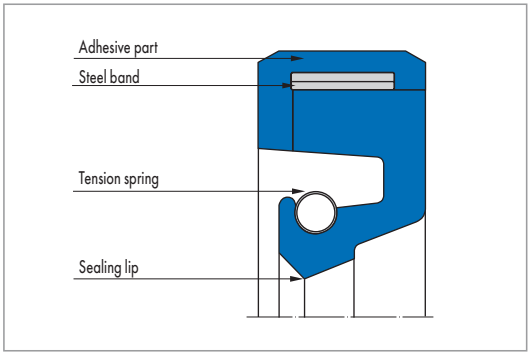
Design notes



Available dimensions

Profile S x L	Ø range
32 x 25	d >1100 ... 3000

Simmerring Radiamatic® RS 85



Simmerring Radiamatic® RS 85

Product description

Self-holding Simmerring made from two functionally suitable elastomer components and an integrated steel strip. The tension springs support the radial contact pressure on the shaft.

Product advantages

Self-holding Simmerring for shaft pass through walls in heavy machinery manufacture.

- Long-lasting tight fit
- Lasting radial contact pressure
- Highly wear-resistant.

An axially accessible housing is necessary for the fitting. The non-pressurised side of the sealing ring is to be reinforced for pressurisation. In the unpressurised state, an axial reinforcement on the non-pressurised side is not necessary. Only endless self-holding Simmerrings Radiamatic RS 85 are available.

Application

Rolling mills, large gearboxes.

Material

Sealing lip	Static part	Steel strip	Tension spring
80 NBR B241	85 NBR B247	ST 1.4310	ST 1.4571
75 HNBR U467	85 HNBR 10040	ST 1.4310	ST 1.4571
80 FKM K670	90 FKM K683	ST 1.4310	ST 1.4571

Operating conditions

Material	80 NBR B241	75 HNBR U467	80 FKM K670
	Temperature range in °C		
Mineral oils	−30 ... +100	−20 ... +140	−10 ... +180
Water	+5 ... +100	+5 ... +100	+5 ... +80
Lubricating greases	−30 ... +100	−20 ... +140	−10 ... +180
Rolling oil emulsion	on enquiry		
Pressure p in MPa	0,05		
Running speed v in m/s	20	25	25

Other media on enquiry. Application parameters are recommended values, do not utilise all parameters simultaneously.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	≤0,6 µm	≤2,5 µm
Housing	≤4,0 µm	≤15,0 µm

The contact area is machined by plunge grinding, i.e. without feed. The surface hardness must be approx. 60 HRC (depth of hardening min. 0,5 mm). With increasing circumferential speed, the contact area should be manufactured with increasing peak-to-valley heights R_a. The surface should not be too smooth so that an adequate film of lubricant can form. Recommended value: $R_{a\ min}$ = 0,1mm. Percentage contact area M_r >50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%. Abrasive surfaces, ridges, scratches and blow-holes are to be avoided.

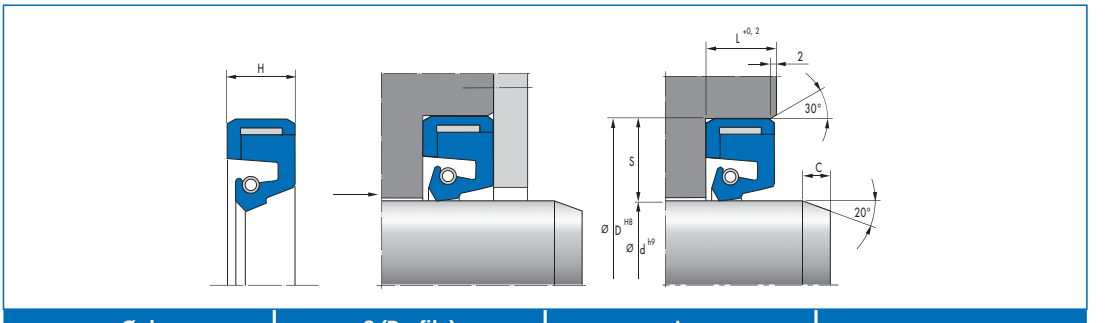
Design notes

Please observe our general design notes.

Fitting & installation

Careful fitting is a prerequisite for the correct function of the seal.

Housing recommendations for new designs

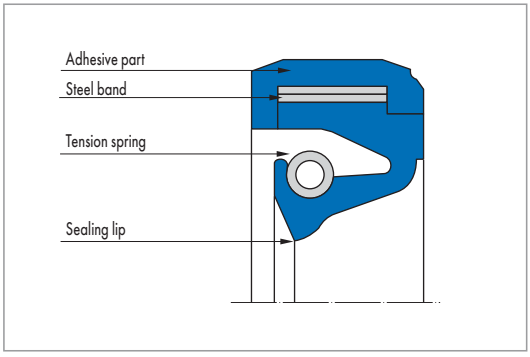


Ø d	S (Profile)	L	a
200 ... 450	20	20	4
	22	20	4
>450 ... 750	22	22	4
	25	22	4
>750	25	25	5
	30	25	5
	32	25	5

Lead-in chamfer

Ø d	c
<200	8
>200 ... 500	10
>500 ... 800	13
>800 ... 1200	16
>1200	20

Simmerring Radiamatic® RHS 51



Simmerring Radiamatic® RHS 51

Product description

High-speed Simmerring made from two functionally suitable elastomer components and an integrated steel strip. Two interleaved tension springs ensure an even radial force over the entire circumference length of the sealing edge even with high shaft centre offset.

Product advantages

Self-holding Simmerring for shaft pass through walls in mills and large gearboxes in heavy machinery manufacture. The sealing ring has radial grooves to facilitate additional lubrication from outside. Only endless self-holding Simmerrings are available

- Long-lasting tight fit
- Lasting radial contact pressure
- Highly wear-resistant
- High permissible shaft offset
- High permissible circumferential speed.

Application

Rolling mills, large gearboxes.

Material

Sealing lip	Static part	Steel strip	Tension spring
80 NBR B241	85 NBR B247	ST 1.4310	ST 1.4571
75 HNBR U467	85 HNBR 10040	ST 1.4310	ST 1.4571
80 FKM K670	90 FKM K683	ST 1.4310	ST 1.4571

Operating conditions

Material	80 NBR B241	75 HNBR U467	80 FKM K670
	Temperature range in °C		
Mineral oils	−30 ... +100	−20 ... +120	−10 ... +150
Water	+5 ... +100	+5 ... +100	+5 ... +80
Lubricating greases	−30 ... +100	−20 ... +120	−10 ... +150
Rolling oil emulsion	on enquiry		
Pressure p in MPa	0,02		
Running speed v in m/s	25	30	35

Other media on enquiry. Application parameters are recommended values, do not utilise all parameters simultaneously.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	0,15 ... 0,3 µm	≤2,5 µm
Housing	≤4,0 µm	≤15,0 µm

The contact area is machined by plunge grinding, i.e. without feed. The surface hardness must be approx. 60 HRC (depth of hardening min. 0,5 mm). With increasing circumferential speed the contact area should be manufactured with increasing peak-to-valley heights R_a. The surface should not be too smooth so that an adequate film of lubricant can form. Recommended value: $R_{a\ min}$ = 0,1 µm. Percentage contact area M_r >50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%. Abrasive surfaces, ridges, scratches and blow-holes are to be avoided.

Design notes

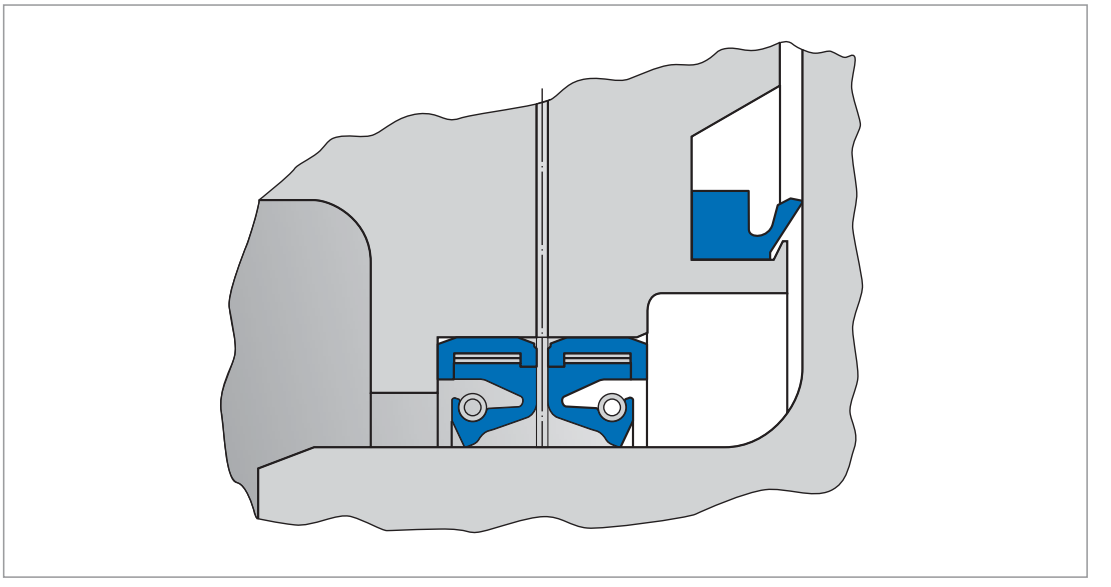
The permissible shaft offset (static eccentricity, centre offset) is dependent on the shaft diameter.

Shaft Ø d	Permissible shaft offset
200 ... 320	2,0 mm
>320 ... 450	2,5 mm
>450	3,0 mm

The permissible shaft offset (dynamic eccentricity) is dependent on the seal profile and the circumferential speed. Please request recommended values.

Lead-in chamfer

See dimension "C" in the housing recommendations for new designs.

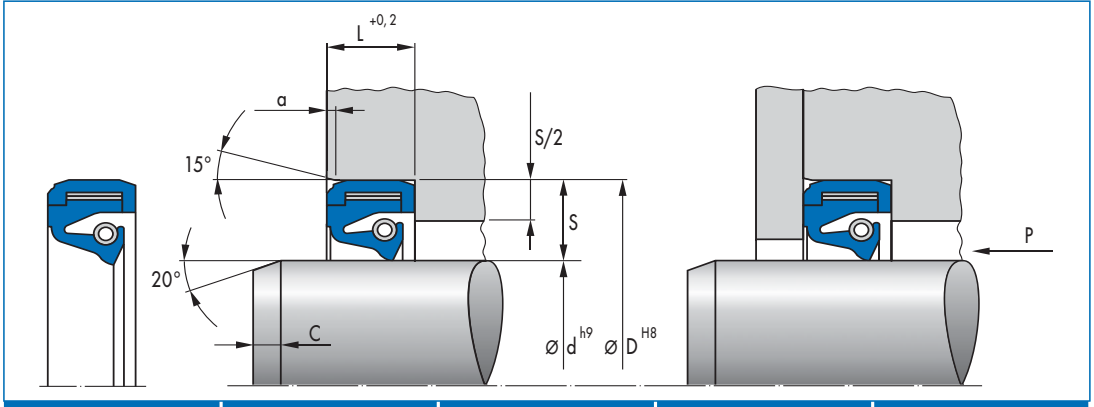


Typical seal arrangement

Fitting & installation

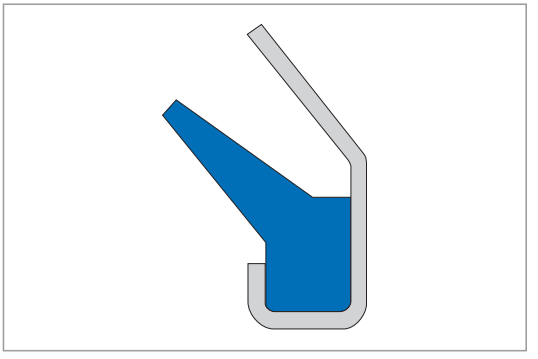
An axially accessible housing is necessary for the fitting of the Simmerring Radiamatic RHS 51.
Only endless self-holding Simmerrings Radiamatic RHS 51 are available.

Housing recommendations for new designs

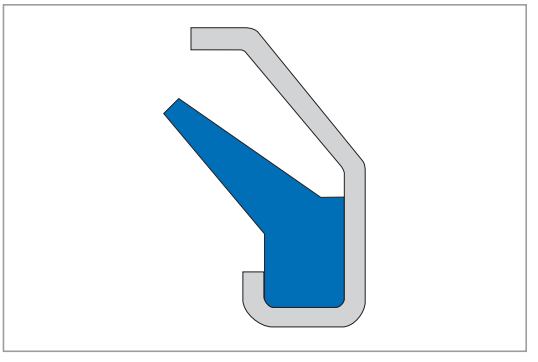


Ø d	S (Profile)	L	C	a
200 ... 450	20	20	12	4
	22	20	12	4
>450 ... 750	22	22	15	4
	25	22	15	4
>750	25	25	18	5
	30	25	18	5

Simmerring Modular Sealing Component (MSC 01, MSC 02)



Simmerring MSC 01



Simmerring MSC 02

Product description

- Outer casing: metal housing
- Dust lip without spring.

Product advantages

- Simple proven sealing component for secondary applications
- As a seal against grease
- As additional seal against moderate to medium dust and dirt ingress
- Can be used as part of the Simmerring Modular Sealing Solution (MSS).

Application

- Power tools
- Industrial gearboxes
- Pumps.

Material

Acrylonitrile-butadiene rubber

Code	80 NBR 177458
Colour	Black
Hardness	80 Shore A

Fluoro elastomer

Code	80 FKM 177459
Colour	Red brown
Hardness	80 Shore A

Metal housing	Yellow chromated, deep-drawn steel sheet as corrosion protection.

Alternatively in stainless steel on enquiry.

Operating conditions

Media	Greases
T	−40 ... +100 °C (NBR) −25 ... +160 °C (FKM)
v	to 6 m/s

Max. permissible values depend on the other operating conditions.

Fitting & installation

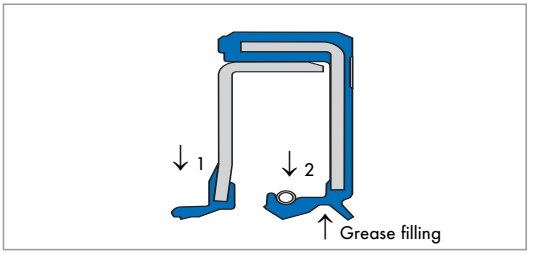
Shaft

Tolerance	ISO h 9
Runout	IT 8
Roughness	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm

Range of dimensions for shafts-Ø D_1

Simmerring MSC 01	10 ... 135 mm
Simmerring MSC 02	15 ... 100 mm

Simmerring Modular Sealing Solution 1 (MSS 1)



Simmerring MSS 1

Product description

- Outer casing: elastomer (smooth)
- Spring-loaded sealing lip and sealing lip with helix edge without spring
- Additional dust lip
- Modern sealing lip profile
- Friction-optimised primary seal lip 1 made from fluoro rubber 75 FKM 585
- Secondary seal lip with additional dust lip 2
- Grease filling with special lubricant Klüber Petamo GHY 133 N.

Product advantages

- Broad range of applications, for example in industrial gearboxes
- Reliable sealing of the housing bore, even with increased roughness of the bore, thermal expansion and split housings, thus a sealing of low viscosity and gaseous media is also possible
- Very long service life and reliability, especially when subject to strong external dirt and/or contamination (metal abrasion, cast sand) of the lubricant
- Optimal for vertical unit application
- Very narrow axial design
- Reliable sealing of the housing bore etc.

Application

- Industrial gearboxes.

Material

Acrylonitrile-butadiene rubber/Fluoro elastomer

Code	72 NBR 902/75 FKM 585
Hardness	72 Shore A/75 Shore A

Fluoro elastomer/Fluoro elastomer

Code	75 FKM 585/75 FKM 585
Hardness	75 Shore A/75 Shore A

Metal insert	Unalloyed steel DIN EN 10027-1
Spring	Spring steel DIN EN 10270-1

Operating conditions

Materials combination	NBR/FKM	FKM/FKM
T	–25 ... +100 °C	–25 ... +160° C
v	0 ... 6 m/s	0 ... 6 m/s
p	0 ... 0,05 MPa/ 0,5 bar	0 ... 0,05 MPa/ 0,5 bar

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = <6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

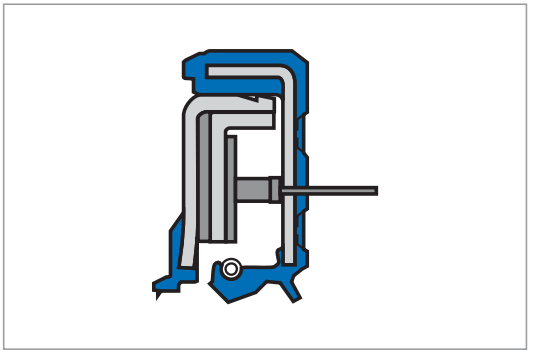
Tolerance	ISO H8
Roughness	R_z = 10 ... 25 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

Simmerring MSS 1	35 ... 145 mm

Simmerring Modular Sealing Solution 1+ (MSS 1+ Condition Monitoring)



Simmerring Modular Sealing Solution 1+
(MSS 1+ Condition Monitoring)

Product description

Modification of the standard MSS 1 design with additional function for detection of early leakage. Additional function: Optical sensor and special fleece leakage collector with evaluation electronics for transmission and interpretation of the signals.

Product advantages

Simmerring MSS 1+ CM features:

- Reliable warning of leakage
- Maintenance intervals can be planned
- Cost-effective small volume series, no tool costs
- Media-specific adaptation of the evaluation electronics.

Application

Industrial gearboxes, drive shafts, pumps and other conceivable application areas.

Material

Acrylonitrile-butadiene rubber/Fluoro elastomer

Code	72 NBR 902/75 FKM 585
Hardness	72 Shore A/75 Shore A
Sensor	Sensor, ribbon cable

Operating conditions

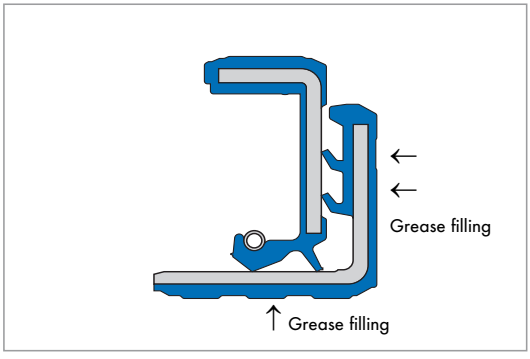
Materials combination	NBR/FKM
T	–25 ... +100 °C
v	0 ... 6 m/s
p	0 ... 0,05 MPa/0,5 bar

Max. permissible values depend on the other operating conditions.

Design notes

Limited range of sizes, larger Simmerrings may be equipped with several sensors.

Simmerring Modular Sealing Solution 7 (MSS 7)



Simmerring MSS 7

Product description

- Outer casing: elastomer
- Spring-loaded sealing lip
- Additional dust lips
- Modern sealing lip profile
- High resistance to dirt ingress
- Robust solution
- Grease between the sealing lip and dust lip with special lubricant Klüber Petamo GHY 133 N.

Product advantages

- Broad range of applications
- Reliable sealing of the housing bore, even with increased roughness of the bore, thermal expansion and split housings, thus a sealing of low viscosity and gaseous media also possible
- Additional axial dust lip(s) against moderate to medium dust and dirt ingress from outside.

Application

- Sealing of special gearboxes (e.g. automated washing system/car wash)
- Axles for agricultural and construction machinery, axles for special vehicles.

Material

Acrylonitrile-butadiene rubber

Code	72 NBR 902
Hardness	72 Shore A
Metal insert	Unalloyed steel DIN EN 10027-1
Spring	Spring steel DIN EN 10270-1

Material 75 FKM 585 on enquiry.

Operating conditions

Material	72 NBR 902
T	<80 °C
v	0 ... 5 m/s
p	0 ... 0,05 MPa/0,5 bar

Max. permissible values depend on the other operating conditions.

Fitting & installation

Shaft

Tolerance	ISO h8
Runout:	IT 8
Roughness	R_z = 10 ... 16 µm

Housing bore

Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal.

Range of dimensions for shafts-Ø d_1

Simmerring MSS 7	35 ... 150 mm

Simmerring Cassette Seal Typ 1

Simmerring Cassette Seal Typ 1

Product description

- Design: special types, on enquiry
- Outer casing: elastomer/sheet metal
- Spring-loaded sealing lip
- Additional dust lips
- High resistance to dirt ingress
- Robust solution.

Product advantages

- Lengthening of maintenance interval for individual units
- Shaft must not be hardened or ground
- Old solution can usually be replaced by Simmerring Cassette Seal without change to housing
- The shaft must not be machined on maintenance or seal replacement.

Application

These examples of use provide general information on the primary applications for Simmerring Cassette Seals and their performance in relation to dirt from the outside. Simmerring Cassette Seals (types 1, 2 or 3) must be selected taking into account the application conditions (shaft speed, oil temperature, etc.).

- Agricultural machinery (tractors)
  - Axles: pinions
- Construction machinery
  (road rollers, excavators, fork-lift trucks, mixers)
  - Axles: pinions
  - Power take-off drives
- Commercial vehicles
  (lorries, busses, trailers, special vehicles)
  - Axles: hubs
  - Axles: propeller shafts*
  - Axles: pinions.

* With axial shaft movement, special design necessary.

Material

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown

Metal insert	Unalloyed steel DIN 1624 – EN10139
Spring	Spring steel 17223

Operating conditions

Materials combination	75 NBR 106200	75 FKM 595
T	<80 °C	<100 °C
v	to 7 m/s	to 9 m/s
p	max. 0,05 MPa/0,5 bar	max. 0,05 MPa/0,5 bar

For material definitions, it must be taken into account that it is possible that not all extreme conditions will occur simultaneously.

Fitting & installation

Shaft

Tolerance	ISO h8
Runout	IT 8
Roughness	R_z = 10 ... 16 µm

Housing bore

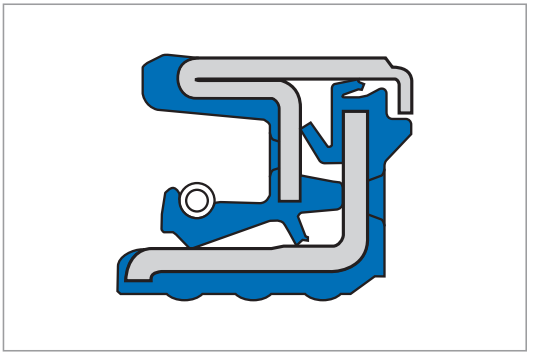
Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. Further information on enquiry.

Range of dimensions for shafts-Ø D_1

Simmerring Cassette Seal Typ 1	55 ... 133,35 mm

Simmerring Cassette Seal Typ 2



Simmerring Cassette Seal Typ 2

Product description

- Design: special types, on enquiry
- Outer casing: elastomer/sheet metal
- Spring-loaded sealing lip
- Additional dust lips
- High resistance to dirt ingress
- Robust solution.

Product advantages

- Lengthening of maintenance interval for individual units
- Shaft must not be hardened or ground
- Old solution can usually be replaced by Simmerring Cassette Seal without change to housing
- The shaft must not be machined on maintenance or seal replacement.

Application

These examples of use provide general information on the primary applications for Simmerring Cassette Seals and their performance in relation to dirt from the outside. Simmerring Cassette Seals (types 1, 2 or 3) must be selected taking into account the application conditions (shaft speed, oil temperature, etc.).
Further information on enquiry.

- Agricultural machinery
  - Tedders
  - Sewing machinery
  - Pricking out machinery
  - Combine harvesters
  - Threshing machinery.

Material

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown

Metal insert	Unalloyed steel DIN 1624 – EN10139
Spring	Spring steel 17223

Operating conditions

Materials combination	75 NBR 106200	75 FKM 595
T	<80 °C	<100 °C
v	to 5 m/s	to 7 m/s
p	max. 0,05 MPa/0,5 bar	max. 0,05 MPa/0,5 bar

For material definitions, it must be taken into account that it is possible that not all extreme conditions will occur simultaneously.

Fitting & installation

Shaft

Tolerance	ISO h8
Runout	IT 8
Roughness	R_z = 10 ... 16 µm

Housing bore

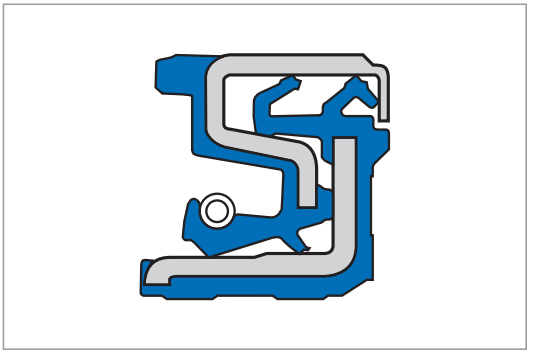
Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. Further information on enquiry.

Range of dimensions for shafts-Ø D_1

Simmerring Cassette Seal type 2	35 ... 190 mm

Simmerring Cassette Seal Typ 3



Simmerring Cassette Seal Typ 3

Product description

- Design: special types, on enquiry
- Outer casing: elastomer/sheet metal
- Spring-loaded sealing lip
- Additional dust lips
- High resistance to dirt ingress
- Robust solution.

Product advantages

- Lengthening of maintenance interval for individual units
- Shaft must not be hardened or ground
- Old solution can usually be replaced by Simmerring Cassette Seal without change to housing
- The shaft must not be machined on maintenance or seal replacement.

Application

These examples of use provide general information on the primary applications for Simmerring Cassette Seals and their performance in relation to dirt from the outside. Simmerring Cassette Seals (types 1, 2 or 3) must be selected taking into account the application conditions (shaft speed, oil temperature, etc.).
Further information on enquiry.

- Agricultural machinery
  - Tractors/hub
  - Tractors/propeller shafts*
  - Harrows
  - Motorised cultivators
  - Tillers
  - Fertiliser spreading machinery
- Construction machinery
  (road rollers, excavators, fork-lift trucks, mixers)
  - Axles: hubs
  - Axles: propeller shafts*.

* With axial shaft movement, special design necessary.

Material

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown

Metal insert	Unalloyed steel DIN 1624 – EN10139
Spring	Spring steel 17223

Operating conditions

Materials combination	75 NBR 106200	75 FKM 595
T	<80 °C	<100 °C
v	to 4 m/s	to 6 m/s
p	max. 0,05 MPa/0,5 bar	max. 0.05 MPa/0.5 bar

For material definitions, it must be taken into account that it is possible that not all extreme conditions will occur simultaneously.

Fitting & installation

Shaft

Tolerance	ISO h8
Runout	IT 8
Roughness	R_z = 10 ... 16 µm

Housing bore

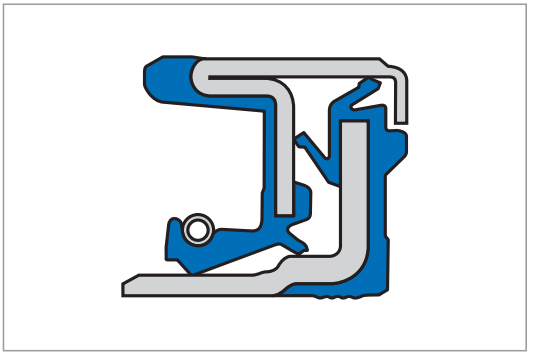
Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. Further information on enquiry.

Range of dimensions for shafts-Ø D_1

Simmerring Cassette Seal type 3	25 ... 210 mm

Simmerring Cassette Seal HS (high speed)



Simmerring Cassette Seal HS

Product description

- Design: special types, on enquiry
- Outer casing: elastomer/sheet metal
- Spring-loaded sealing lip
- Additional dust lips
- High resistance to dirt ingress.

Product advantages

- Strategic principle: elastomer/metal sheets on the inside diameter and special design
- Extremely useful for applications with high r.p.m.
- Elastomer surface guarantees static seal at inside diameter
- Metal surface guarantees higher thermal conduction and better heat distribution
- Fast and reliable replacement for applications in the spare parts sector
- Shaft surface treatment not necessary.

Application

These examples of use provide general information on the primary applications for the Simmerring Cassette Seal HS.
The Simmerring Cassette Seal HS is used in pinions, in both the industrial and commercial vehicle sectors:

- Agricultural machinery (tractors)
- Commercial vehicles (small trucks, small special vehicles)
- Pinions
- Differential
- Drive engineering.

Material

For slip ring:

Fluoro elastomer

Code	75 FKM 585
Colour	Dark brown

For Simmerring:

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black

Acrylate rubber

Code	68 ACM
Colour	Black

Metal insert	Unalloyed steel DIN 1624 – EN 10139
Spring	Spring steel 17223

Operating conditions

Materials combination	For Simmerring 75 FKM 585	For slip ring 75 NBR 106200	For slip ring 68 ACM
T	<120 °C	<80 °C	<100 °C
v	bis 12 m/s	–	–
p	max. 0,03 MPa/0,3 bar	–	–

For material definitions, it must be taken into account that it is possible that not all extreme conditions will occur simultaneously.

Fitting & installation

Shaft

Tolerance	ISO h8
Runout	IT 8
Roughness	R_z = 10 ... 16 µm

Housing bore

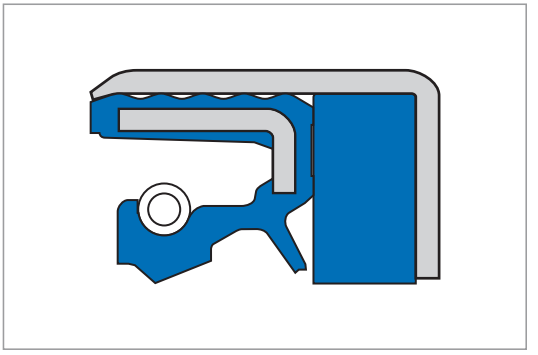
Tolerance	ISO h8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. Further information on enquiry.

Range of dimensions for shafts-Ø D_1

Further information on enquiry.

Simmerring Combi Seal



Simmerring Combi Seal

Product description

- Design: special types, on enquiry
- Combination of a Simmerring and an additional seal against dirt from the outside in one housing
- Spring-loaded sealing lip
- Additional dust lip
- Primarily for usage in all applications with high level of soiling, e.g., in axles for off-road vehicles
- Use preferably instead of the Simmerring Cassette Seal in case of superimposed rotational and translation movements.

Product advantages

- Long service life
- High resistance to dirt ingress due to the optimal positioning of sealing lip and dust lip.

Performance in relation to dirt from the outside

- High resistance to dirt from the outside. Suitable for protection against dry dirt.

Application

- Agricultural machinery
- Drives for agricultural vehicles and in general industry
- Drives for rotating, sometimes running shafts in dry application areas.

Material

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black
Hardness	75 Shore A

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown
Hardness	75 Shore A

Metal insert	Unalloyed steel DIN 1624 – EN10139
Spring	Spring steel 17223
Dirt wiper	Polyurethane (AU)

Operating conditions

Materials combination	NBR/AU
T	to +80 °C
v	to 5 m/s
p	max. 0,05 MPa/0,5 bar

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = ≤6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

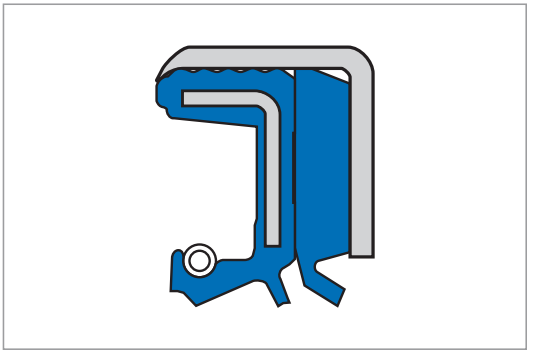
Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. Further information on enquiry.

Range of dimensions for shafts-Ø D_1

Simmerring Combi Seal	30 ... 220 mm

Simmerring Combi Seal SF5



Simmerring Combi Seal SF5

Product description

- Design: special types, on enquiry
- Combination of a Simmerring and an additional seal against dirt from the outside in one housing
- Spring-loaded sealing lip
- Additional dust lip
- Primarily for usage in all applications with high level of soiling, e.g., in axles for off-road vehicles
- Use preferably instead of the Simmerring Cassette Seal in case of superimposed rotational and translation movements.

Product advantages

- Long service life
- High resistance to dirt ingress due to the optimal positioning of sealing lip and dust lip.

Performance in relation to dirt from the outside

- High resistance to dirt from the outside. Suitable for protection against sludge.

Application

- Agricultural machinery
- Drives for agricultural vehicles and in general industry
- Drives for rotating, sometimes running shafts in dry application areas.

Material

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black
Hardness	75 Shore A

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown
Hardness	75 Shore A

Metal insert	Unalloyed steel DIN 1624 – EN10139
Spring	Spring steel 17223
Dirt wiper	Polyurethane (AU)

Operating conditions

Materials combination	NBR/AU	FKM/AU
T	to +80 °C	to +100 °C
v	to 4 m/s	to 6 m/s
p	max. 0,05 MPa/ 0,5 bar	max. 0,05 MPa/ 0,5 bar

For material definitions, it must be taken into account that it is possible that not all extreme conditions will occur simultaneously.

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = ≤6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

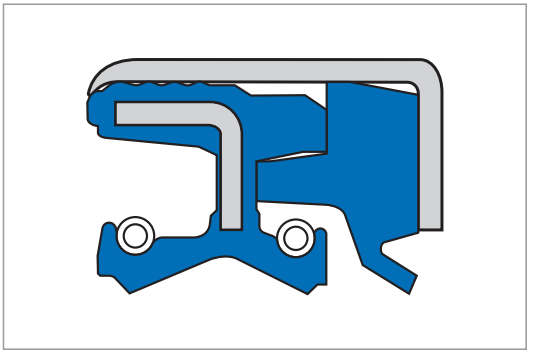
Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. The use of sealing material on the outer diameter is recommended for the fitting. Further information on enquiry.

Range of dimensions for shafts-Ø D_1

Simmerring Combi Seal SF5	35 ... 120 mm

Simmerring Combi Seal SF6



Simmerring Combi Seal SF6

Product description

- Design: special types, on enquiry
- Combination of a Simmerring and an additional seal against dirt from the outside in one housing
- Spring-loaded sealing lip
- Additional dust lip
- Primarily for usage in all applications with high level of soiling, e.g., in axles for off-road vehicles
- Use preferably instead of the Simmerring Cassette Seal in case of superimposed rotational and translation movements.

Product advantages

- Long service life
- High resistance to dirt ingress due to the optimal positioning of sealing lip and dust lip.

Performance in relation to dirt from the outside

- High resistance to dirt from the outside. Suitable for protection against sludge.

Application

- Agricultural machinery
- Drives for agricultural vehicles and in general industry
- For rotating, sometimes running shafts in wet/moist application areas.

Material

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black
Hardness	75 Shore A

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown
Hardness	75 Shore A

Metal insert	Unalloyed steel DIN 1624 – EN10139
Spring	Spring steel 17223
Dirt wiper	Polyurethane (AU)

Operating conditions

Materials combination	NBR/AU	FKM/AU
T	to +80 °C	to +100 °C
v	to 4 m/s	to 6 m/s
p	max. 0,05 MPa/ 0,5 bar	max. 0,05 MPa/ 0,5 bar

Fitting & installation

Shaft

Tolerance	ISO h 11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = ≤6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

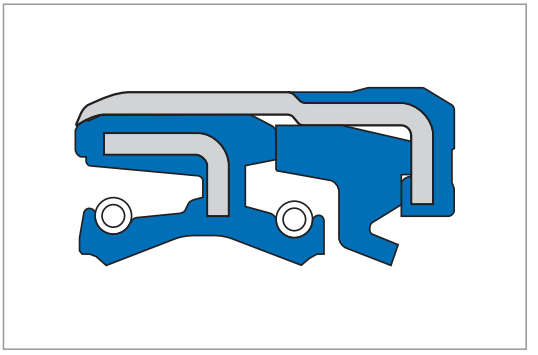
Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. The use of sealing material on the outer diameter is recommended for the fitting. Further information on enquiry.

Range of dimensions for shafts-Ø D_1

Simmerring Combi Seal SF6	30 ... 130 mm

Simmerring Combi Seal SF8



Simmerring Combi Seal SF8

Product description

- Design: special types, on enquiry
- Static seal on the outer diameter (in comparison to the Combi SF6)
- Combination of a Simmerring and an additional seal against dirt from the outside in one housing
- Spring-loaded sealing lip
- Additional dust lip
- Primarily for usage in all applications with high level of soiling, e.g., in axles for off-road vehicles
- Use preferably instead of the Simmerring Cassette Seal in case of superimposed rotational and translation movements.

Product advantages

- Long service life
- High resistance to dirt ingress due to the optimal positioning of sealing lip and dust lip.

Performance in relation to dirt from the outside

- High resistance to dirt from the outside. Suitable for protection against sludge.

Application

- Agricultural machinery
- Transmissions drives for agricultural vehicles and in general industry.
- For rotating, sometimes running shafts in wet/ moist application areas.

Material

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black
Hardness	75 Shore A

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown
Hardness	75 Shore A

Metal insert	Unalloyed steel DIN 1624 – EN10139
Spring	Spring steel 17223
Dirt wiper	Polyurethane (AU)

Operating conditions

Materials combination	NBR/AU	FKM/AU
T	to +80 °C	to +100 °C
v	to 4 m/s	to 6 m/s
p	max. 0,05 MPa/ 0,5 bar	max. 0,05 MPa/ 0,5 bar

For material definitions, it must be taken into account that it is possible that not all extreme conditions will occur simultaneously.

Fitting & installation

Shaft

Tolerance	ISO h11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = ≤6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

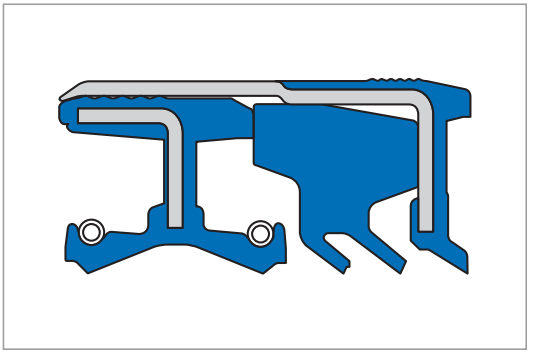
Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. Further information on enquiry.

Range of dimensions for shafts-Ø D_1

Simmerring Combi Seal SF8	37 ... 75 mm

Simmerring Combi Seal SF19



Simmerring Combi Seal SF19

Product description

- Design: special types, on enquiry
- Combination of a Simmerring and an additional seal against dirt from the outside in one housing
- Spring-loaded sealing lip
- Additional dust lip for preventing the ingress of dirt and for protection under extreme operating conditions
- Primarily for usage in all applications with high level of soiling, e.g., in axles for off-road vehicles
- Use preferably instead of the Simmerring Cassette Seal in case of superimposed rotational and translation movements.

Product advantages

- Long service life
- High resistance to dirt ingress due to the optimal positioning of sealing lip and dust lip.

Performance in relation to dirt from the outside

- High resistance to dirt from the outside. Suitable for protection against sludge.

Application

- Agricultural machinery
- For extreme dirt ingress and critical applications
- Drives for agricultural vehicles and in general industry.

Material

Acrylonitrile-butadiene rubber

Code	75 NBR 106200
Colour	Black
Hardness	75 Shore A

Fluoro elastomer

Code	75 FKM 595
Colour	Red brown
Hardness	75 Shore A

Metal insert	Unalloyed steel DIN 1624 – EN10139
Spring	Spring steel 17223
Dirt wiper	Polyurethane (AU)

Operating conditions

Materials combination	NBR/AU	FKM/AU
T	to +80 °C	to +100 °C
v	to 4 m/s	to 6 m/s
p	max. 0,05 MPa/ 0,5 bar	max. 0,05 MPa/ 0,5 bar

For material definitions, it must be taken into account that it is possible that not all extreme conditions will occur simultaneously.

Fitting & installation

Shaft

Tolerance	ISO h11
Runout	IT 8
Roughness	R_a = 0,2 ... 0,8 µm
	R_z = 1,0 ... 5,0 µm
	R_{max} = ≤6,3 µm
Hardness	45 ... 60 HRC
Finish	No lead; preferably plunge ground

Housing bore

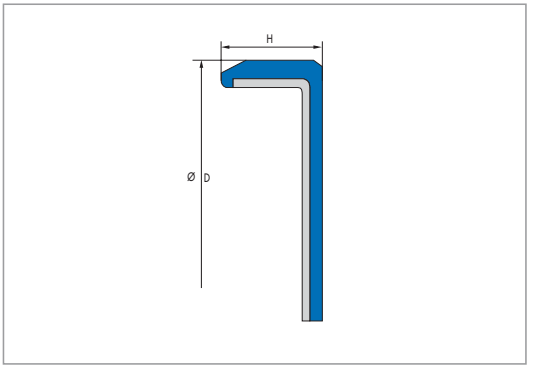
Tolerance	ISO H8
Roughness	R_z = 10 ... 16 µm

Careful fitting according to DIN 3760 is a prerequisite for the correct function of the seal. Further information on enquiry. Further information on enquiry.

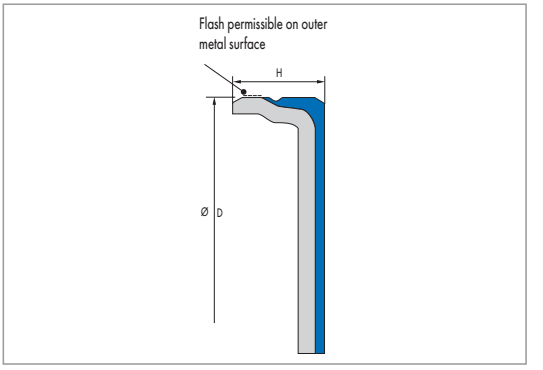
Range of dimensions for shafts-Ø D_1

Simmerring Combi Seal SF19	37 ... 75 mm

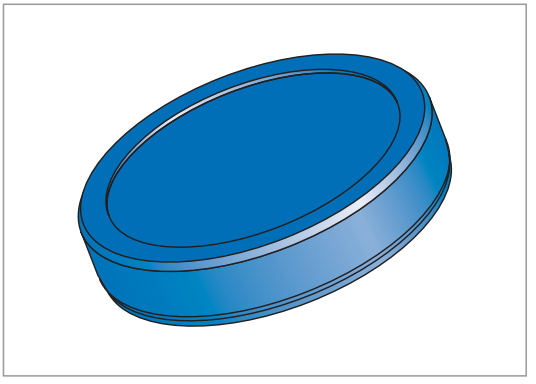
Sealing Cover GA, GSA



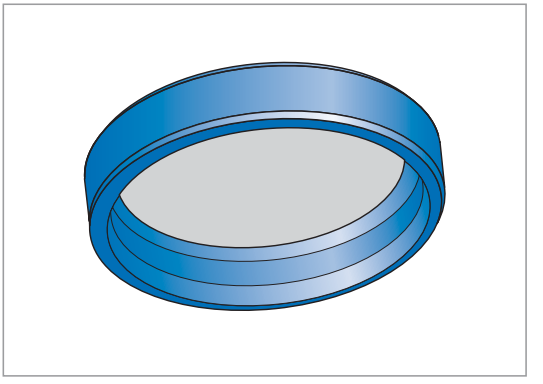
Sealing Cover GA



Sealing Cover GSA



Sealing Cover GA – Top view



Sealing Cover GA – Bottom view

Product description

- GA (normal design, rubber outside): sealing cover with vulcanised metal inserts made of sheet steel
- GSA (special design, rubber/steel outside): sealing cover with vulcanised metal inserts made of sheet steel with metal seat (H8).

Product advantages

- Secure sealing to the housing bore, even with increased roughness of the bore, higher thermal expansion and split housings
- Very stable construction
- Can be painted
- Variety of standard versions.

Application

Sealing cover for the static sealing of boreholes in housings with press fitting e.g. shaft pass through walls in gearbox housings.

Material

Acrylonitrile-butadiene rubber

Designation	75 NBR 99004
Colour	Black
Hardness	approx. 75 Shore A
Metal insert	unalloyed steel DIN EN 10139 (DIN 1624)

Sealing covers made of omaterials and in other dimensions available on enquiry.

Operating conditions

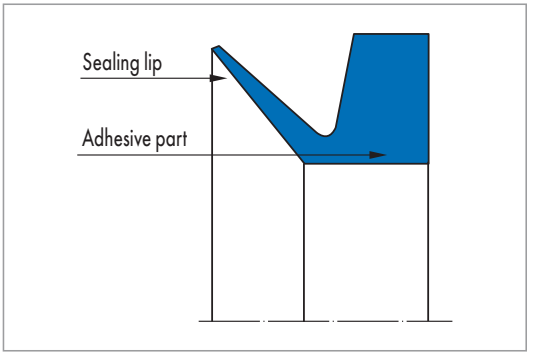
Media	All common mineral oils
Temperature	−40 ... +100 °C

Fitting & installation

Design of locating bore

Tolerance	ISO H8
Roughness type GA	R_{max} <= 25 µmr R_a = 1,6 ... 6,3 µmr R_z = 10 ... 25 µm
Roughness type GSA	R_{max} <= 16 µm R_a = 0,8 ... 3,2 µm R_z = 6,3 ... 16 µm

Simmerring Water Guard WA Typ A



Simmerring Water Guard WA Type A

Product description

Seal with an axially acting, wear-resistant sealing lip. Type A is the standard design for small housings.

Product advantages

Water guards are used in roller bearings for the retention of grease and to repel dust, scale, splash water, roller oil and similar media

- Especially low frictional forces
- High axial working capacity
- Easy fitting.

Application

Mills.

Material

Material	Code
NBR	60 NBR B297
FKM	65 FKM K698

FKM on enquiry.

Operating conditions

Material	60 NBR B297	65 FKM K698
	Temperature range in °C	
Mineral oils	–	
Water	+5 ... +100	+5 ... +80
Lubricating greases	−40 ... +100	−20 ... +150
Rolling oil emulsion	–	
Pressure p in MPa	0,03	
Running speed v in m/s	20*	

* The specifications refer to stationary WA. For circumferential seals, other limit values apply.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	0,8 µm	≤4 µm
Housing	≤4 µm	≤16 µm

The surface hardness of the running surface must be approx. 30 HRC. Percentage contact area M_r > 50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%.

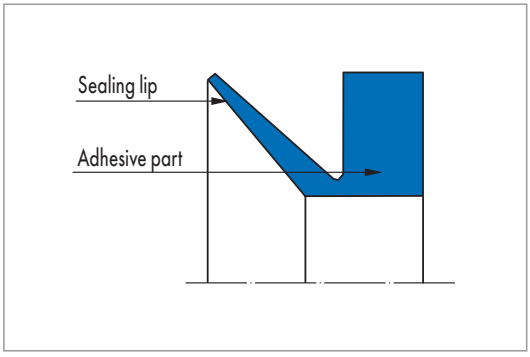
Design notes

Please observe our general design notes.

Fitting & installation

Careful fitting is a prerequisite for the correct function of the seal.

Simmerring Water Guard WA Typ AX



Simmerring Water Guard WA Type AX

Product description

Seal with an axially acting, wear-resistant sealing lip. Type AX is designed for heavy loads and high deflections.

Product advantages

Water guards are used in roller bearings for the retention of grease and to repel dust, scale, splash water, roller oil and similar media

- Especially low frictional forces
- High axial working capacity
- Easy fitting.

Application

Mills.

Material

Material	Code
NBR	60 NBR B297
FKM	65 FKM K698

Operating conditions

Material	60 NBR B297	65 FKM K698
	Temperature range in °C	
Mineral oils	–	
Water	+5 ... +100	+5 ... +80
Lubricating greases	−40 ... +100	−20 ... +150
Rolling oil emulsion	on enquiry	
Pressure p in MPa	0,03	
Running speed v in m/s	20*	

* The specifications refer to stationary WA. For circumferential seals, other limit values apply.

Surface quality

Peak-to-valley heights	R_a	R_{max}
Running surface	0,8 µm	≤4 µm
Housing	≤4 µm	≤16 µm

The surface hardness of the running surface must be approx. 30 HRC. Percentage contact area M_r > 50% to max. 90% at cutting depth c = Rz/2 and reference line C ref = 0%.

Design notes

Please observe our general design notes.

Fitting & installation

Careful fitting is a prerequisite for the correct function of the seal.

Profiles for Rotatory Applications

Product overview

- Profiles
  - U-rings
  - Mating rings for U-rings
  - X Profiles
  - Other special profiles
- Cords
  - Cord
  - Cord rings.

Product description

Special profiles or cords are utilised whenever large sealing contact areas cannot be effectively sealed by form seals or O-rings, for example, in tunnelling machines, ships engines and hatchways. Over 3500 different profile nozzles as well as numerous materials area available. In addition, the development and production of customer-specific designs is possible, where the tool costs are very low compared to shape related components.

Product advantages

- Sealing large seal contact areas that cannot be sealed by an O-ring or a shape related component
- Customer-specific product development
- Low tool costs in comparison to shape related components
- In-house tool construction to ensure short supply times
- All common elastomers can be utilised
- Special materials competency
- Low number of pieces/amounts possible
- Profile rings in NBR and FKM are available with vulcanisation to butt. Advantages of batch vulcanisation:
  - Peak tensile strength values
  - Identical elastomer as connecting element provides long-lasting durability.

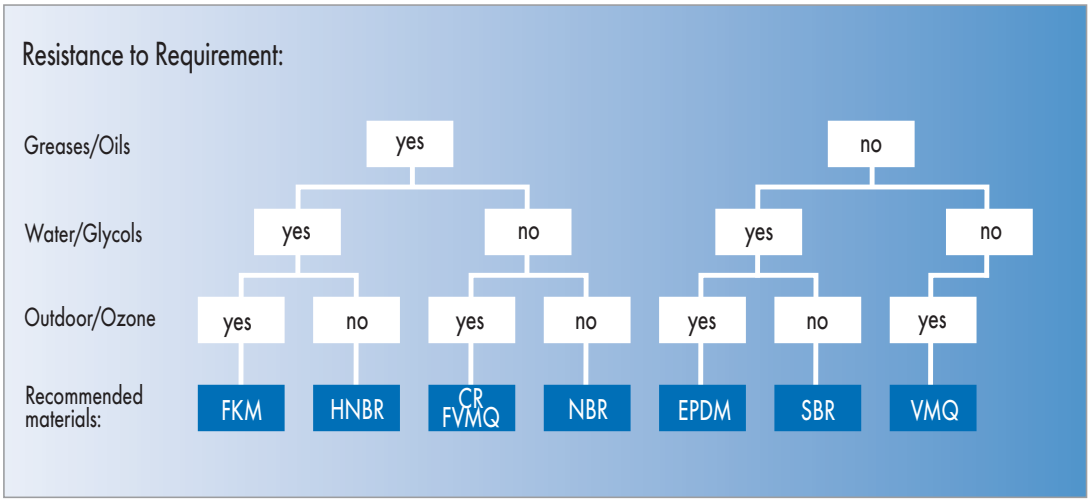
Application

Components manufactured from profiles perform sealing tasks in numerous industrial sectors.

- Heavy-duty mechanical engineering, e.g. tunnel driving technology, cement/rock mills
- Plant engineering, e.g. turbines, shut-off valves, process cylinders
- Prime movers, e.g. ships' engines
- Separators, e.g. filtering technology, large separators
- Mechanical engineering, e.g. industrial washing machines, rotating assemblies
- Chemical industry, e.g. bins/reaction vessels, dosing units/dosing pumps
- Medical technology, e.g. diagnostic equipment components, dosing units
- Foodstuffs industry, e.g. industrial juice presses, separators, and butchering machines.

Material

Besides the common materials with shorter delivery times, numerous special materials are also offered. These feature outstanding quality and durability. In the following overview, suitable materials can be selected according to their requirements.



Material configuration

Material	Colour	Operating temperature range
50 NBR 121*	Black	–30 ... +90 °C
60 NBR 122	Black	–30 ... +90 °C
70 NBR 221	Black	–25 ... +90 °C
70 NBR 803	Grey	–25 ... +90 °C
70 NBR 173216	Black	–30 ... +70 °C
72 NBR 872	Black	–30 ... +100 °C
79 NBR 105	Black	–30 ... +90 °C
80 NBR 709*	Black	–30 ... +90 °C
85 NBR 714	Black	–20 ... +90 °C
88 NBR 101	Black	–30 ... +100 °C
39 CR 174240*	Grey	–40 ... +80 °C
55 CR 852	Black	–40 ... +110 °C
67 CR 853	Black	–40 ... +110 °C
67 CR 215595	Black	–40 ... +80 °C
58 EPDM 215550	grey	–40 °C ... +120 °C
70 EPDM 275	Black	–40 °C ... +120 °C
70 FKM 598	Green	–15 °C ... +200 °C
70 FKM 215450	Black	–10 °C ... +200 °C

Material	Colour	Operating temperature range
72 FKM 588	Black	−10 °C ... +200 °C
60 FVMQ 143026	Beige	−80 °C ... +175 °C
50 VMQ 570	Beige	−40 °C ... +200 °C
50 VMQ 114721	Yellow transparent	−40 °C ... +180 °C
58 VMQ 518	Red brown	−40 °C ... +200 °C
60 VMQ 114722	Yellow transparent	−40 °C ... +180 °C
70 VMQ 114723	Yellow transparent	−40 °C ... +180 °C
78 VMQ 526	Red	−40 °C ... +200 °C

* Special material on enquiry

Design notes

Tolerances

All profiles and cords are manufactured to DIN ISO 3302-1 E2. In special cases, production to E1 is also possible. Limits for dimensions of cross sections of extruded components not supported (all dimensions in mm):

Nominal dimension		Tolerance class	
over	to	E1*	E2
0	1,5	0,15	0,25
1,5	2,5	0,20	0,35
2,5	4,0	0,25	0,40
4,0	6,3	0,35	0,50
6,3	10,0	0,40	0,70
10	16	0,50	0,80
16	25	0,70	1,00
25	40	0,80	1,30
40	63	1,00	1,60
63	100	1,30	2,00

* Partially possible in individual cases

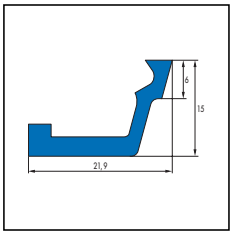
Other special profiles

Profiles can be produced and supplied as follows:

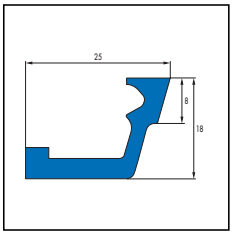
- By the metre
  - With/without integral bend
- Profile sections
  - Produced to customer requirements (up to 2000 mm without integral bend possible)
- Profile rings
  - Bonded to butt or batch vulcanised.

Profile nozzles

Below is a selection of the 3500 profile nozzles in stock.
Individual tools can be developed and produced for special designs on enquiry. This normally takes around 4 weeks.



Profile 162



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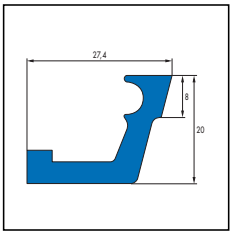

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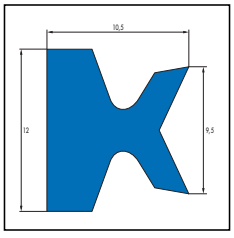

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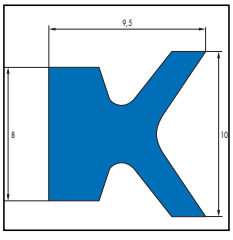

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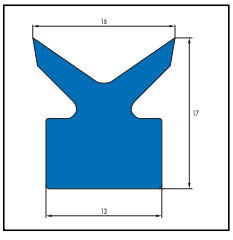

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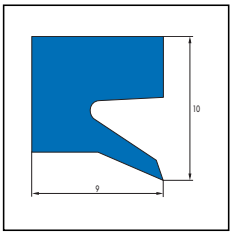

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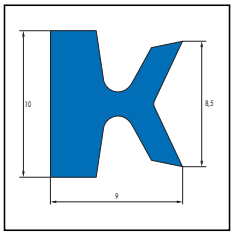
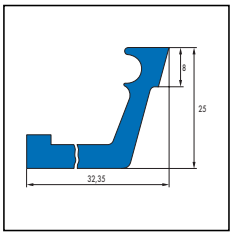


Profile 1123



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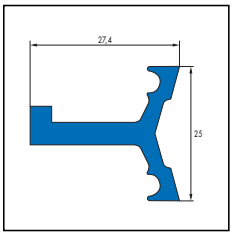

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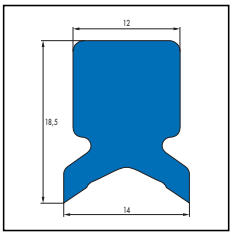

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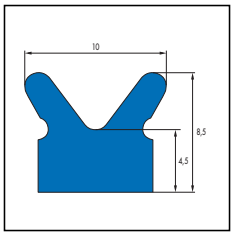

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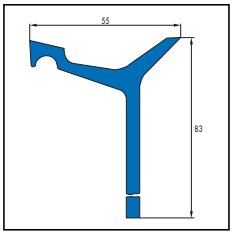

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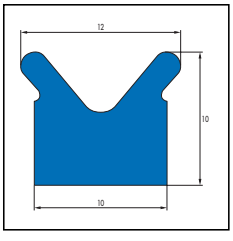

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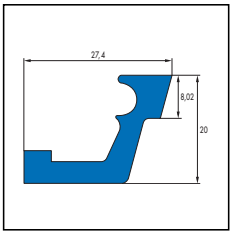

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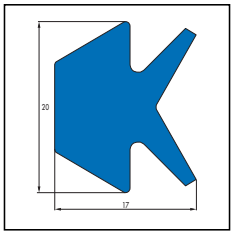

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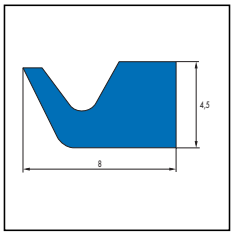

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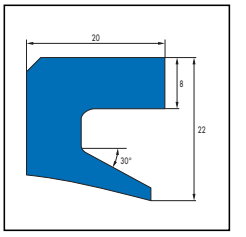

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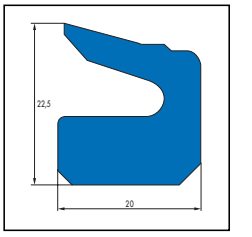

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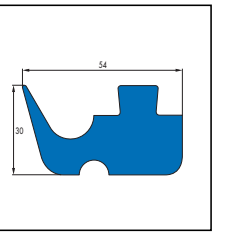

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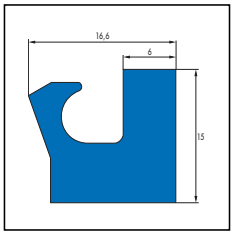

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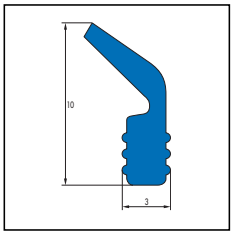

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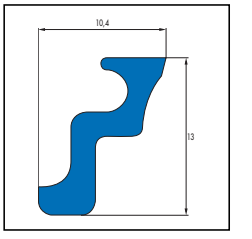
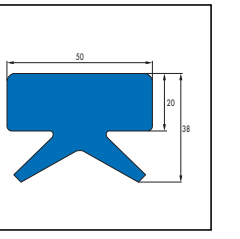


Profile 2849



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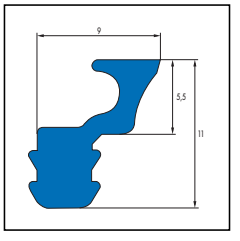

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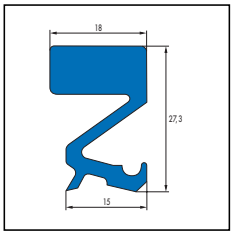

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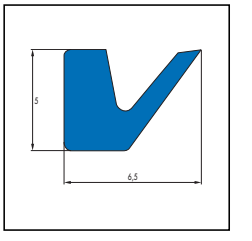

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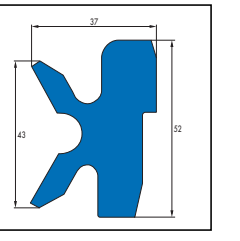

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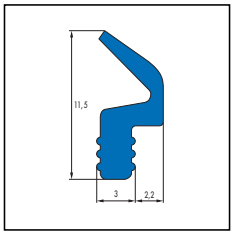

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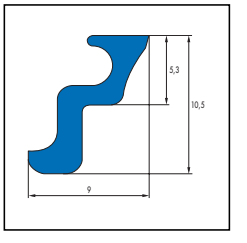

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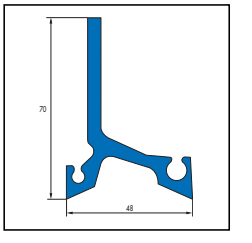

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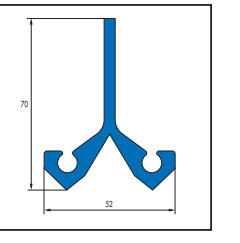

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